RADIO

Formerly Pacific Radio News

JANUARY, 1922

20 CENTS

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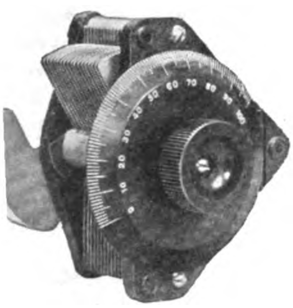
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No. 2.	Mounted	.00055	4.50
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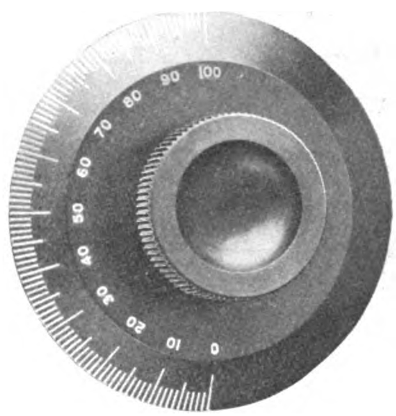
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RADIO

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Volume IV *for* JANUARY, 1922 *Number 1*

CONTENTS *for* JANUARY, 1922

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Forecast of Contributions for February Issue

Announcement of the winner of the $25.00 prize contest for the best description of an all-wave regenerative receiver will be made in the next issue. The judges of the contest are Leonard F. Fuller, consulting engineer, Colin B. Kennedy Co., B. F. McNamee, chief engineer, Atlantic-Pacific Radio Supplies Co., and D. B. McGown, assistant radio inspector, sixth district. This contest has called forth a number of excellent ideas to be incorporated in receiving sets. These will be published in forthcoming issues, the first manuscript submitted being published this month.

Next month Ensign Jennings B. Dow will follow up the first installment of his "C. W. Manual" series with descriptive comment on Modulating Systems, Alternating Current C. W. Circuits, and The Power Amplifier.

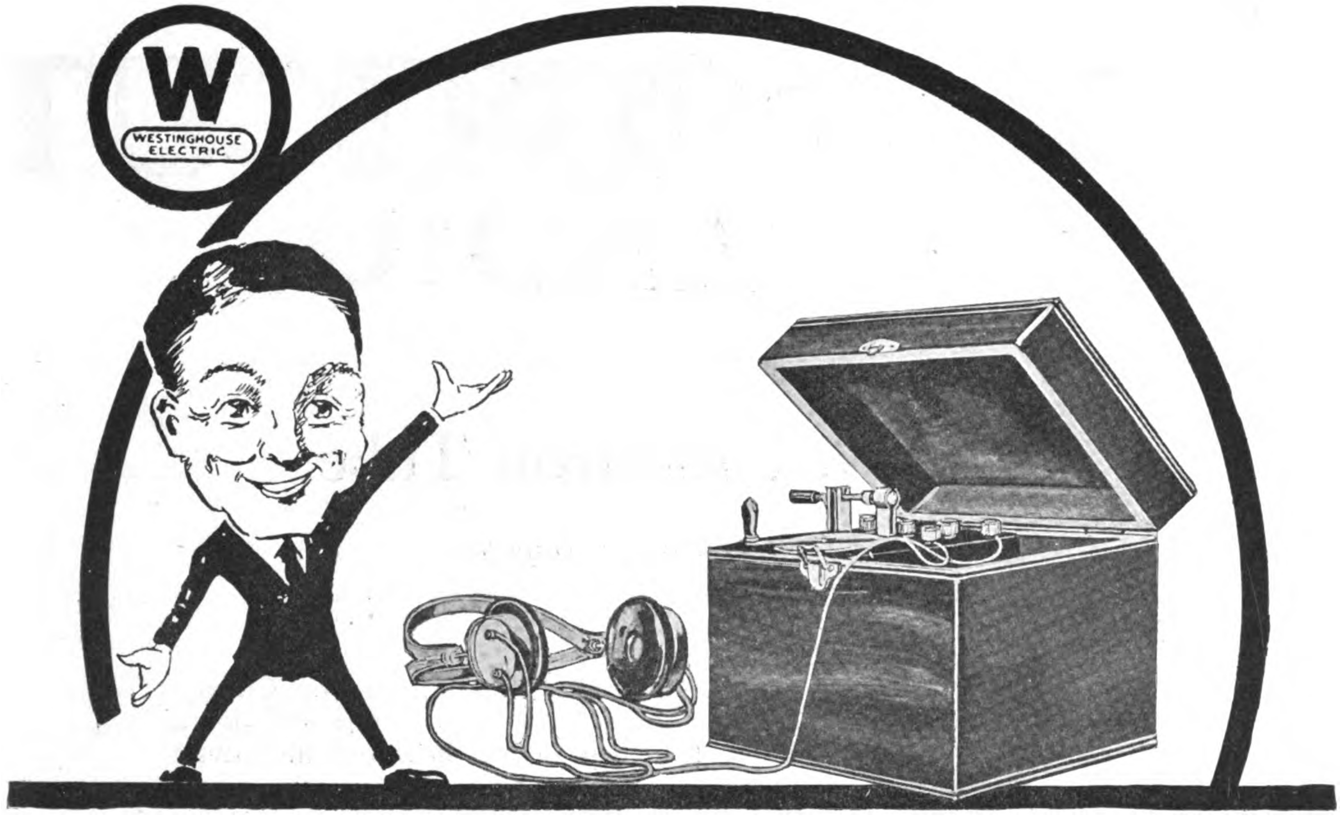
A dozen questions for answer by Gerald M. Best, technical adviser, were received too late for publication in this issue. They will appear next month, together with answers to any other questions that may be received prior to the first of January.

The new "Pacific Plan" for radio traffic regulation, as determined by the convention at San Francisco, Dec. 29-30th, will be given first publication in February RADIO. By this plan it is hoped that much of the present chaos of the air may be eliminated.

Edward M. Sargent will detail some successful experiments with ground antennæ as a result of his recent experiences in Mexico. This, as well as an article on "The Click Method of Determining Resonance," by G. W. Cattell, will be of especial interest to the technically inclined.

For the practical constructors, A. H. Babcock, electrical engineer, Southern Pacific Railroad, has written simple directions for winding transformers. D. B. McGown will continue his articles on how to make equipment for laboratory measurements, and several other good men will tell how to "roll your own."

Fiction features will include a soul-stirring story of "The Small Person," by Lawrence Mott, who in addition to being 6XAD in private life, is one of the more successful American writers of short stories and scenarios, as is well shown by the story of "Martin Robbins" in this issue. Our old friend Volney G. Mathison, of Samuel Jones fame, will come back with "The Kick-back," a tale with a real kick, and Clyde C. Young, better known as "Squawk McGuff," has some weird words of wireless rejuvenation and escapes from cannibals.



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The Type AD Receiving Antenna Outfit includes 150 feet of No. 14 Copper Weld Wire, one Splicer, two Micarta Receiving Antenna Insulators, two Screw Eyes, three Porcelain Knobs with holding screws, one Porcelain Wall Tube, 50 feet of insulated Ground Wire, one Ground Clamp and one Receiving Antenna Protective Device.

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Westinghouse

January, 1922 **RADIO** Vol. 4 No. 1

Radiotorial Comment

ENTHUSIASTIC assurance has been given that large and representative delegations will be present from thirty Western radio clubs at the convention in San Francisco Dec. 29th and 30th, to draft a "Pacific Plan" for regulating radio traffic and to organize the C. W. Club of America. The convention will be held in San Francisco Gymnastic Building, at 2460 Sutter St., with Major J. F. Dillon as chairman. A banquet will be held on the evening of the 29th and a radio ball on the evening of the 30th. A radio show will be held in conjunction with the meeting. Each club will be entitled to six votes through its accredited delegates. Visitors will be welcome. Our readers are urged to be there and to pass the word on to their radio friends.

A REMARKABLE instance of the benefits of co-operation is afforded by the action of the radiophone broadcasting operators of Northern California in agreeing to a schedule which allows each in turn to work on 360 meters, as now required by the Department of Commerce. The tentative schedule, which is published elsewhere in these columns, will probably be revised after a few weeks' trial, especially as several new stations will soon be on the air. The sentiment is rapidly crystallizing that the ultimate solution of the problem will be the establishment of one great station to be sustained by the Pacific Radio Trade Association. Thus it will be possible to command the best musical talent and news features to serve the thousands of people now enjoying the novelty of radio concerts.

WITH any art that is advancing as rapidly as is radio, regulatory laws may be expected to lag behind radio progress. But when the angle of time lag becomes years instead of months, 'tis seemly that corrective action be substituted for long-suffering endurance. Great expectations were held out for accomplishment at the Paris conference. But, as may be noted in the summary thereof elsewhere in these columns, these hopes have been dashed to the ground. Now the only recourse for immediate relief rests with Congress.

That Commissioner Carson is alive to the situation may be readily gathered from his letter to the associate editor of RADIO which appears on the C. W. Club of America page. Most welcome is the news that due consideration is being given to allocating a band from 200 to 280 meters for continuous wave stations and that amateur spark transmitters be graduated from 150 to 200 meters as the operators become more proficient.

FROM out of the editor's mail comes a subscriber's letter too long for publication, but too pertinent to pass by without comment. The writer is a radio concert enthusiast, one of thousands to whom radio is bringing new pleasures. His ideas are constructive as to the popularization of radiophone concerts, but restrictive of radio telegraphy.

He urges that no 200 meter spark set work during the concert hours, which in California are now practically from noon till nine at night. He is vexed at having a beautiful orchestral or vocal selection spoiled by, to him, an unintelligible series of disturbing dots and dashes. But he forgets that some boy thereby is enjoying himself at home and learning things that will always be of value to him. He suggests that this evil be corrected by C. W. transmitting, but forgets that this may be beyond the boy's limited pocket-book.

Eventually the spark set will be as obsolete as the Marconi coherer. In fact it is probable that it will be prohibited by law, just as are automobiles without a muffler banned from hospital zones. Its one merit is its broad and attention-compelling interference in sending out distress signals from a ship. And many an old-timer will note its passing with regretful sentiments.

But we will have the spark set with us for some time to come and it is only through the voluntary consideration and courtesy of the amateur operator that others may be undisturbed in their enjoyment of radio music. Many operators now lay off between eight and nine in the evening or when special events are being broadcasted, and it would be well for all to do so. For, remember, boys, we are on the air, not as a right, but as a privilege—a privilege which should not be abused.

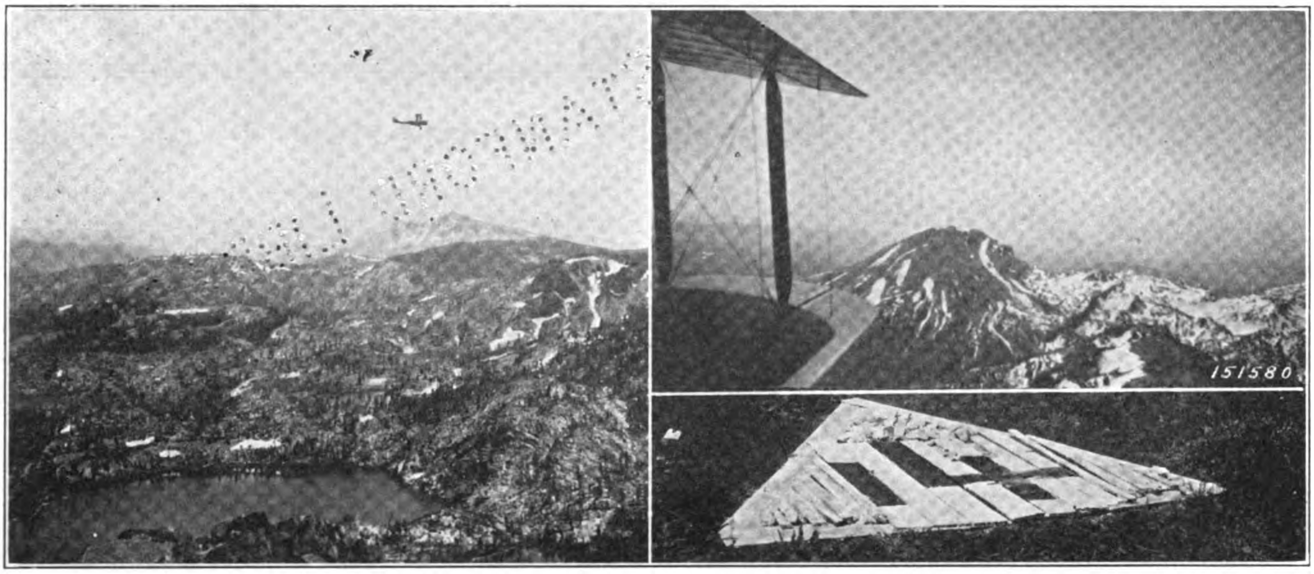
EDOUARD Belin's method of radio transmission of photographs has successfully sent a picture of President Harding from Annapolis to Paris in twenty minutes' time. A gelatine print of the picture in relief was pasted on a motor-driven cylinder at the sending end and received on sensitized paper on a revolving cylinder on which a beam of light was directed from a mirror galvanometer at the receiving end. The two cylinders were kept in synchronism by means of radio controlled chronometers. A microphone point traveling over the relief print, much as a phonograph reproducer travels over a record, causes a variation in outgoing radio impulses which produce a corresponding variation in the mirror galvanometer and thus reproduces the picture at the receiving end.

The same method is employed to reproduce hand-writing by using a special ink giving sufficient relief to affect the sending needle. The first trans-Atlantic messages sent by this new method were between Premier Briand and General Pershing.

The day is not far distant when, with the perfection of secrecy in sending and receiving, much of the world's business and pleasure will be conducted by radio. Wireless movies in every home is not an impossible dream. The sky's the limit in the development of radio's application.

Fighting Forest Fires with Radio

By Clyde C. Young



Airplane Patrol in the High Sierras, Showing Mt. Elwell on the Left, Mt. Lassen on the Upper Right, and Signal on the Lower Right. Photos by Courtesy U. S. Forest Service.

WIRELESS telegraphy has taken an important part in the newly organized airplane fire patrol system in the timbered area of the Pacific Coast, which comprises several states. The amateur with his little set once more stands out as an essential spoke in the wheels of progress.

Paul G. Redington, District United States Forester, told the Twelfth Annual Convention of the Pacific Logging Congress something about wireless, and the part the amateur has played in the government's campaign against fires, which was not only of interest to those present but to the world as well.

"Boys and young men interested in wireless telegraphy," said Mr. Redington, "are being utilized by the United States Forest Service to man radio stations in national forests as a part of the government's campaign against fires." "Radio communication is supplanting the less effective telephone communication in the forests," he added.

The airplane patrol in California for the season 1921 covered practically the entire forested area of the state, with the exception of the Coast redwood region. It included the Coast range from the Oregon line to Lake County, the Sierra Nevadas from the Oregon line to Kern County, and the Angeles and Santa Barbara National Forests in the south. It was a cooperative project, undertaken by the United States Air Service, the United States Forest Service, the State Forester, and local communities. Briefly, the part taken by each was as follows:

1. The Air Service furnished and maintained the planes and furnished the personnel for the patrols, including the observers, also the radio on the planes and at the bases, and the radio equipment for the fifteen forest stations, located at the various Forest Service headquarters throughout the state.
2. The Forest Service furnished a liaison officer at each base to handle fire reports and attend to all other business except such as was strictly Air Service; furnished the maps; prepared emergency landing fields, and furnished the operators for the radio receiving stations located in the forests.
3. The State Forester contributed in a financial way toward the subsistence of the Air Service personnel.

A very important part of the air patrol program is efficiency in communication. As soon as the airplanes land at the bases or sub-bases, they report all fires discovered enroute, and these reports are telephoned or telegraphed to the proper forest officers. The periods of flight, however, are often two hours or more in length, and the bases are out in the valley, necessitating the transmission of reports by telegraph or long distance telephone. This often consumes another hour, so that if it were depended alone upon the reporting of fires after the planes landed, there would be a delay of two to four hours in getting the reports to the men who would actually fight the fires.

It is necessary, therefore, to have a direct and continuous means of communication from the planes equipped with wireless transmitting sets, which are operated by the observers. There are ground wireless stations at all the bases and sub-bases, and in addition radio receiving stations are maintained at all the forest headquarters throughout the state. The latter are manned by operators employed by the Forest Service, who are usually well-qualified amateurs, including school boys and others who wish to go out into the forest during their summer vacations and who are particularly enthusiastic and ambitious on radio work.

The observer on the plane reports regularly to the ground stations at intervals of fifteen or twenty minutes. If he discovers any fires, he reports them; if not, he merely gives his location and anything else that he may have observed of interest. As he passes over one forest and out of range of the radio station there, he picks up the radio station on the next forest and is thereby in continuous touch with the ground forces.

The Forest Supervisor is enabled to trace on a map in his office the exact location of the plane, as it flies over his office, by the radio reports he is receiving at these regular intervals. If any fires are burning, he knows it immediately; if not, he has the assurance that everything is safe.

That the readers may know further what the Forest Service thinks of our amateurs, we quote directly the following from a report by that organization:

FIRES REPORTED BY PLANES
Forest Air Patrol, Season 1921

Patrols	Reported from planes: By radio	Reported from planes: Verbally on landing	Elapsed time from discovery of fire to delivery of report to Forest organization: 10 min. & less	11-20 min.	21-30 min.	31-40 min.	41-50 min.	51-60 min.	Over 1 hr.
Corning, Calif.	171	51	161	14	3	3	3	4	34
Mather Field, Calif.	228	42	205	14	2	5	3	8	33
Visalia, Calif.	35	15	18	3	1	2	1	3	22
March Field, Calif. (approx.)	44	3	33	10	1	0	1	0	2
Oregon and Wash.	482	171	339	69	31	31	29	31	123
Totals	960	282	756	110	38	41	37	46	214

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Radio Central, For World-Wide Wireless

WITH a message from President Harding, the Radio Corporation of America on November 5th formerly inaugurated world-wide radio telegraph service from the first unit of Radio Central, its new station on Long Island, 70 miles northeast of New York City. This high-power, multiplex transmitting station is operated in conjunction with a multiplex receiving station at Riverhead, L. I., 16 miles east. Both outgoing and incoming messages are directly controlled by operators at the company's central office in New York City.

This first unit of an eventual eight consists of twelve 410-foot towers, spaced 1250 feet apart, together with a power house accommodating two 200 k. w. high frequency transmitting alternators with auxilaries and equipment. The towers are arranged radially, with six towers on each radius, like the spokes of a huge wheel, covering an area of 10 acres, with the final installation of 72 towers. The ultimate power installation will consist of ten 200 k. w. high frequency alternators. Power for operation is supplied through a 23,000 volt transmission line from the Long Island Light Company's plant at Northport.

The alternators are Alexanderson 20,000 cycle machines, operated for the present at 18,200 cycles. Future operation will probably be in parallel for charging two or more sections of antenna wings. Such operation is entirely practicable and will be employed where great distances are to be covered. Even as it is, President Harding's message was received at Auckland, New Zealand, a distance of over 10,000 miles, and in practically every important country in the world.

A sending speed of 100 words per minute is possible with each transmitting unit, giving a combined sending capacity of 200 words per minute for the two completed units. No operators are located at either the transmitting or receiving stations, as remote control of land wires from the New York office cares for actual transmission, and the received radio signals are likewise automatically transferred to wire lines and received at New York.

A 150-foot cross-arm on the top of each tower supports the antenna wires. Each antenna consists of 16 silicon bronze cables three-eights of an inch in diameter, stretched horizontally from tower to tower. Fifty miles of this cable were used for the first two antennæ systems. The ground system for both antennæ consists of 450 miles of copper wire buried in the ground of the entire system in starfish and gridiron fashion.

A multiple tuned antenna is employed to reduce wasteful resistance of the long, low, flat topped aerials and to permit the length of such aerials to be increased indefinitely for the use of greater powers. The radiation of flat topped antennæ are not impaired by multiple tuning, as a series of tests have shown that with an equal number of amperes in either type, the same signal audibility is obtained at a receiving station, but there is an enormous saving of power in the case of the multiple tuned antenna.

Another interesting factor concerned with Radio Central is the use of the magnetic amplifier. As is well known, tele-

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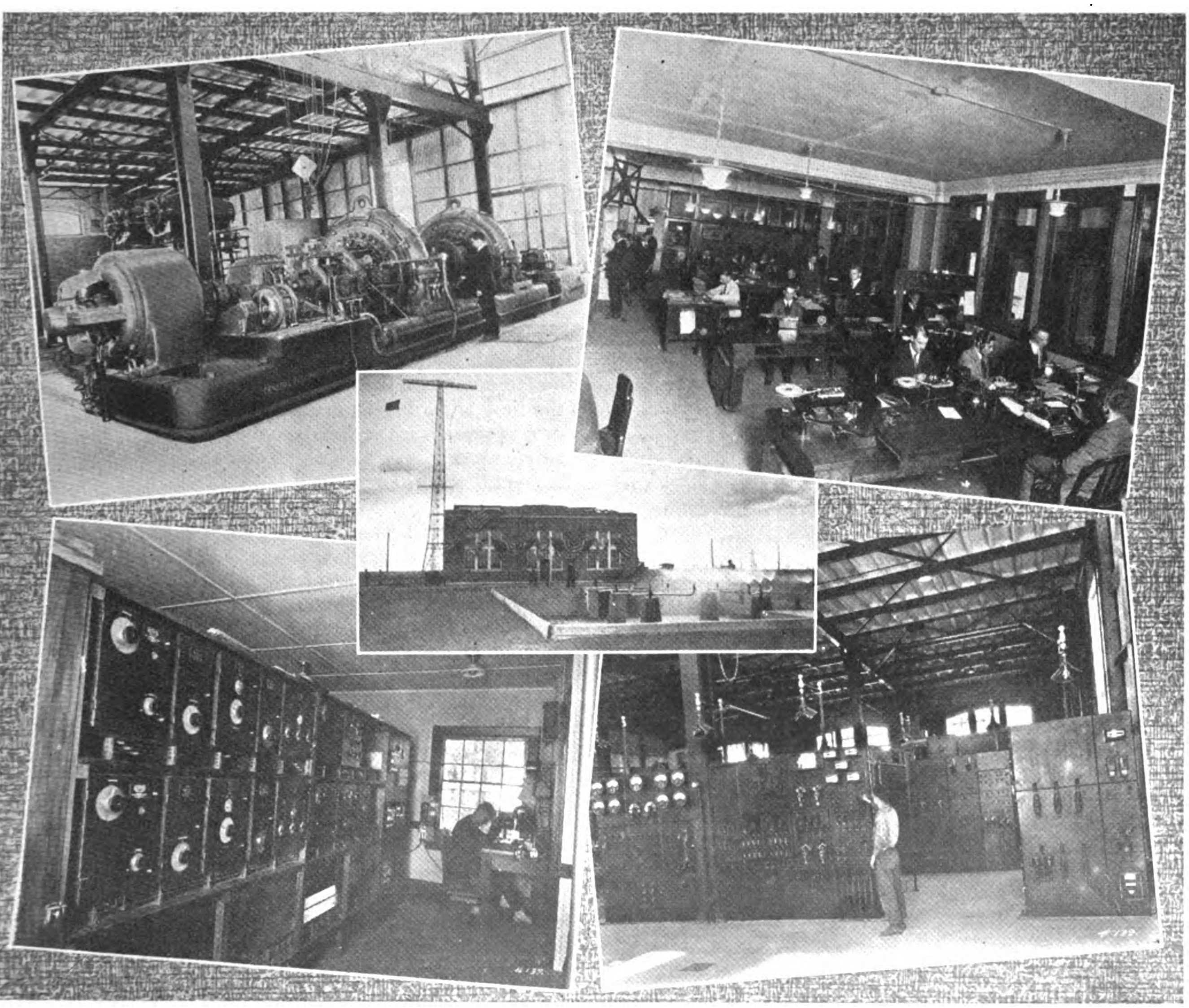

Radio Central Power House and Cooling Pond in the Center. High Frequency Alternators on Upper Left. Receiver Section on Lower Left. Operating Room on Upper Right, and Main Switchboards on Lower Right.

The Vacuum Tube Transmitting Circuit

The First in a Series of Articles on the Construction and Operation of Continuous Wave Apparatus which, when finished will Constitute and later be reprinted as "A C. W. Manual."

By Jennings B. Dow
Ensign U. S. Navy

THE reader is assumed to be familiar with the principles involved in the operation of the three-electrode valve, the triode, or to have access to the literature available on this subject. Consequently, to avoid duplication and to save space, we will begin by considering the vacuum tube circuit. With slight variation, but consistent with the words of Van Der Bijl,[1] the conditions that are necessary to make the tube act as an oscillation generator may be stated briefly as follows:

1. The tube must be capable of amplifying, that is, it must have an unilateral impedance which is occasioned by potential variations on the grid producing a greater effect on the current in the plate circuit (output circuit) than the effect produced on the current in the grid circuit by potential variations on the plate.
2. Part of the energy in the output circuit must be returned to the input circuit by suitable coupling of these circuits electro-statically or magnetically, and in order to insure a re-amplification of this energy, the output and input must be in phase.
3. An oscillating circuit must be attached to the tube, having inductance, capacity and resistance of such values as to make the tube oscillate at the desired frequency. These values should be such that a maximum efficiency is obtained with maximum output.

Fig. 1 shows a typical vacuum tube transmitting circuit—a Hartley circuit.

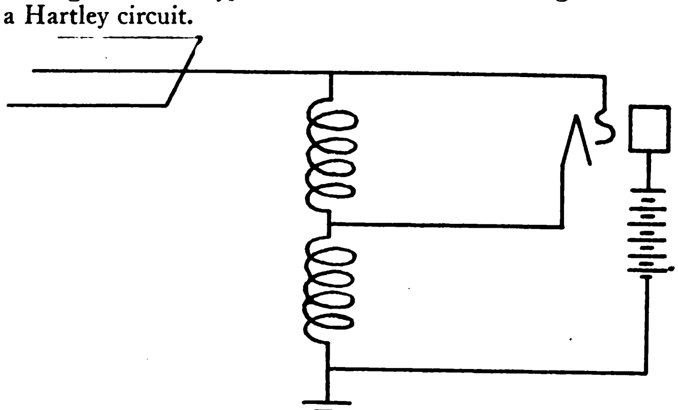

Fig. 1. The Hartley Circuit.

Fig. 2 shows this same circuit reduced to a simpler form for purposes of explanation. The antenna of Fig. 1 is represented by the dotted portion of Fig. 2.

The grid and filament of the tube in this circuit are connected to the branched circuit containing inductance and capacity, constituting the oscillatory circuit, in such a manner as to include a portion of the inductance of that circuit represented by the symbol L_g. In a similar way the inductance represented by L_p is included between the filament and plate.

[2]Suppose first that the circuit is not oscillating. Because of the potential impressed upon the conducting path between filament and plate, a steady current will flow from plate to filament inside the tube and from filament through inductance L_p outside the tube. The magnitude of this current will vary with the voltage of the grid. It can become zero when the flow of electrons between filament and plate is made negligible by a highly negative potential on the grid, but it cannot reverse. A current can also flow from grid to filament inside the tube, the current returning from filament to grid through the inductance L_g in the external circuit. This latter current is appreciable only when the grid is positive with respect to the filament. Like the plate to filament current mentioned above, this current is also unidirectional and its magnitude is dependent upon the potential on the grid.

When the tube is oscillating, these currents will, of course, not be steady, but pulsating. The pulsating currents

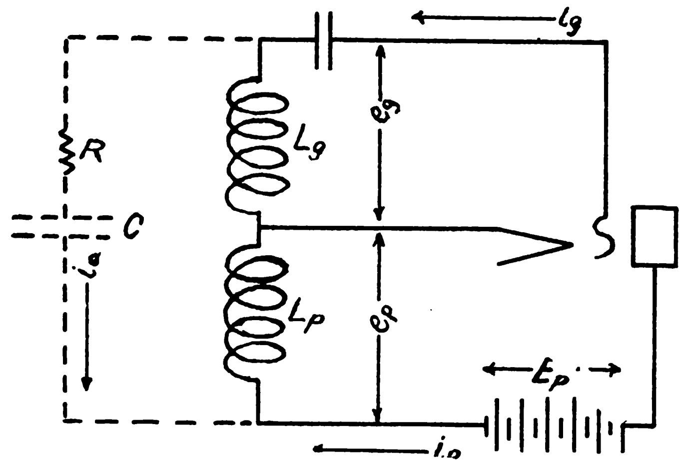

Fig. 2. Simplified Diagram of Hartley Circuit.

generated by the tube enter the circuit from the filament and leave it through the plate and grid connections. They are pulsating and not alternating on account of the unidirectional conductivity between filament and plate and filament and grid. The circuit CL_gL_p is resonant to these pulsating currents and an oscillatory current is generated and circulates around this branched circuit, flowing through the capacity C and the inductances L_p and L_g. This current, which will be called the output current, can be many times greater in amplitude than either of the pulsating currents.

The pulsations in the steady current which flows during the stable condition from filament to plate are, as stated heretofore, caused by periodic variations in the potential of the grid with respect to the filament and these variations in grid potential are induced in the grid coil L_g by the output current. There is a similar potential induced by the output current across the plate coil L_p.

It is true of this circuit and typical of any circuit for generating oscillations, that during the portion of the cycle of the output current when the grid is positive with respect to the filament as a result of the potential difference across the coil L_g, the voltage drop between the plate and filament connections (across the inductance L_p) is such as to oppose the potential of the plate battery and hence to reduce the potential between filament and plate inside the tube. During the other part of the cycle when the grid is negative with respect to the filament the potential acting between plate and filament is increased above that of the stable potential of the plate battery. During the portion of the cycle when the grid is positive with respect to the filament, current flows within the tube between the grid and filament and this current increases as the grid becomes more positive. The direction of the current flow is in the direction of the potential, that is, from grid to filament inside the tube and from filament to grid outside. Further, as the grid becomes positive with respect to the filament, there is a resultant increase in the current flow between the plate and

(1.) Thermionic Vacuum Tube, VAN DER BIJL (P267)

(2.) Bureau of Standards publication No. 355, L. M. HULL, Dec. 1, 1919.

filament of the tube, even though the plate potential on the tube is being reduced. This increase is limited, when the stable oscillating condition has been reached, by the saturation effect, which may occur at lower values of plate current than that corresponding to the total filament emission owing to the loss of electrons to the grid.

As has been stated, the plate current wave is distorted at the other extreme of the cycle—that is, when the grid is negative—by rectification effects; moreover, the grid current is always pulsating, and is zero for a considerable part of a cycle, while the grid is negative. Consequently, the waves of current supplied to the circuit between filament and plate, and filament and grid (Fig. 3) are each composed of a direct or average constituent, a fundamental constituent corresponding in frequency to that of the output current, and a number of higher frequency or harmonic constituents.

The useful oscillating output current depends neither upon the direct or average values of the plate and grid currents nor upon the multiple frequency constituents; it is determined solely by the fundamental constituents of these currents, to which the same consideration as regards direction and phase relations apply as have been roughly stated with regard to the distorted current waves.

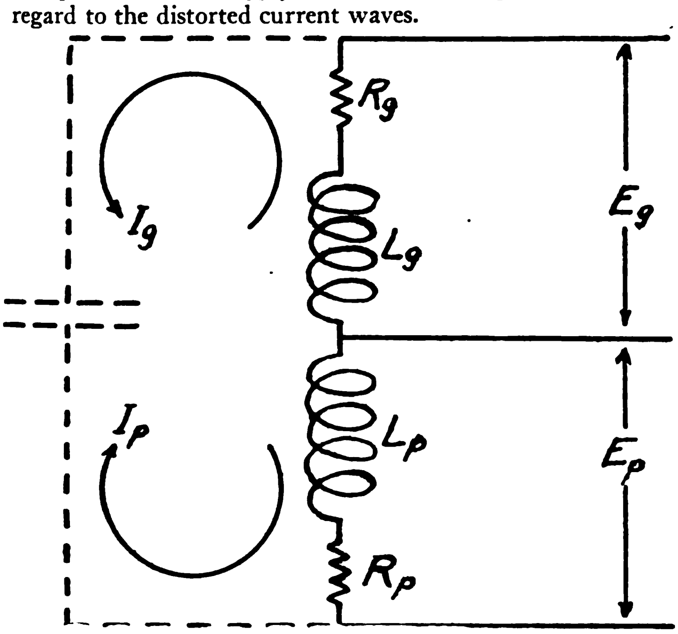

Fig. 3. Showing Direction of Grid Current and Plate Current.

Thus, speaking only in terms of useful current constituents, a sinusoidal alternating current flows in the grid circuit in phase with the alternating e. m. f. across the inductance L_g, and therefore represents a withdrawal of power from the output circuit, which power is expended within the tube. On the other hand, a sinusoidal, alternating constituent of plate current flows in opposition to the e. m. f. across the inductance L_p; this means that power is being supplied to the output circuit from the plate circuit of the tube. As will appear later, the impedance of the output circuit to all frequencies that are harmonic multiples of the fundamental is very great. Hence there are no appreciable multiple frequency constituents of the current circulating in the output circuit and the alternating e. m. f.'s across the inductances L_p and L_g are in all cases practically sinusoidal. Consequently the useful power supplied by the tube can be determined in terms of the alternating e. m. f. across L_p and the fundamental constituent of the plate current. If we would neglect the grid current, this would be the power available for dissipation in the resistances. As the output current increases, the amplitudes of the alternating e. m. f.'s across the plate and grid inductances increase proportionately. The alternating grid current increases more and more rapidly as the amplitude of the plate e. m. f. becomes larger. On this account, the power loss to the grid increases. The power supplied by the plate increases with increasing plate potential, but as the grid potential increases the effective saturation current is reached when the grid is positive and the plate current becomes zero for an appreciable part of the cycle when the grid is negative. Consequently, a continued increase in the amplitude of the output current results chiefly in an increase in the harmonic constituents of plate current without greatly increasing the fundamental. Obviously, then, a condition of stability ensues when the power supplied by the fundamental of plate current minus the power dissipated by the fundamental of grid current is just equal to the power dissipated by the output current in R_g, R_p and R_c.

C-W Circuits to Date

There are as many as five vacuum tube circuits that may be considered of primary importance. Only two of these, however, are found in common use in modern transmitting circuits, namely, the Hartley circuit and Heising's modified Colpitts circuit. Meissner's circuit, while used to some extent in its basic form, resolves itself into a modified Hartley or Colpitts circuit in practice. Its approach to either of these depends upon the constants of the circuit.

Both the Hartley circuit and Heising's modified Colpitts circuit possess certain advantages and disadvantages, all of which are not common, and the experimenter, in selecting one will do well to consider each. For example, the Colpitts circuit, while highly efficient, does not well adapt itself to flexibility insofar as rapid change of wavelength is concerned. This disadvantage was largely overcome by Heising's alteration. The Hartley circuit, probably the most efficient, retains

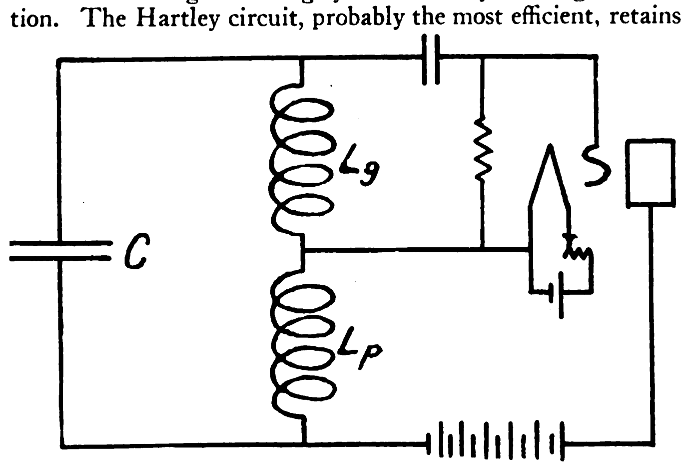

Fig. 4. Hartley Circuit as Used in the Laboratory.

its efficiency only through the narrow band of wave lengths for which a given installation is designed; this, because the variable feature is vested in inductance rather than in capacity. Large amounts of inductance are obviously necessary for operation at the longer wave lengths, and when using only a small portion of this inductance for the shorter wave lengths, there is added resistance in the circuit resulting from the so-called "dead end effect" and from corona losses which are very apparent in any open end inductance adjacent to circuits where high frequency currents of any magnitude are flowing.

Fig. 4 shows the common Hartley laboratory circuit as used to generate sustained oscillations for calibration work, heterodyning incoming signals, producing high potentials for testing insulation, etc. If the resistance of the circuit CL_gL_p is sufficiently low, a simple circuit of this kind may be made to generate oscillations from a few per second to upwards of 3,000,000 per second. If. in place of the concentrated capacity C, an antenna having distributed capacity and appreciable resistance is substituted, the band of frequencies at which the circuit will oscillate will be restricted to a comparatively narrow range. In this circuit, both inductances L_p and L_g necessarily coupled to obtain the required grid input, are a part of the oscillatory circuit and must be wound with low resistance wire, tubing, or tape in order to keep the resistance of the circuit as low as possible. In practice, in transmitting circuits, L_g is exterior to the oscillating circuit and may be wound with almost any kind of conductor. In so far as the supply of power to this circuit is concerned, it is of the series power circuit type—the plate battery or generator is in series with the plate and is unshunted by capacity. Here the plate circuit is not a part of the oscillatory circuit and the current which flows in this circuit is pulsating rather than oscillating as previously explained.

In Fig. 4, a small capacity and large resistance are used to obtain the required negative potential on the grid. With this arrangement the grid obtains a positive potential only during the small fraction of the cycle when the grid leak current is building up to rob the grid of its positive charge. Notwithstanding the fact that the grid attains a positive charge during a small fraction of each cycle, which results in a grid to filament current inside the tube, the capacity-grid-leak resistance method of obtaining the required negative potential is more efficient than the method of inserting a grid battery in the circuit. In using the latter method the plate potential must be increased to a much greater value before oscillations will start, than when the former method is used. The value of the current in the oscillating circuit is greatly dependent upon the value of the grid leak resistance, which will vary with the type of the tube used, but will usually lie within the limits of 5,000 to 12,000 ohms.

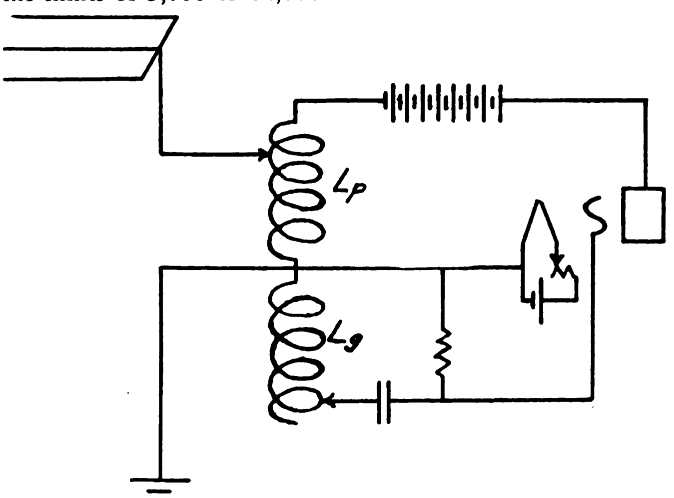

Fig. 5. Hartley Circuit as Used in Practice.

Fig. 5 shows the Hartley circuit as used in practice. Here the inductance, L_g, is not a part of the oscillating circuit, but is merely coupled to the oscillating circuit to obtain the required input for the regeneration of oscillations. The variable feature of the inductance L_g may be obtained either by a fixed coil inductively related to L_p, with a variable contact, or by a coil having a fixed amount of wire in circuit at all times, but so mounted as to provide a means of changing the degree of coupling with L_p, or by a combination of both of these methods as found in some of the more refined sets. In this circuit, the filament and grid are more or less strongly tied to earth which results in the plate only being "hot." This is a feature which is very desirable in a power circuit where high voltages are used. The period of oscillation of this circuit is dependent upon the value of antenna capacity and inductance, and the inductance L_p. At very high frequencies, however, intra-electrode capacities and other capacities and inductances in the circuit may influence the period of oscillation, and in all circuits these values, together with the resistances, determine the upper limit of oscillation. In the design of the transmitters to operate at short wave lengths (wave lengths under 250 meters) the Hartley circuit is recommended. As a matter of information the General Electric Company has been able to obtain waves six meters long with such a circuit. At this wave length, which corresponds to a frequency of 50,000,000 cycles per second, the inductances resolve themselves into nothing more than the straight connecting wires.

Fig. 6 shows a Colpitts laboratory circuit. In the case of the Hartley circuit, the coupling between input (grid) circuit and output (radio frequency) circuit was obtained inductively. In the Colpitts circuit, the coupling between input and output is capacitive and is varied by changing the value of the capacity C_1. In changing this capacity as required in adjusting the circuit for most efficient operation, the period of oscillation of the circuit $LC_1C_2C_3$ is changed and it is necessary to change the capacity C_2 an amount necessary to obtain the desired period of oscillation. This double adjustment is somewhat of a disadvantage in practice. In this circuit, the plate potential is applied across the capacity C_1, and in order not to affect the oscillating circuit

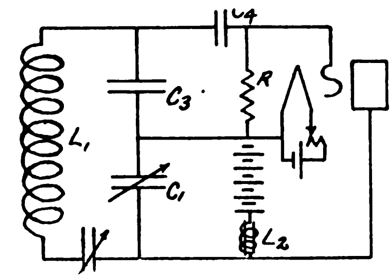

Fig. 6. Colpitts Laboratory Circuit.

$LC_1C_2C_3$ a radio frequency choke L_2 must be inserted in the plate supply lead as shown. The matter of obtaining the proper value of this choke inductance will be considered in detail later. The capacity grid-leak resistance method of obtaining the required negative potential on the grid is used here, also.

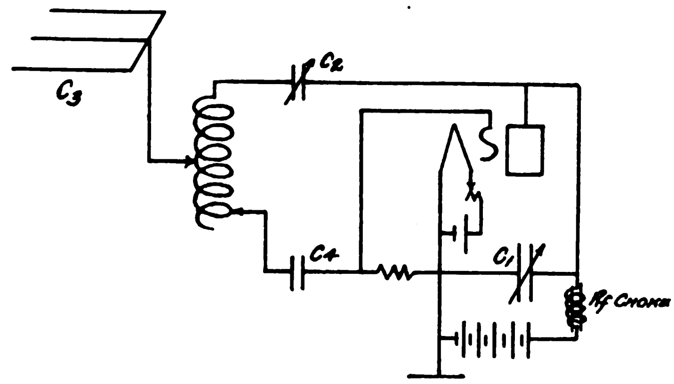

Fig. 7. Colpitts Circuit as Used for Transmission.

Fig. 7 shows the Colpitts circuit as applied to a power transmitting circuit possessed of an antenna which is represented by the capacity C_3.

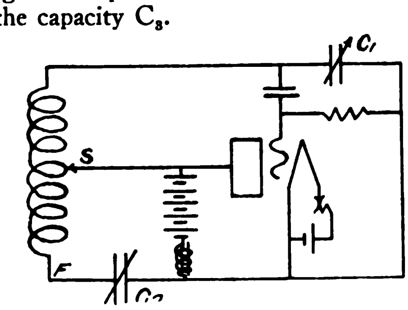

Fig. 8. Heising Circuit in Theory.

Credit is due Heising for the circuit represented in Fig. 8. This is one having a number of very desirable features. The coupling between input and output is varied by changing the position of the contact S. If contact S is moved along the inductance to the point F and a variable capacity is inserted in the circuit between the plate and F, the circuit shown in Fig. 6 will result. By means of Heising's variable contact S, then, it has been possible to eliminate the variable capacity C_2 of Fig. 6 and at the same time provide a method of chang-

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A Medium and Short Wave Regenerative Receiver

By F. L. Wisner

The First Entry in the $25.00 Prize Contest which Closed December 15th. This Set Has a Range of 175 to 2400 Meters

IN ORDER to have a simple and efficient receiver for medium wave lengths, including time signals, weather reports, etc., and yet maintain maximum efficiency on short wave lengths, the following receiver was designed. In the short wave position the receiver has a range of from 175 meters to 500 meters. It is a plain variometer regenerative receiver and, as may be seen in Fig. 2, there are no extra coils or condensers connected to lower its efficiency.

brackets, on either side of the stators. Care must be taken when connecting these two coils in circuit to see that their polarity is correct. Fine regenerative results have been obtained and the receiver will oscillate over its entire range. These secondary loading coils each have 34 turns of No. 22 double cotton-covered copper wire and are of the five-layer bank-wound type on a formica tube 3 3-4 inches in diameter and 1 inch long.

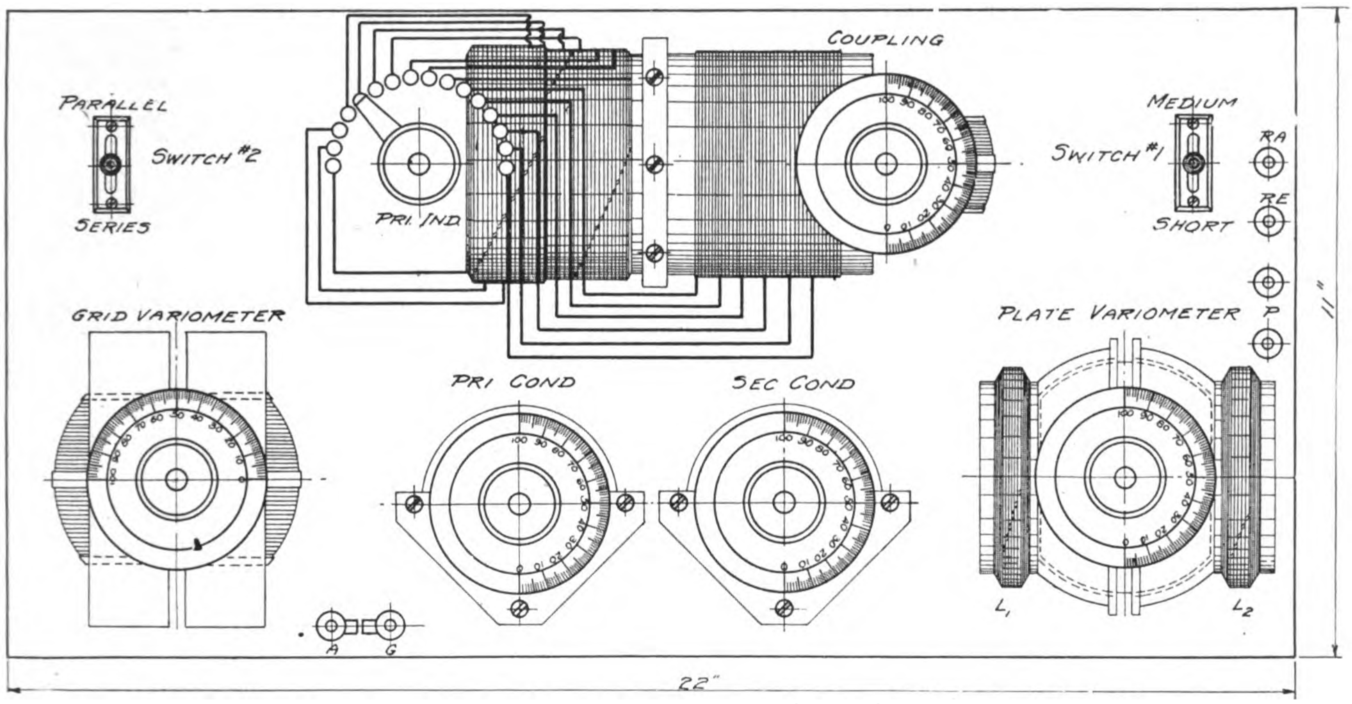


Fig. 2. Phantom View of Regenerative Receiver.

On the medium wave position of switch No. 1 in Figs. 1 and 2, two secondary loading inductances are connected in the circuit as well as a secondary variable condenser of 0.0011 microfarads capacity, which brings the wave length range up to from 450 meters to 2400 meters. This switch also connects the bank wound primary loading inductance in the circuit, giving the antennae circuit the same range as the secondary. In this position the plate variometer becomes a variable tickler because of its close inductive relation to the two secondary loading coils which are mounted with brass

A variable condenser of 0.0011 microfarads capacity is connected either in parallel for long waves or in series for short waves by switch No. 2 in Figs. 1 and 2. There is sufficient inductance in the loading coil and primary of the vario-coupler to use the condenser in series up to 1200 meters wave length.

The primary loading inductance is wound in a two-layer bank winding for 42 turns and then three-bank winding for 53 turns, using No. 20 double cotton-covered copper wire on a formica tube 3 3-4 inches in diameter and 4 inches long.

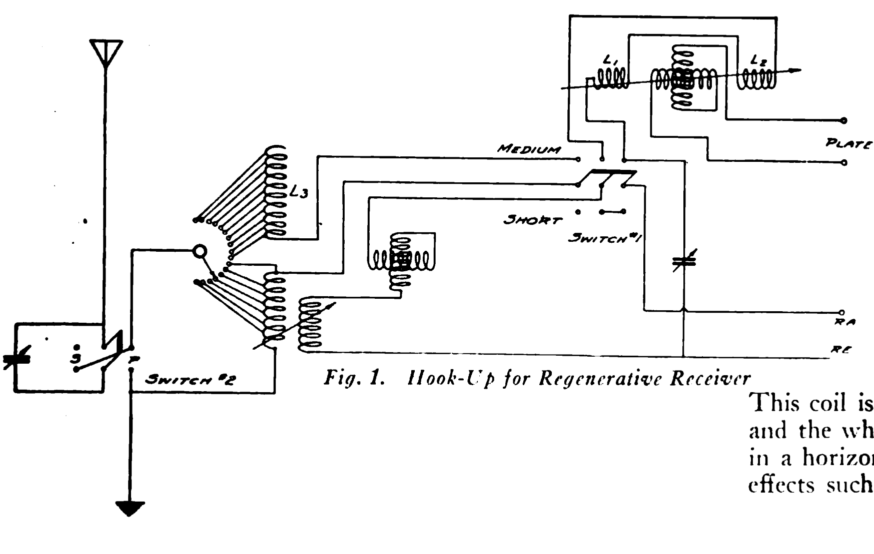


Fig. 1. Hook-Up for Regenerative Receiver

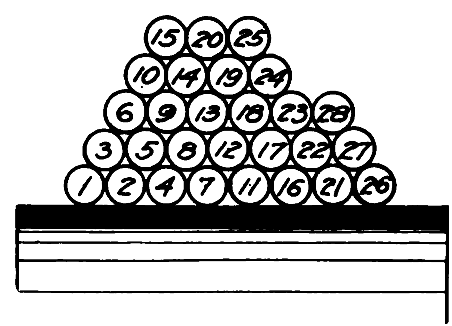


Fig. 4. Arrangement of Wiring for Five Bank Winding

This coil is mounted on the bottom of the vario-coupler base and the whole unit is mounted on the panel with the tubing in a horizontal position, as this conserves space with no bad effects such as coupling to either variometer. The primary

Continued on page 43

Tuning for Long Waves

A Discussion of the Theory and Practice of Using Multi-Layer Coils

By B. F. McNamee

TUNING apparatus for long waves presents some difficulties not met with in the short wave apparatus. The loose coupler, when made of sufficient size to tune to the long waves, is a very bulky and awkward object. Many attempts, more or less successful, have been made to use coils of several layers of wire to replace the single layer coils of the ordinary loose coupler. In the radio trade the term "loose coupler" has been pretty much confined to two telescoping single layer coils, such as shown in Fig. 4 of the author's article on "The Handling of Tuning Apparatus" in December RADIO. But the term really means a combination of two coils of any kind to act as a radio frequency transformer.

Let us take a single layer coil of 1000 turns wound on a tube 4 inches in diameter. Another coil of about the same diameter, but much shorter, has also 1000 turns of wire, wound in 10 layers of 100 turns each. While the inductances of the two coils may be somewhere near equal, the 10 layer coil will not tune to as short a wavelength as the single layer one. This is due to its *distributed capacity*, or we might term it the turn-to-turn or layer-to-layer capacity.

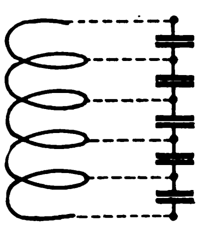


Fig. 1. Effect of Distributed Capacity.

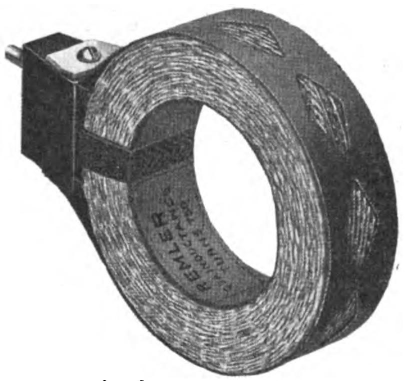


Fig. 2. Honeycomb Coil.

Two adjacent turns of wire, with the insulation between them, constitute a small condenser. The voltage drop due to the inductance of a single turn is appreciable at high frequency, and serves to charge this small condenser. This much is true of both types of coil, and may be called the turn-to-turn capacity. But in the 10 layer coil we have also a number of condensers consisting of the layers of wire and the insulation between them. In this case the capacity is therefore much greater than in the single layer coil, and since the wavelength to which the coil will tune depends on the capacity of the circuit as well as the inductance, the 10 layer coil with its larger fixed capacity will not cover as great a range of wavelengths with a given variable condenser as the single layer coil.

Fig. 1 shows the effect of distributed capacity by the imaginary condensers connected between adjacent turns. In circuits where variometers are used for tuning without any shunting condenser, the capacity of the circuit (which is necessary for tuning) is the distributed capacity of the variometer coils, in addition to some small capacity between leads, etc.

The common practice of "tapping," i. e., using only a part of large coils in order to tune to shorter wavelengths, often results in great losses in signal strength, due to what is known as the "dead end" effect. The term "dead end" refers to the unused portion of the coil, which in virtue of its distributed capacity, is more or less tuned to the signal. It therefore absorbs more or less of the incoming energy. For some wavelengths the inductance and capacity in the dead end is tuned perfectly to the signal, and the coil will give very poor results at such wavelengths. One method much used in the past to overcome this effect is a dead end switch, which disconnected the unused turns from the part in use. But the presence of the unused turns, even if disconnected, makes possible their absorbing energy by induction.

Multi-layer coils of the "honeycomb" type have proved a success in overcoming these difficulties in some degree. The distributed capacity is low because the wires touch only at crossing points, and are kept apart by the thickness of one wire at all other points. The largest coil required for wavelengths now in use has 1500 turns, and is only 1 inch wide and about 4½ inches outside diameter. A plug and socket arrangement makes them easily removable.

Since no "taps" are provided for using only a part of the turns, the whole coil is always in use, and dead end effects are completely done away with. When a wave is too short for a given coil, it is replaced by a smaller one.

Coils termed "duolateral" are a modification of the "honeycomb," and are wound with the wires a little further apart, giving a slight decrease in distributed capacity.

In tuning with honeycomb coils it is necessary to observe the same cautions regarding coupling as stated in the December issue about the loose coupler; i. e., every time the coils are moved it is necessary to retune with the variable condensers to keep in resonance with a given signal.

It is generally possible to tune in a station on two or more coils of different sizes. Let us say that some particular signal comes in when the secondary coil is a 35 turn honeycomb and the secondary condenser is set at 130 degrees. If we now substitute the 50 turn coil, we will no doubt tune in the same signal at a lower condenser setting. This is because tuning to any particular wavelength does not mean selecting just one certain amount of inductance and one certain amount of capacity, but selecting one certain value for the product of the inductance and capacity. So we should be able to select any value of inductance whatever, and then choose a sufficiently large or small capacity to make the product come out right.

We are limited in this, however, by two things. First, we have always the distributed capacity of the coil as the minimum capacity. Second, the tuning will be too broad if too little inductance is used, and difficulty in coupling is experienced due to fewness of turns in coils. So it is generally best to use as large a coil as possible on any given wavelength.

TABLE OF CONSTANTS FOR DEFOREST DUO-LATERAL COILS

By EDWARD M. SARGENT

Coil	No. of Turns	Outside Diameter	Inductance at highest wavelength (Milhenries)	Wavelength when shunted with condenser having capacity of .0001 mf	.001 mf	.0015 mf	D. C. Resistance Ohms
DL-25	19	2.22"	.020	100	270	338	.37
DL-35	40	2.30"	.092	225	580	698	.72
DL-50	49	2.32"	.144	287	710	887	.70
DL-75	74	2.37"	.322	405	1090	1310	1.31
DL-100	102	2.47"	.567	560	1450	1740	1.77
DL-150	135	2.56"	.875	693	1765	2160	2.31
DL-200	172	2.59"	1.61	945	2360	2930	3.97
DL-250	250	2.87"	3.51	1390	3580	4330	5.73
DL-300	329	3.03"	5.10	1680	4200	5300	7.44
DL-400	420	3.15"	10.2	2300	6000	7360	10.04
DL-500	519	3.47"	15.4	2925	7370	9200	13.70
DL-600	760	3.34"	32.0	4440	11120	13130	37.20
DL-750	990	3.56"	56.2	5500	14200	17300	51.20
DL-1000	1200	3.87"	99.5	7400	18850	23000	67.00
DL-1250	1410	4.13"	137.	8700	22150	27000	81.00
DL-1500	1670	4.00"	180.	10000	25450	31100	97.00

Martin Robbins

An Inspiring Story of Heroism

By Lawrence Mott

(Dedicated to KJM)

FATE—or whatever it is that seemingly controls the destinies of Man, sometimes with harsh severity—had laid ruthless hands on Martin Robbins, only —and hence Chief Radio Operator on the *Bloomton*, an irresponsible, waggly, creaking old steam lumber schooner that had worn a path of her own into Pacific waters, between a northern port to that of San Pedro. Up in ballast, and back in lumber—Plimsoll mark more than awash on pressing occasion, she drudged her weary way, pushing her scarred fore foot clumsily through the heaving water spaces.

Captains came—and went. Cooks stood the old, rattle-trap range, and the dearth of proper utensils, for a time, and then departed, vowing her "a d—— slob of a ship!" Mates, crews—all changed with periodic brevity.

But Martin Robbins was a fixture on board. And for the reason that an accident had made of a splendid, virile lad of 19, a hopeless cripple, who could navigate, after a fashion, on a badly-fitting wooden leg and two heavy walking sticks. Radio, as a profession, had never been his ambition, but by the force of unhappy circumstance, it was practically all that he could do—and the stipend thus earned went far toward the support of the idol of his heart—his mother—and himself.

Robbins was a good operator, with a Class A-1 Commercial. The owners fully realized this, and—being kindly men, albeit intent worshippers of the almighty dollar—they had made things as comfortable for him as lack of space permitted.

But, at best, it was a rough, wearyingly-monotonous existence, with little or nothing to do, and Robbins would hunch himself into a comfortable position abaft the squat funnel, and sit there for hours on end, all alone, watching the graceful flight of the swooping gulls and listening to the crooning lullabies of the wind, droning from the great distances —into them again. He never complained —nor railed—child-fashion—at the immutable cross that was his to bear during this existence, for he was of good stuff—was Robbins—going about his duty thoroughly and conscientiously.

Only once did the cry of a tortured, aching heart burst forth. It was in Grays Harbor, on a hot afternoon. Loading had been delayed, and the foreman was driving the crew. One of them—a burly figure of a man, perfect in wind and limb—stopped at the door of Robbins' quarters and asked for a drink of water. Wiping the sweat from his face, this whole-limbed tower of human strength broke out in a string of curses at the hardness of the work, at the penny-grabbing owners—at anything and everything.

Robbins listened—then:

"How would you like to be—*me*?" The tense passion in his voice checked the other's outburst.

"Without a thought of self he groped to his apparata."

"God ought to strike you dead! You have health! You are a *whole* man! You can earn a real day's wages, without feeling that you are accepting charity! *You* can dance—sing—be happy—while I . . . " a sob choked him and he threw himself on the narrow bunk. The other tiptoed away, shocked into thinking.

* * *

HOW well Robbins remembered when *she* had come on board—at San Pedro—for the run, North!

Captain Malcolm's Elsie was of that clean-cut, fine type of young womanhood that instantly appeals to the finest in a man. Full of fun, with a contagious spirit of gayety, she owned the ship from the time that the San Pedro breakwater was turned, and course set—up coast. He watched her as she passed about the grimy vessel, investigating everything, and a greater sense of his physical condition bit, deeply.

The radio apparatus had to be explained. She listened-in, and he showed her how to distinguish *dots* and *dashes*. At her insistent demand he printed the code, that she might learn it. With a woman's quick intuition she read his burden in his big grey eyes, as though they were the open pages of a book, and her heart ached for him, in his bare and drab existence.

One night she tactfully led him to talk of his mother, and the girl's eyes went wet as he told, quite quietly, of the difficulties of keeping both their bodies and souls in comfortable relationship; of his one-time hopes of being a marine engineer—and so forth.

"This is about all that I can do—now," he finished unheroically, merely making a statement of fact, and unseeking of sympathy.

She went out on the little after-deck, where a full moon swathed the world in steel-white light, and as she leaned against the grubby rail, listening to the

Continued on page 32

The Fable of the Frenzied Feline

With apologies to Lem N. Ade

By Dave Gibbons

ONCE upon a time there lived in a Small Town a youth named Katt. His folks spelled it with a "K" and two "t's" and that Helped Some. He was an Eager Reader and perused all the Popular Periodicals of a Mechanical Nature to be found on the newsstands.

He knew How to Use old phonograph records for eleven different purposes, besides the original, and Quite a Number of ways of making Fords Useful. But it was the Back Pages that captivated him. For a long time he tried to decide whether to be a Finger Print Expert in Six Lessons or a Hawaiian Guitar Player in Four. The Traffic Manager Dope and the Traveling Salesman Stuff gave him several Exalted Moments.

But what finally hypnotized him was the Double Page Dream of the publicity agent of the Grand Supreme Wireless University of Kankakee, Mo. He swallowed the Whole Business and filled out the Coupon. He enrolled for the Special Six Weeks course at so much down and so much per, and received Free in Addition their Marvelous Patented Battiometer. Seven or eight months later he amazed the entire Katt family by getting a License.

All he needed then was a job. He packed His Things and Came On to San Francisco. For many days he haunted the Various Offices and finally one morning there was an Opening. He felt that he was In Luck but forgot that there are Two Kinds of luck. The second on the steamship Jessie Jay had quit as he couldn't seem to get along with the second steward and Katt was put in his place.

After parking his toothbrush and his Other Collar in the Operator's Cabin Katt went on watch. He felt fine and had No Misgivings as he knew the game from A to Z, and had often seen sets work.

They headed north bound for Seattle and other Foreign Ports and met a Moderate Westerly Swell. The motion was Unpleasant and Katt was Uneasy. He hoped strongly that it wouldn't Affect him. A few minutes after noon, and as he was deciding he didn't Feel like eating as he had a Late Breakfast, the telephone from the bridge rang and a rough voice wanted to know what was the matter with the Time Tick and how was the weather at Table Bluff. Katt wasn't aware of any time-tick or other trouble and hoped the weather at Gable Ruff, or whatever he called it, was pretty nice, but he had no definite information to go on.

He woke up the first and told him the Circumstances. The first had been out at the Beach the night before delivering some Real Stuff he got at a Bargain in Vancouver for twelve a quart. He wasn't quite over it yet and Katt couldn't Make Much of his Explanation. He gathered however that he had Missed Something.

He also realized that the good ship Jessie Jay was a Poor Performer in a little sea, and he thought it strange he hadn't heard any signals yet as there ought to be some other ships around. The motion of the ship Increased and Katt's enthusiasm Waned, and when the first relieved him and pointed out that he could hear better if he had Both Terminals of the Phone connected to the Binding Posts he was only Mildly Interested.

Next day he received his first message from another one of the company's ships but all he could make out was the Best Regards part until the fourth repetition and even then he was a Little Doubtful about the Names. He had Quite a Time with his key too as it wasn't nearly so Easy to Work as his practice set. He heard Marshfield call QST alright but the beginner on duty there was a very Snappy Sender with a very Individual Fist of his own and Katt didn't get the rest of it. Afterwards he figured it might have been a storm warning, but anybody could see the wind was getting worse right along.

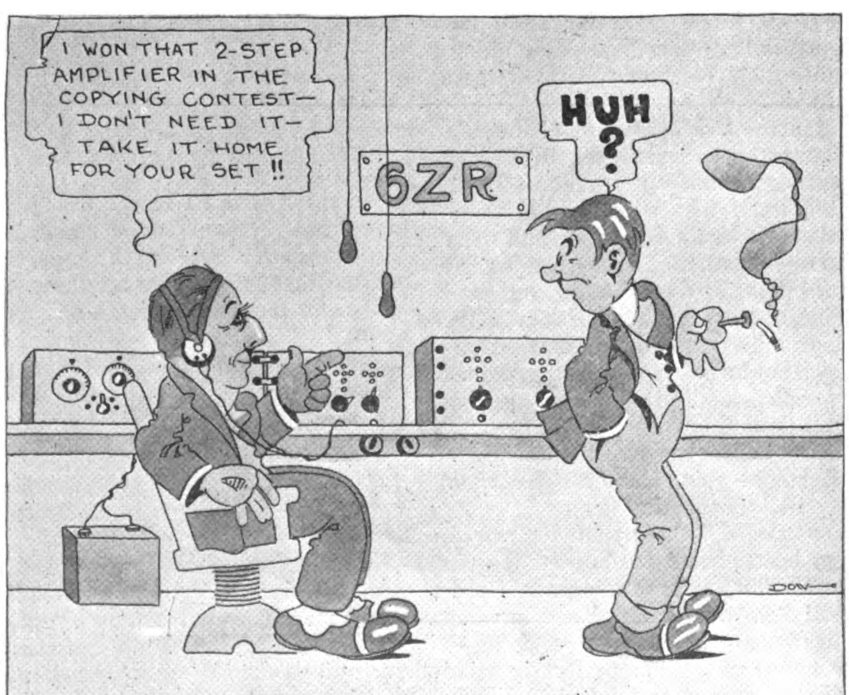
The skipper then wanted to know the weather at North Head and how was the Bar. He came in and sat in the shack while Katt Called and Called and Called. And every time he called he Knocked His Detector. There was only one Good Spot on that lump of coal and It was Hard to Find. He finally gave it up and the Old Man grunted and left. Katt had not been told that NPE never answers until at least four ships call him Twenty Minutes Each, as it's lots of trouble Starting Her Up.

When they got to the bar there was Considerable Sea running and Katt didn't like the Looks of Things. After a couple of hours of such Rolling And Pitching as Katt never believed possible, the Jessie Jay tried vainly to roll All The Way Over and at last got inside into smooth water. Katt thought there couldn't be anything worse than the Awful Experience he had been through and when the freight clerk told him it was always Much Easier going in than coming out he made up His Mind.

When they tied up at Astoria he didn't wait for the gang-plank. He took his tooth-brush along but left all his Other Stuff on board. He headed directly for the Interior of Oregon and although many years have passed he has never since returned to Civilization. It is said that after a time Katt became quite wild, and that his Descendants are all wild too.

The Natives claim that this is the True Explanation of the Origin of the Wildcat, but as there still exists Some Doubt everybody is entitled to Their Own Opinion in the matter.

Moral:—You learn a lot After You Leave School.



Things That Never Happen

International Allocations of Frequencies

Reviewing the Report of the Meeting of the Interallied Technical Committee on Radio Communication, Paris, 1921

A LENGTHY draft of the recommendations of the Interallied Technical Committee on Radio Communication, which conferred at Paris from June 21 to August 22, 1921, has been issued by the U. S. Department of Commerce. The recommendations, together with any changes that may be proposed by any of the five governments represented, will be submitted for adoption at a world conference which will probably be held during 1922. The views of American commercial and private radio concerns were presented at a meeting called by Secretary Herbert Hoover at New York City on November 25th.

The committee's report consists essentially of answers to a set of fourteen questions that had been prepared by the 1920 Washington conference and answers to four questions subsequently introduced. These questions have to do with the classification and allocation of waves, restrictions on damped waves and on radio telephony, and the determination of the normal range of a radio station.

Nomenclature

A preliminary series of recommendations on nomenclature are given for the attention of the International Electrotechnical Commission. Herein it is suggested that "atmospheric disturbances" be used instead of "statics" or "X's" this designation being reducible after first mention to either "disturbances" or "atmospherics."

"Electron tube" is recommended as the generic title of the thermionic tube, of any number of electrodes and in any of its recognized modes of operation. The three-electrode tube is called a "triode," being further designated as a rectifier triode, an amplifier triode or a generator triode, depending upon the use for which it is intended.

"Radio-telegraphy" or a "radio-telephony" are substituted for "wireless." In describing couplings of antenna systems or triodes use "resistance coupling," "inductive coupling," "auto-inductive coupling," "capacity coupling" or "capacitive coupling," as the case may be. In describing an instrument for determining the direction of propagation of waves use "direction finder" or "radiogoniometer."

An "antenna is the electrical conductor, or system of conductors, for receiving or emitting electromagnetic waves. The term antenna is not understood as including mechanical supports, a 'tower' is a self-supporting structure, a 'mast' a non-self-supporting structure.

"It is believed that in many cases there is a distinct advantage in the use of frequencies rather than wave lengths." Cycles per second is abbreviated as c/s, kilocycles as k/s, and megacycles as Mc/s.

"In regard to 'wired wireless,' the representatives of France, Great Britain and Italy state that the terms 'high frequency telegraphy' and 'high frequency telephony' have already been adopted in their respective countries. The Japanese representatives were also in favor of these terms although other terms have been used in Japan. The American Delegation was stated to favor the term 'line radio.' "

Classification of Waves

The different classes of waves and their definitions are:

Type A—Continuous waves—Waves which, after reaching the steady state, are periodical, i. e., the successive oscillations are identical.

Type A1—Continuous waves, key modulated—Continuous waves of which the amplitude or frequency is varied by the operation of keying in telegraph transmission.

Type A2—Continuous waves modulated at audible frequency—Continuous waves in which the amplitude or frequency is varied in a periodic manner at an audible frequency.

Type A3—Continuous waves modulated by speech—Continuous waves in which the amplitude or frequency is varied according to the characteristic vibrations of speech.

Type B—Damped waves—Waves consisting of successive wave trains in which the amplitude of the oscillations, after reaching its maximum declines gradually.

These definitions do not refer to types of transmitting apparatus. They do not exclude, for example, from type A1 emissions from spark apparatus which produce real continuous waves. They also do not exclude from type A2, spark apparatus which may produce real modulated continuous waves.

In the case where bands of frequencies are allotted to a service, or to a station, or to different nations, each administration should ensure that the stations under its jurisdiction employ frequencies which are sufficiently far removed from the limits of these bands, in order that no objectionable amount of interference be caused to traffic of other services or stations employing frequencies outside the bands.

Within each type, waves are classified according to the degree of interference they produce at any distance.

A particular emission will be considered as coming in a given class, regardless of whether the interference is caused by high-signaling speed, modulation, spacing wave, actual decrement, harmonics, variation of frequencies of the generator, etc.

At present, four such classes are admitted, these being defined by their *equivalent decrement.*

No difficulty exists in the definition of *equivalent decrement* when the resonance curve is such that a sufficiently, nearly constant value is obtained for the quantity

$$S = \pi \frac{f_1 - f_2}{f_r} \sqrt{\frac{I^2}{I_r^2 - I^2}}$$

where f_1 and f_2 are the frequencies at which I is measured, and f_r is the resonance frequency at which I_r is measured; it being conventionally accepted that the frequencies be selected over the range between the limits 0.9 f_r and 1.1 f_r, and that the values of I^2 do not exceed one-half of I_r^2.

When the value of S is found to be not independent of the frequency, the largest value of S given by the formula should be taken as the *equivalent decrement.* Account should be taken of the effects introduced by the measuring apparatus. It is desirable, if possible, that the determination of the resonance curve should be made at a distance greater than one wave length, in order to secure freedom from local disturbance.

The four classes are then as follows:

Class 1—
Equivalent decrement 0.000 to 0.005
Class 2—
Equivalent decrement 0.005 to 0.02
Class 3—
Equivalent decrement 0.02 to 0.08
Class 4—
Equivalent decrement 0.08 to 0.16

In order to eliminate emissions which produce unnecessary interference it was recommended that each administration should assure itself that all the stations under its jurisdiction be operated in accordance with the best practice of the art. Even Type A waves can be purified by the employment of loose coupling, filter circuits, absorption circuits and other selective arrangements.

The extent of interference caused by a station is approximately indicated by its equivalent decrement, although this does not take into account slow variations of wave frequency or the emission of frequencies differing from the frequency of transmission (harmonics, etc.). It is therefore recommended that each administration should fix an upper limit of permissible variation. With regard to harmonics it is recommended that the electromagnetic field measured at any frequency less than 0.9 or greater than 1.1 of the frequency employed shall not exceed a definite value at a specified distance. It is requested that experiments be made to determine the proper value and distance.

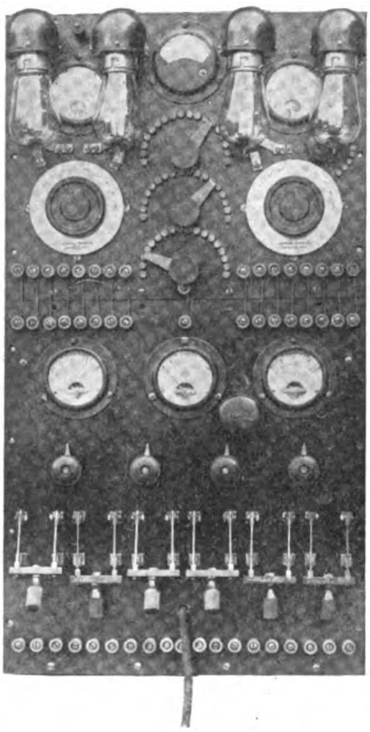
Continued on page 56

Four-Tube C W Transmitter at 2 BAK

By Frederick Koenig

HEREWITH is a picture and diagram of a continuous wave transmitter at 2 BAK, Tarrytown, N. Y. This two panel transmitter is part of a larger cabinet also including an arc transmitter, amplifying set and receivers. It was designed by Frederick Koenig and is operated by Joseph B. Slavin.

The Heising-Colpitts circuit is used for the phone or buzzer and the Colpitts circuit for C. W. or I. C. W. The circuit is similar to that used by J. O. Smith, 2Z1, with some modifications.



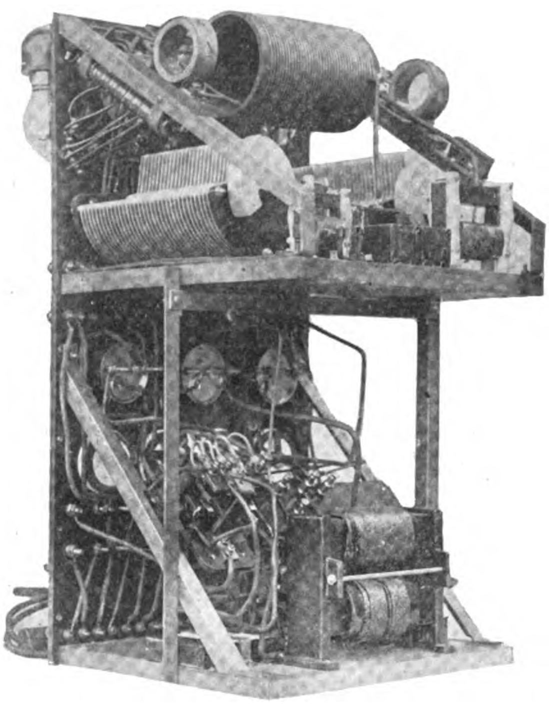
Front View of 2BAK C. W. Transmitting Panel

Using five watt tubes with 500 volts, 200 milliamperes space current, 0.9 ampere radiation is employed on phone, and using 600 volts, 250 milliampere space current on C. W., 1 ampere radiation is obtained. All the adjustments are variable.

The transmitter is made up in two units. The upper panel contains the transmitter proper, while the controls are mounted on the lower panel. In the upper panel on the left and back of the tube are the grid milliammeters, radio frequency is in center, while the plate milliammeter is on the right. The three double-throw switches under the first three tubes are to change from C. W. to phone or vice versa. Switch points under fourth tube is a variable 5000 ohm Ward-Leanord grid-leak with taps every 500 ohms.

The three rows of switch points in the center are for the inductance, which consists of 34 turns of hard drawn copper wire wound on a Formica tube 4 inches in diameter and 72 inches long, which has been previously grooved. A tap is taken off every other turn and goes to each switch point common to wave length, plate and grid coupling switches, top row wave length, middle row plate and bottom row grid coupling.

The condenser on the left is .0015, feed back condenser and on the right is .0015 grid condenser. These condensers were made up specially by the General Radio Co., and are tested to 1500 volts.



Rear View of 2BAK C. W. Transmitting Panel

In the lower panel are mounted the controls, the meter on left is a 0-5 A. C. ammeter for the two modulator tubes, while the meter on the right is 0-5 A. C. ammeter for the two oscillators. The center meter is 0-15 A. C. voltmeter. A Century buzzer is mounted between the voltmeter and ammeter.

The single-throw double-pole switches at the bottom of the panel are as follows: The first one is for C. W., second for I. C. W., third for phone, fourth for buzzer, fifth A. C. for filament heating and sixth for D. C. for plate.

The filament heating transformer is mounted in lower panel and is an Acme 10 and 12 volt. Also in this panel is mounted a relay that operates by a switch in the microphone. In one of the leads from the transformer is placed a one ohm resistance which keeps the filaments always heated slightly and when the relay is closed the resistance is cut out and they then heat up to the proper degree. The idea of this is that the tube is always warm and ready for transmitting. It also takes away the shock when the plate voltage is applied, especially where the tube is rushed with high voltage. This relay also connects the receiver or the transmitter with the antenna, applies the plate voltage, and either heats or puts out the amplifier tubes. It will be thus noted that everything is automatic in this station.

A ground system was used at first, but due to the long lead .6 amp radiation could not be obtained, so a counter-poise system was installed and .4 amp. more radiation was obtained.

Continued on page 40

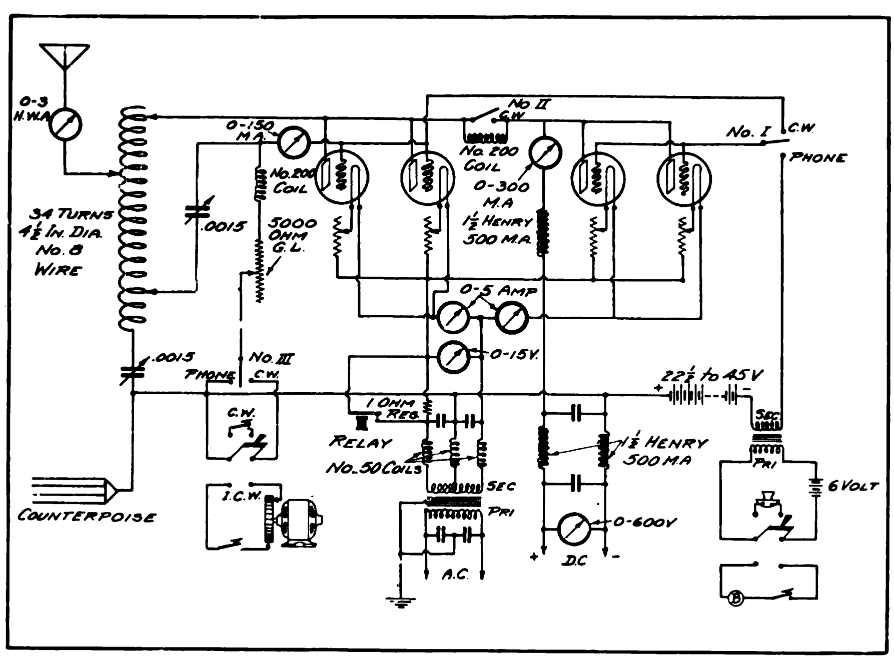


Diagram of Connections for 2BAK

AN EFFICIENT SMALL TRANSMITTER

By Lawrence Mott

It has so often been asked of me what I am using on my smaller transmitter at 6 X A D that I am impelled to give herewith the exact hook-up and a brief explanation. This for the reason that there are many amateurs who have the erroneous impression that a great deal of power, and a very expensive plant, is required to do long-distance work.

Let me say that I am in effective touch with 9AMB, 9ALG, 9XAH, 9WD, 9ZAC, 9DVA, 7ZU, 7YJ, 7JD, etc.—without straining apparata at all! All of these stations are over the 1000 mile range from Catalina Island, that is situate 30 miles from the port of San Pedro, Southern California. 9ZN has reported me, by mail, and—it will be admitted that to reach Chicago on but 20 watts is a very interesting achievement—proving, as it indubitably does, the great possibilities of the *low*-powered, inexpensive, CW transmitter.

The hook-up is, I think, clear. A few words as to the out-of-doors equipment may not be amiss. My aerial is of 4 wire, Navy-type, 7-strand material, with a slightly inclined flat-top of 90 feet in length, and a lead-in of 58 feet. The taller spar is 91 feet high and the lesser 62 feet. Ground systems consist of 30 metal plates, buried under the antenna, 5 feet down and soldered together with 1-inch copper ribbons. Stand pipes 3 inches in diameter, go down to these plates at regular distances, and into these I turn the salt water hose every few days, thus keeping the sub-strata thoroughly moist all the time. I am also using that which is said to be the latest "wrinkle" in transmission efficiency, viz.: a counterpoise of exactly the same length as the aerial and directly under it, made of the same size wire, and parallel to the ground 9 feet above it—most carefully insulated, etc. Besides this system I have a fan effect of 1-inch copper ribbons, running from a center, directly under the transmitter, and—of course—the usual soldered connections to the Avalon water system. Hence I have a thorough ground-plus-counterpoise-plus-city-water-connection that, I am certain, is the chiefest cause of the very excellent antenna current that I attain: with 1-VT2 equals 1.5 amps.; with 2 tubes equals 1.9; with 3 tubes equals 2.2 and with 4 tubes equals 2.7 amps.

Such a transmitter as this is NOT "strenuously" expensive, and it is—as I have said — remarkably effective. At least, I have found it so. The transmitter was built to order for me by the Western Radio Electric Company of Los Angeles, and a very handsome piece of work they did. Be it noted that although I have mentioned only the WE-VT2 tubes, I also use, and with as good effect, the Radio Corporation UV202-5 watt tubes. These, of course, are to be had for the buying, whereas the others are more difficult to be "got at."

Call Heard and Worked at "6XAD."

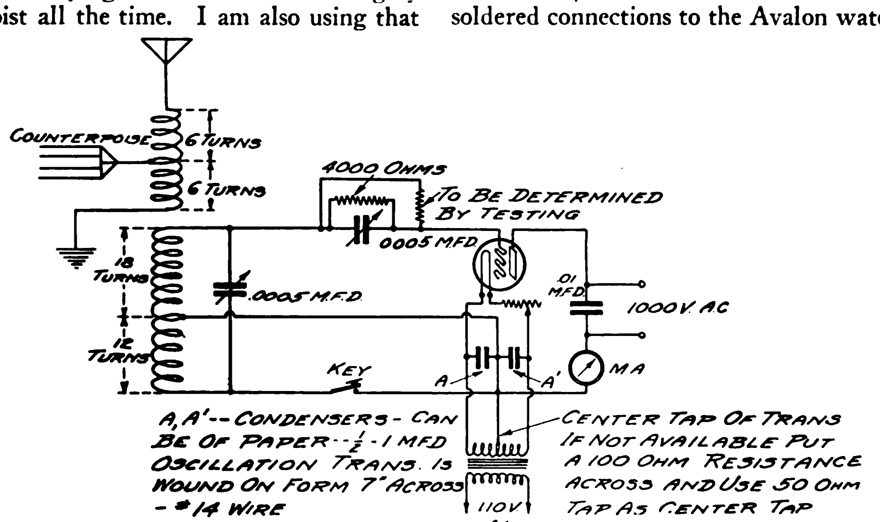
(N. B.—The entire list of Stations that I have heard, and worked, is too long for publication purposes. Hence I have chosen a fairly representative night's efforts. The occasion was in late November.)

"Five" Stations: IF, CR (Canadian).

"Six" Stations: EA, EB, EF, GM, ZN, ZA, GN, OC, KA, GI, MZ, FK, GT, ZU, ZZ, UO, GR, WV, EN, AT, ALE, AQT, AUN, AKL, ABA, GP, JX, AJS, BAF, ALU, XAC, ME, XAK, ZB.

"Seven" Stations: ZU, YJ, MF, XD, JD, EX.

"Nine Stations: ZAC, ALG, ZN, DVA, HT, WD, AQR.



6XAD's Hook-Up

NEW DX RECORDS REPORTED

6 A L E, W. W. Lindsay, Reedley, Calif., was heard by I E S, Brookline, Mass., at 5:14 a. m., Nov. 23, 1921, eastern standard time, while he was calling 9 C P on schedule. One 50-watt Radiotron with 1500 volts a. c. 60 cycles on the plate was used in a master oscillator circuit.

6 A M E, Robert H. Potts, Riverbank, Calif., heard 8UJ (CW) working 5 L A, at 9:15 p. m., Nov. 4, 1921, Pacific time, and again on Nov. 9th he heard 8 U J working 9 Z Y. 8 U J is Clarence R. Witte, 1182 Lewerenz Avenue, Detroit, Mich., who confirms the reception. He is using two 5-watt Radiotrons, radiating 2.2 amps. 6 A M E is using one Cunningham tube, honeycomb coils and Murdock phones with a 1-wire aerial, 90 feet long, 40 feet and 25 feet high at either end.

9 A M B on Oct. 29th, while calling 8 U J and working 9 A A O, was heard by G. C. Farmer on board S. S. West Prospect, 2500 miles from San Francisco. Mr. Farmer also heard 8 L F on Oct. 30th, while 2750 miles from San Francisco.

ELIMINATION OF AC HUM

A bit of very important information comes through from E. E. Bucher, commercial engineer of The Radio Corporation of America. Quoting from a letter of his:

"If any of your friends use Fig. 1 in the 2d or 3d revised edition of our catalog, where two 5-watt tubes are energized from the rectified A. C. source, will you please tell them that they can greatly reduce the A. C. hum—indeed, reduce it almost to zero—by putting 5 micro farads on the filter—that is to say, 3 micro farads on one side and 2 on the other. Do you know that it is perfectly possible to obtain 50-watts output from four of our 5-watt tubes, without excessively overloading them? It is being done every day in this vicinity."

In connection with Radio Corporation apparata, in general, I have heard a great many bitter complaints anent the tardiness of deliveries, and so forth, and I would point out that the demand for all manner of CW material has been so great that the Corporation and all other manufacturers have been very hard pressed in turning out an adequate supply.

Governmental Approval of Amateur Radio Activities

Some Significant Letters from Secretaries Denby and Wainwright, Major-General Squier and Commissioner Carson

THE SECRETARY OF THE NAVY
WASHINGTON

November 2, 1921.

Dear Sir:

In reply to your letter of October 17th, 1921, concerning the efforts of RADIO, of which you are Associate Editor, to assist the Government in every way by fostering a spirit of enthusiasm on the part of amateur Radio Operators, I am pleased to state that your efforts meet with my hearty approval.

In the event of an emergency, a large number of radio operators of experience will be immediately needed for service in the Navy. It is apparent that a large percentage of them will necessarily have to come from the rank and file of amateur operators.

If RADIO can increase the number and efficiency of qualified Radio Operators it will have performed a most patriotic service.

Sincerely yours,
Edwin Denby.

TWIN SUNSHINE
AVALON, CATALINA ISLAND, CALIF.

October 27, 1921.

My Dear Mr. Carson:

It is with apologies that I begin this missive, as I fain would not take of your time, but hereinafter set down for your consideration are certain things that—sooner or later—will have to be officially recognized and acted upon.

As department rulings now stand, the amateur wave-length of 200 meters, is woefully overcrowded. So much so that it is next the impossible—if in, or near, a city of any size—to do any research, experimental or long-distance work. I do not mean to infer that experimental stations, with their permission to use higher wave-lengths are seriously hampered, but as it is almost out of the question to keep ALL the thousands of amateurs, operating each night, on exactly 200 meters, the result is a confusion in the ether that is exasperating, and that does NOT tend for amateur radio progress and development. Another resultant of the clamor, and infernal din, is that there is a very strong tendency on the part of spark operators to open up on FULL power—and sometimes a little "fuller"—in order to "get through," and your imagination will convey the rest.

It is, I think, an admitted fact that Continuous Wave transmission is the coming thing. Perhaps this may be pointed out very strongly in that the Radio Corporation of America, for instance, are putting vast quantities of CW apparata on the market—to the almost complete shelving of instruments for spark transmission. As you are, of course, aware, sir, CW lends itself to the sharpest sort of transmission, its decrement being practically nothing—if the apparata is properly set up.

Therefore, would it be possible to grant CW operators the range of wave lengths between 200 and 280? The 20 meters between that and the commercial 300 is PLENTY, and to spare, in order to avoid any possibility of infringing on the commercial wave. As an aside: it is a fact that 300 meters is not much used—that of 600 being the principal carrier of all commercial traffic—save in comparatively few cases.

Then again: between 300 and 600 meters is a range of wave lengths that would be a God-send to the CW operators, and that would, in the aggregate, not interfere with anyone. From 600 to 1000 meters is another commercially "bare" space.

Continued on page 70

WAR DEPARTMENT
WASHINGTON

October 25, 1921.

My Dear Mr. Mott:

The devotion shown by the amateur radio men of our country in the building up of a reserve for the Signal Corps is worthy of the highest commendation. Their service to their flag is not limited to that which they will give in case of war, but extends all through the years of peace.

Radio communication as an art and a science, and as a factor in developing the national spirit of team work, is receiving a great impetus from the enthusiasm and intelligence of the thousands of amateur radio men throughout the country.

I wish you the greatest success in your work of fostering this patriotic movement.

Yours very truly,
J. M. Wainwright,
Acting Secretary of War.

Geo. O. Squier
Maj. Genl. U.S.A.

WAR DEPARTMENT
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON

November 14, 1921.

My Dear Mr. Mott:

The universal support which the amateur radio operators of America have accorded the Radio Reserve has been to me the source of great satisfaction. The fact that thousands of patriotic and intelligent men stand ready to help the Signal Corps in case of an emergency is an important part of the armor of preparedness.

But we must also remember that the Signal Corps is a branch of our Army whose work is not limited to strictly military duties and activities. In the world of commerce and science it plays no unimportant part. The far-flung Alaskan system of communications is for miner and military commander, alike. The constant search for new methods of electrical communications, new conceptions of meteorological principles, new photographic procedure, and even new and improved types of message bearing pigeons, brings to our country a considerable return of scientific achievement. In this peace time service, the radio reservist is a prominent factor. All of his hours of patient study and investigation go to swell the total of our national communication abilities.

I wish to commend you in your endeavors to help build and improve this spirit of service which pervades the Signal Corps Radio Reserve.

Very sincerely,
George O. Squier, Major-General,
Chief Signal Officer of the Army.

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
WASHINGTON

November 23, 1921.

My Dear Mr. Mott:

I have received your letter of the 27th ultimo in which you have suggested that a little more latitude in the wave-length range be given to amateur stations using continuous wave transmitters. I regret that because of many matters recently coming before me, requiring my immediate attention, I have been unable to reply to your letter sooner.

As you know, the most recent legislation we have on radio is the Act of August 13, 1912, and the International Radio Convention of 1912, since which time there has been so much done in the development of radio apparatus that the present laws are difficult to apply.

Several matters have come before me recently illustrating the urgent need of additional radio legislation and I am of the opinion that such legislation may be considered by Congress as soon as the present important problems before it have been disposed of.

Any new legislation or amendments to the present laws will undoubtedly result in new regulations by this Department and when this is undertaken your suggestion will receive due consideration.

Sometime ago the Radio Inspector at San Francisco suggested for the amateur stations using spark transmitters that a wave-length of 150 meters be assigned to an amateur station when first licensed; that after one year this wave-length be increased to 180 meters and after two years be increased to 200 meters which would place the beginners on a wave-length which would not interfere with the older amateurs.

This suggestion seems to have merit and will also receive due consideration, but because of the limited appropriation and small force this Bureau must be careful not to make any changes which will involve to any great extent additional inspection work or additional clerical work until it has some assurance of being prepared to fully enforce the laws and regulations, which you state appears to be difficult at this time on the Pacific Coast.

The suggestion that continuous wave stations be allowed a range of wave-lengths between 200 and 280 meters seems to be reasonable.

You can be sure I will take pleasure in doing anything I can to further the interests of the amateur radio operators.

Respectfully yours,
D. B. Carson.

Queries and Replies on Continuous Wave Practice

By Gerald M. Best

Question: I have two antennæ; one for short wave transmission and reception, and the other for long wave reception. I accidentally connected the long wave antenna in parallel with the transmitting antenna while the 20 watt C. W. set was operating, and noticed an increase of .5 ampere in the antenna ammeter. Is this increased radiation, or just a false alarm?—L. M.

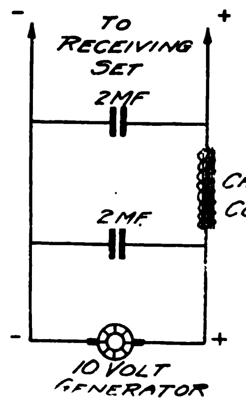
Answer: My inclination would be towards the latter reason. You did not state what happened to the wave length when you made the change. If the wave length was increased, perhaps it placed your antenna circuit in a better state of resonance with the primary circuit, which may not have been exactly tuned to the short wave antenna alone. The chances are that it was a case of circulating energy between the two antennæ, and the additional current was not radiated into the ether.

Question: What is the object of the counterpoise-ground connection to the oscillating circuit of 6XAF's transmitter, as shown in December Radio?—W. L.

Answer: To fully explain the reason for this combination would require considerable space. Briefly, it is to reduce the antenna resistance, and consequently to increase the radiation. Measurements have shown that this combination of antenna and counterpoise has reduced the antenna resistance to only one-fourth the resistance of the ground alone. For a theoretical discussion of this subject, read the article by H. H. Beverage in the new catalog of the Radio Corporation of America. This article describes such an arrangement, giving complete data, except that in Mr. Beverage's station, condensers are used in the ground and counterpoise leads to keep the high plate voltage off the ground system. As the plate voltage is kept off the helix in the Hartley circuit, such as is used at 6XAF, no such condensers are necessary.

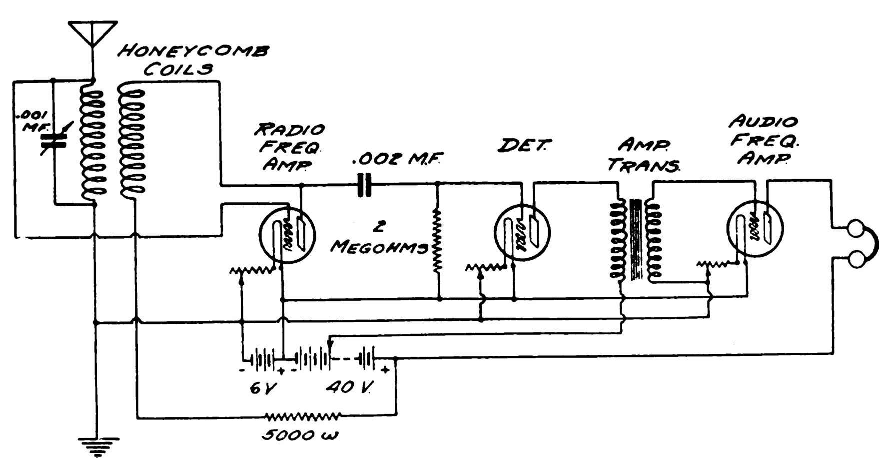
Question: I have a 10 volt, 6 ampere D. C. generator, which I would like to use for furnishing the filament current for my receiving tubes. As there are only 24 segments on the commutator of the machine, I get a prohibitive amount of commutator ripple in my phones. How can this noise be eliminated?—L. F. S.

Answer: This may be accomplished by means of a filter in the positive side of the filament supply. As there is no such article on the market at this time, you will have to build one yourself. The approximate dimensions of the filter coil are as follows: Wind approximately 500 turns of No. 14 single cotton covered wire on a core of at least 1 1/2 square inches cross section. This core should be of the closed type, similar to those used in spark or C. W. transformers. The size and shape of this core is optional, just as long as the cross sectional area is at least 1 by 1 1/2 inches. The object of this choke is to obtain the highest possible inductance with the minimum possible D. C. resistance, and a coil such as the above will have an inductance of approximately .25 henrys and a D. C. resistance of 1.25 ohms. If No. 12 wire is available, you may wind 1000 feet on the core with a D. C. resistance of only 1.5 ohms, and probably double the inductance. The circuit of the filter is shown herewith, the condensers being ordinary paper condensers of 2 M. F. capacity.



Question: Could a one-stage radio frequency amplifier be hooked ahead of my regular detector and one-step audio frequency amplifier. I use honeycomb coils for receiving and would like to use these in such an arrangement as described above.—S. H. J.

Answer: The circuit is given herewith.



THE IMPORTANCE OF KNOWING V. T. CHARACTERISTICS

A Simple and Practical Account of How to Improve Your Tube Reception

By Gerald M. Best

MANY articles have appeared in recent radio publications on the subject of vacuum tube characteristics, and methods by which the amateur may determine them for himself. All the methods, however, call for a relatively large outlay of apparatus and the writer presents an idea which he has incorporated into his own receiving set, by which he may obtain the operating characteristics of any of his tubes at any time, without a great deal of additional equipment.

The principal characteristic of a vacuum tube is its grid-voltage-plate-current curve. This will indicate two important facts—the maximum input voltage which the tube will handle without distortion, and the proper negative grid potential, so that the tube may be worked on the right portion of the grid-voltage-plate-current curve. As most amateurs know, a vacuum tube when used as an amplifier, must have its grid negative with respect to the filament, this voltage being obtained either by a biasing resistance in the filament circuit, or a series of dry cells in the grid circuit. A milliammeter and an ammeter are necessary for these measurements and the writer will attempt to justify the addition of this apparatus to the regular receiving set, to be used in the operation of the set as well as for making tests on the tubes.

Let us consider the average amateur receiving set, employing a soft tube for a detector and one or more amplifiers, the latter tubes having a high vacuum. With possibly one or two exceptions, receiving sets which can be purchased in the open market have no means of measuring either the filament or plate cur-

Continued on page 64

AMATEUR RADIO LABORATORY MEASUREMENTS

By D. B. McGown, Assistant Radio Inspector

WHEN one hears the words "Radio Laboratory," he usually pictures a solemn place, filled with thousands of dollars worth of special and delicate apparatus, presided over by a spectacled ogre, who would enjoy nothing more than to seize and cruelly shock to death some poor innocent victim, who happens to wander within the walls of the sacred building, by hooking his ears up to a high power arc set, or singeing the hair from his head with some deadly and unknown radio ray, and leaving his brains (?) exposed; or actually a radio laboratory may be the smallest hole in the attic or basement, with a few dinky pieces of absurd looking junk lying around with a few simple connecting wires. However, there is a happy medium. After a young man has played around for a time with "bought" apparatus, he generally becomes interested in the actual making of it, or, as more often happens, he has to make his own apparatus from discarded door knobs and picture moldings.

A great need for measurement is usually felt from the very beginning, starting from "How big a tuning coil shall I use to get the concerts, if I wind it with strips of biscuit dough?" to "That coil's all right for looks, but is its distributed capacity too high?" It is realized that most radio experimenters would like to know some of the performance of apparatus they may wish to use, but the usual measuring appliances are costly, and the use for them being less urgent than radio instruments for the station, there are few radio experimenters who have apparatus of this kind. As a result, a great deal of hit and miss work, coupled with some very "shaky" calculations, is about as far as most amateurs get in measurements of even the most common quantities used in their sets.

In this, and the rest of the articles of this series, an attempt will be made to so simplify the measurements and quantities that anyone, with the most common apparatus, can obtain results that will be accurate enough for ordinary purposes. Many quantities measured will even compare favorably with those measured by instruments of high precision.

The first step will be to construct a standard of capacity. If we take two true plane surfaces, both of which are conductors, each being exactly 12 inches square, and separate them by 1/8 inch, this air-dielectric condenser will have a true capacity of .0003 micro farads.

The simplest way to make such a condenser is to coat a piece of glass, preferably plate glass, ON ONE SIDE ONLY, with a piece of tinfoil exactly 12 inches square, using turpentine, or banana oil, as an adhesive. Prepare a second piece of glass in similar manner. Now solder leads of fine wire to the tinfoil by taking a very hot soldering copper, and dropping a bit of solder onto the tinfoil, the wire being held so the solder will drop on it also, some rosin being applied as a flux. Then procure four blocks of any kind of material, (the author used small pieces of sheet bakelite), but be sure they are exactly 1/8-inch thick. Put these blocks on the glass, OUTSIDE of the foil-covered area, the foil being up, and lay the other plate down, foil side down, and you will have a standard condenser of .0003 capacity, with air dielectric. Be sure the two tinfoil sheets coincide with one another exactly, leaving no margin of foil which has no opposite coating.

This will be used as a basis of all our future experiments, or at least will be used to determine the exact capacity of a variable condenser, which will be used as a measuring capacity, as we progress. Several of these condensers would be handy, and of considerable help, so the reader is advised to make up several in his leisure time. With four of these condensers, a number of capacities can be made up. Two in series will give a total capacity of .00015, two in parallel, .0006, three in parallel, .009, etc.

The next step will be to make up a small inductance. This will not be used for direct measuring purposes, yet, but for comparison purposes only. Any kind of inductance will do for our purpose, provided it is made up so it will stand a reasonable amount of handling. A 50 or 75 turn honeycomb, or similar coil will serve nicely, altho if not available, a coil of say 50 turns can be wound on a cardboard tube, and carefully shellaced, the leads being brought to binding posts at the ends of the tube. Allow this to dry, or still better, put it in a warm oven (about 150 degrees, F.) and bake the coil for an hour or so.

We are now ready to proceed with a calibration of a variable condenser, which will be taken up in the next installment.

RENEWED YOUTH—

By The Associate Editor

The other evening a most charming, grey-haired gentleman came to my Station and introduced himself—with quaint whimsicality—as: "The father of 6——" Naturally, I was delighted to welcome him.

The conversation was all of radio effort and its betterment. I suggested that he operate a bit. He joyously accepted and sat himself at the instruments.

And I watched him.

No youth, in the full prime of the right-side-of-30-years, could have been more enthusiastic.

Time passed.

He turned to me, excitedly: "I'v got 6——" (a station in the far north of the State).

For two hours he sat at the key and I enjoyed having him there!

Midnight—as he left me—a touch of wistfulness in his voice:

"Do you know that this radio is a God-send! It keeps me in touch with my boy's active interests, and so we have one common ground to meet on, at least! Also—" he hesitated—"also it keeps me young and enables me to enjoy my boy's youth."

And I watched him walking briskly away in the soft moonlight—in very truth a father with youth renewed—because of his pathetic desires to "stay young with the boy."

To me, it was a touching bit of paternal sentimentality, and one that fathers—generally—would do well to ponder over!

FEDERAL TELEGRAPH COMPANY

TELEGRAM

R. P. SCHWERIN, Pres.

The Federal Telegraph Company transmits and delivers this message subject to the terms and conditions accepted by sender.

D 1 ND SD 50 BH CO

PORTLAND, OREGON, SEPTEMBER 28, 1921.

MR. P. P. SCHWERIN.
PRESIDENT, FEDERAL TELEGRAPH COMPANY,
SAN FRANCISCO, CALIF.

THIS MESSAGE MARKS THE FIRST COMMERCIAL APPLICATION OF PRINTERS IN THE RADIO FIELD AND DENOTES A BIG ADVANCEMENT IN RADIO COMMUNICATION. IT WAS PRINTED BY THE MORKRUM TELETYPE, THE OPERATION BEING MADE POSSIBLE BY THE HALL RADIO RELAY.

WITH BEST WISHES FOR A BRILLIANT FUTURE FOR YOUR MOST PROGRESSIVE COMPANY.

HALL RESEARCH CORPN.

9.56 P.M.

AN IMPORTANT RULING

To the Editor—Sir: The licenses of an Amateur Operator have just been suspended and may be revoked for installing and operating his set at a point other than the place specified in the license.

Will you kindly inform your readers that a license issued to cover the operation of a station at a specified locality authorizes the use of apparatus described at that location only and hence if the equipment is operated at any other place without specific authority, the law is violated in the same sense as if no license had ever been issued to the person.

Such violations in the future will jeopardize the continuance of any license held by them.

Whenever a change of location is contemplated, applications should be submitted in advance for authority to operate the apparatus at the new location, and the transmitter should not be used until the necessary authority is obtained.

Operators signing their station call at stations other than their own will thereby forfeit their licenses.

Respectfully,
J. F. DILLON,
Radio Inspector.

San Francisco, Dec. 2, 1921.

RADIO TELEGRAPH TIME, PRESS, AND WEATHER SCHEDULES

By EDWARD M. SARGENT

Time (120th M.)	Call	Transmitter	Location	Wave	Service
0000	NPG	Arc	San Francisco	4650	Px to NPL
0000	NPG	Spark	San Francisco	1905	Weather
0100	NPG	Arc	San Francisco	8600	Px to NPM
0115	NPG	Spark	San Francisco	1905	Px to QST
0200	NBA	Arc	Darien, C. Z.	10500	Time
0200	FL	Spark	Eiffel Tower	2700	Time
0200	NPL	Arc	San Diego	9800	Px to QST
0249	FL	Spark	Eiffel Tower	2700	Time
0300	NPG	Arc	San Francisco	8600	Px to NPM
0330	NBA	Arc	Darien, C. Z.	10500	Px to QST
0400	FFZ	Spark	Shanghai, China	600	Time
0400	NPG	Spark	San Francisco	1905	Weather
0405	JOC	Spark	Otchishi, Japan	4750	Time
0600	NPO	Arc	Cavite, P. I.	5000	Time
0600	NPG	Arc	San Francisco	8600	Px to NPM
0800	NPG	Spark	San Francisco	1905	Weather
0900	NAA	Spark	Washington, D. C	2500	Time & wtr
0900	NSS	Arc	Washington, D. C	16900	Time
0900	NAT	Spark	New Orleans	2400	Time & wtr.
0900	NPG	Arc	San Francisco	8600	Px to NPM
1000	NBA	Arc	Darien, C. Z	10500	Time
10:36:20	XDA	Spark	Mexico City	2400	Time
1100	NPG	Arc	San Francisco	8600	Px to NPM
1200		Time Signals and Weather Forecast, as follows:			
	NPG	Spark	San Francisco	1905	Repeat on 600
	NPL	Spark	San Diego	2400	Repeat on 600
	NPW	Spark	Eureka, Calif	2400	Repeat on 600
	NPF	Spark	Marshfield, Ore	1905	Repeat on 600
	NPE	Spark	North Head, Wn	1905	Repeat on 600
	NPC	Spark	Bremerton, Wn	1905	Repeat on 600
	NPG	Arc	San Francisco	4650	Time only
	NPL	Arc	San Diego	9800	Time only
1300	NPG	Arc	San Francisco	8600	Px to NPM
1500	NPG	Arc	San Francisco	8600	Px to NPM
1549	FL	Spark	Eiffel Tower	2700	Time
1600	NPM	Arc	Pearl Harbor	11500	Time
1600	NPG	Spark	San Francisco	1905	Weather
1700	NPG	Arc	San Francisco	8600	Px to NPM
1735	XDA	Spark	Mexico City	5500	Px (Spanish)
1800	NAH	Spark	Brooklyn, N. Y	1500	Px to QST
1900	NAA	Spark	Washington, D. C	2500	Time, wtr., px.
1900	NSS	Arc	Washington, D. C	16900	Time
1900	NPG	Arc	San Francisco	8600	Px to NPM
1945–2000	6XC	CW	Cal. Theater, S. F	1250	Px to QST
2100	NAY	Spark	Pt. Isabel, Tex	2000	Weather
2100	NPG	Arc	San Francisco	8600	Px to NPM
2200		Time and Weather Forecast (See 1200)			
2300	NBD	Spark	Bar Harbor, Me	1905	Px to QST
2300	NPG	Arc	San Francisco	8600	Px to NPM

SAN FRANCISCO BAY RADIO - TELEPHONE SCHEDULE

Broadcasted on 360 meters

Every afternoon except Sunday	2:30— 3:30 P.M.	Hobrecht's, Sacramento, News and Concert.
	3:30— 4:30 P.M.	Atlantic Pacific Radio Supplies Co. Concert.
	4:30— 5:30 P.M.	Leo J. Meyberg. Press, Market and Concert.
Every night except Sunday	7:00— 7:10 P.M.	Atlantic Pacific Radio Supplies Co. Press—Sports and Foreign.
	7:10— 7:20 P.M.	Hotel Oakland. Press—General News.
	7:20— 7:30 P.M.	Leo J. Meyberg. Press—Financial and Weather.
Sunday	10:00—11:00 A.M.	Leo J. Meyberg. Concert.
	11:00—12:15 A.M.	Trinity Center. Sermon.
	12:15— 1:00 P.M.	Warner & Linden. Concert.
	7:00— 9:00 P.M.	Presidio. Concert and Instruction.
Monday	7:30— 8:30 P.M.	Colin B. Kennedy. Concert and Industrial News.
	8:30— 9:00 P.M.	Leo J. Meyberg. Concert.
Tuesday	12:15— 1:00 P.M.	Warner & Linden. Concert.
	7:30— 8:15 P.M.	Hotel Oakland. Concert.
	8:15— 9:00 P.M.	The Radio Shop, San Jose. Concert.
Wednesday	7:30— 8:15 P.M.	Atlantic Pacific Radio Supplies Co. Concert.
	8:15— 9:00 P.M.	Herrold Laboratory, San Jose. Concert.
Thursday	7:30— 8:30 P.M.	Leo J. Meyberg. Concert.
	8:30— 9:00 P.M.	Colin B. Kennedy. Concert.
Friday	12:15— 1:00 P.M.	Warner & Linden. Concert.
	7:30— 8:15 P.M.	The Radio Shop, San Jose. Concert.
	8:15— 9:00 P.M.	Hotel Oakland. Concert.
Saturday	7:30— 8:15 P.M.	Warner & Linden. Concert.
	8:15— 9:00 P.M.	Atlantic Pacific Radio Supplies Co. Concert.
Sunday	2:00— 3:00 P.M.	Oard Radio Laboratories, Stockton. Concert.
Tuesday and Friday	8:00— 9:00 P.M.	Oard Radio Laboratories, Stockton. Concert.

N. B.—Trinity Center schedule will probably start at date to be announced later.

Questions and Answers

By the Radio Inspector

Question: Should not amateurs be careful about sending S O S's and obscene language on a practice buzzer in the vinicity of the receiving set described in the preceding question.

Answer: Yes. Amateurs should NEVER send the distress call under any circumstances, even on a practice set, as there is a chance that if sent, some station listening might pick it up, and start a false alarm. This call should never be sent, unless there is actual necessity for its use, and then only under the direction of some one who realizes the full significance of the matter. The regulations forbid the sending of obscene language. "Par. 210. No person shall transmit or make a signal containing obscene words or language." Amateurs, or other persons disregarding this regulation may expect to have proper remedial action taken against them.

Question: I am operator at a limited commercial station. We have very little traffic here, and I would like to know if I can work with special and general amateur stations in my spare time?—G. J., Visalia, Cal.

Answer: Limited commercial stations are licensed for communication with certain other stations, and are LIMITED to correspondence with these stations ONLY, and can work with no others, unless required to do so in the case of a vessel in distress in the vicinity, when they will be only acting as emergency stations. No authority can be granted by any radio inspector for these stations to work with any others, than those provided as above. If the station is to be used for general amateur work, a regular amateur license will be required, and the station must work on 200 meters. Operation as you propose would be the same in every way, as working without a license.

Continued on page 40

DIGEST OF RECENT RADIO PATENTS

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

William C. White, 1,393,594, Oct. 11, 1921. Means for producing high frequency oscillations.

This patent describes a receiving system using the heterodyne principle. An evacuated thermionic tube 1 is used to generate the local oscillations, and the feature of the invention is the production of these oscillations without any coupling between the grid and plate circuits. The oscillations are described as due to the effect of slight traces of residual gas in the vessel. The oscillations may be produced at will by causing the grid 4 to have a negative potential of the proper value. This negative potential is obtained by the aid of the battery 7. The input circuit including the grid 4 and filament 2 is coupled to an antenna circuit at 5, and the output circuit includes a source of potential 12 and the telephone receivers 13.

Goldsmith and Weinberger, 1,396,571, Nov. 8, 1921. Radio receiving system.

This patent describes a scheme for preventing a transmitting antenna from affecting a receiving coil placed near it. Thus it is possible to receive and send from the same place. The interference is due mostly to the electrostatic coupling between the transmitting antenna 1 and receiving coil 2. By the arrangement shown, any current induced from the antenna in coil 2 passes off to earth and does not interfere with the receiving circuit including the thermionic device 5 and receiver 8. This result is obtained by having an earth connection at the center of coil 2, the two halves of which have good mutual inductance, and by connecting the receiving circuit only to one-half of this coil which should for best reception have large horizontal and vertical dimensions. It is found that with such an arrangement, the interfering currents are neutralized, but those due to electromagnetic waves from a distant station are not.

G. M. Wright, 1,394,600, Oct. 25, 1921. Wireless telegraph receiver.

A vacuum thermionic tube *a* is used as a receiver. The filament *b* is not heated to full brilliance but is left dull so as to produce no magnification. In this way the atmospherics are limited in loudness to that of the signals. A magnet 9 may be utilized to advantage for directing the stream of electrons along a narrow path.

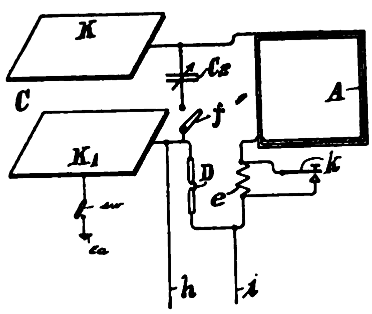
G. M. Wright, 1,394,601, Oct 25, 1921. Thermionic device.

This patent describes an amplification of signals by means of thermionic tubes. The grid filament circuit of the first tube is connected to an oscillatory receiving circuit LC. The grid-plate circuit includes a battery H and resistance r, the negative pole of the battery being connected to the filament. Point *m* is so chosen that preferably there is little or no potential difference between *n* and *m* when the device is working. Variations of internal resistance between the filament and plate, produced by the signals, disturbs this condition, and *m* and *n* do not remain near the same potential. The points *m* and *n* are included in the grid filament circuit of the second tube, where the same arrangement exists. It is stated that the effects of atmospherics are also reduced by this scheme.

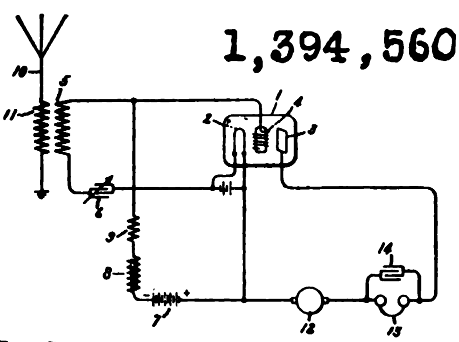
F. A. Kolster, 1,394,560, Oct. 25, 1921. Apparatus for transmitting radiant energy.

This patent describes a transmission system using a closed radiating circuit having low resistance and lumped inductance and capacity; the lumped inductance is in the form of a flat coil A; the capacity may be supplemented by a pair of widely separated plates K-K_1 to assist radiation. Since there is little distributed inductance or capacity, tuning can

Continued on page 46



1,394,560



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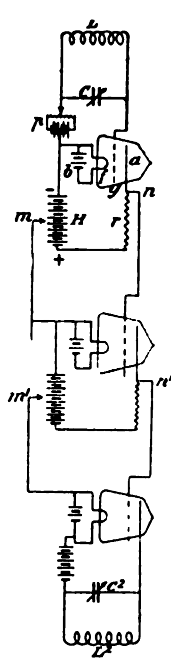

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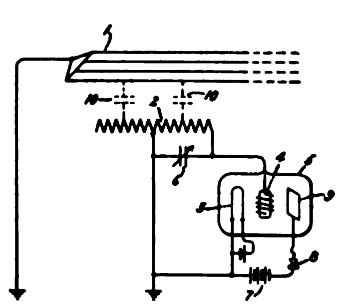

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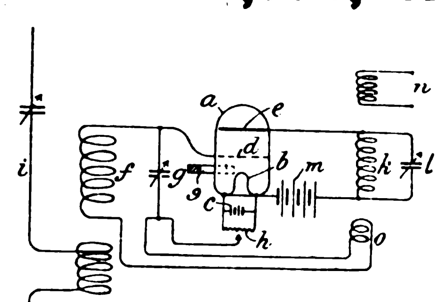


1,394,600

MONTHLY BROADCAST OF RADIO NEWS

Radio 9XM, operated by the physics department of the University of Wisconsin, Madison, is broadcasting weather forecast and market reports daily during the noon hour on 800 meters, radiophone concerts on Friday evenings on 800 and 375 meters, and relay message traffic on other evenings of the week on 375 meters C. W. The market reports are sent out on a special code which may be obtained from the Wisconsin Department of Markets at Madison. The station is in charge of Malcolm P. Hanson, under the direction of Prof. E. M. Terry. Professor Terry has designed eight new power tubes with a rating of from 75 to 100 watts each which are expected to greatly increase the station's range.

6BBO, Harold B. Chambers advises that his address is 780 Rialto Avenue, San Bernardino, Calif., and not Pasadena, as previously reported.

6JQ, R. B. Norton, formerly at Napa, Calif., is now manager of the Western Radio Electric Company store at Oakland, Calif.

Urguha E. Le Fevre, Los Gatos, Calif., advises that her call is 6BCF and not John Fishback's as previously reported.

Sidney Glasson, 6AOR, 2319 Ashby Avenue, Berkeley, Calif., is also 6BDD, Bolinas, Calif., the latter station being his summer home and being erroneously reported in December RADIO with the Berkeley address.

Wilbur R. Cramer and Fred W. Swain, the personnel of the alleged C. & S. Radio Electric Company, and the Glenhurst Research Laboratories of Omaha, Neb., were indicted by a Federal grand jury at Omaha on November 12, for fraudulent use of the mails in the sale of radio equipment. There is little probability that they can liquidate their debts, but the Post Office Department has put a stop to their further use of the mails. The case will be called for trial at an early date.

As a means of affording the maximum of protection to mariners, the United States Hydrographic office and the Naval Communication Service are prepared on and after November 10 to collect and distribute hydrographic information by naval radio.

The navy department will make no charge for receiving messages containing hydrographic information. Vessels co-operating in this service are requested to transmit messages direct to the various radio stations.

The service will cover all waters of the world. Captain L. R. de Steiguer of the U. S. navy, is in charge of the undertaking.

The Northern Orange County Radio Association of Fullerton, Calif., has passed a resolution that the members shall not transmit or relay messages which may be construed as commercial or as encroaching upon the commercial telegraph or radio field.

The Pacific Radio Trade Association has held two enthusiastic meetings at San Francisco since the last report of its activities were given in these columns. The October meeting was addressed by R. L. Eltringham, manager of the California Electrical Cooperative Campaign, on the benefits of cooperation. The November meeting was addressed by Albert H. Elliott, secertary of the Pacific Coast Electrical Supply Jobbers' Association, on ideals for accomplishment. Dr. Herrold of San Jose also gave some interesting radio reminiscences. The association committees are functioning well along their several lines of activity.

LESTER PICKER—6AJH

Lester Picker (6AJH) of San Ysidero, Calif., on November 27, fell from his pole at a distance of over 40 feet and suffered a fracture of the spinal column. The pole collapsed while he was working. He clung to it and was dashed against the roof of an adjacent building. The deepest concern is felt by all Lester's friends in San Diego county and every amateur who knows him or who has heard 6AJH on the air is waiting news of his condition with anxiety. He is paralyzed from the waist down, according to reports and is now in the National City Hospital. The Editor suggests to the fellows of the Sixth District that they write Lester a short letter of encouragement and good wishes. Mail will be forwarded from his station address. Lester is noted among the amateurs of Southern California as being not only one of the most courteous on the air but having one of the most polished fists, his transmitting being most accurate and always brief and to the point. His ideals were those of a first-class A. R. R. L. operator.

Aside from our sympathetic regret for the sad accident to 6AJH, we cannot too strongly emphasize the hazard that the amateur takes in climbing a pole. Under no circumstances should amateurs ascend 2 x 4 poles more than twenty feet high. The danger to life and limb is too great to warrant taking a chance.

At a recent meeting of the B. C. Radio Association, steps were taken to organize a trans-Canada Amateur Radio Relay League.

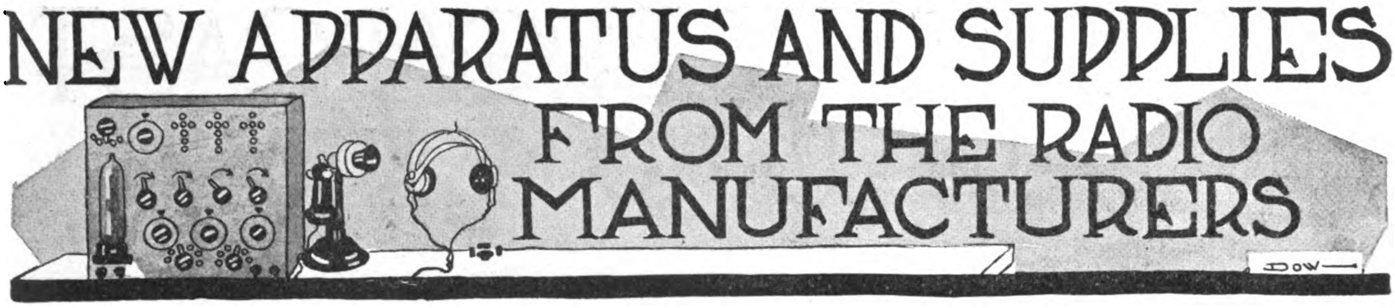
On several occasions within the past month amateur radio station 4CB, located at Morse, Saskatchewan, has been heard by William D. Wood, who has the station at the Barron Hotel. On the last occasion the amateur in Morse, Sask., was heard calling and talking to another amateur in Winnipeg, Man., but only one side of the conversation could be heard in Vancouver. Station 4CB uses only fifty watts power "input," which is about one-fortieth of the power used by ship stations, but his signals were quite readable, both to Mr. Wood and other amateurs who also heard him.

Radiophone communication has been successfully maintained to and from a free balloon during a 150-mile flight from McCook Field, Dayton, Ohio, to a voluntary landing near Cambridge, Ohio. The radio equipment in the balloon consisted of a SCR-75 receiving set, a 300-foot antenna hanging over the side of the basket, and a counterpoise of copper screen and 50 feet of antenna wire hanging from the basket, opposite the antenna. The transmitter was a laboratory model five 50 watt Western Electric tube set and a 90-foot umbrella antenna radiating about 4.5 amperes. The wave length was 425 and 600 meters. The signals and music were received in the balloon with such strength as to allow the receivers to be hung up in the basket so that the four men on board were able to hear distinctly.

An automobile stolen in Newton, Mass., was recovered the next night in Nashua, N. H., when the police, upon looking over their list of police items broadcasted from Boston by radio and received by Henry E. Hall, a local amateur, they were able to identify the machine and return it to its owner. The broadcasting by wireless of stolen automobiles, missing individuals, etc., by the Boston Police Department has been in operation nearly nine months. The broadcasting is done nightly by the American Radio and Research Corporation, Medford Hillside, Mass.

A radio system designed to give information to aviators of weather conditions along their routes of flight, in the air as well as on the ground, has been approved by the army air service, and soon will be extended over the entire continent. Actual construction has begun at Mitchell Field, Long Island; Langley Field, Moundsville, W. Va., and Wilbur Wright Field, at Fairfield, Ohio.

Army aviation officials hope through operation of the system to prevent in the future such disasters as that which occurred last May near Morgantown, Md., and cost the lives of seven persons, by an airplane flying into a violent storm of which its occupants had no knowledge. Plans for installation of the new safety devices, which will function as a network of electrical waves covering the country, provide for the dissemination of weather reports, storm warnings and of all information affecting flying. The army air service contemplates the extension of the net eventually to every field and station in the country. *Continued on page 54*



NEW APPARATUS

The Chelsea Radio Company have recently designed a universal type of Vacuum Tube Socket. The insulation of the various parts has been arranged so as to permit the operation of power tubes up to 1,000 volts. The receptacle embodies a specially drawn highly polished metal tube attached to a moulded bakelite base. Features of great convenience claimed for this device are phosphor bronze contact springs of heavy gauge, assuring positive contact and permanence of adjustment, together with four binding posts externally arranged to permit quick and positive connections to be made even though the socket be fastened to the table or panel.

Chelsea Vacuum Tube Socket

NEW HOME OF THE WIRELESS SHOP, LOS ANGELES, CAL.

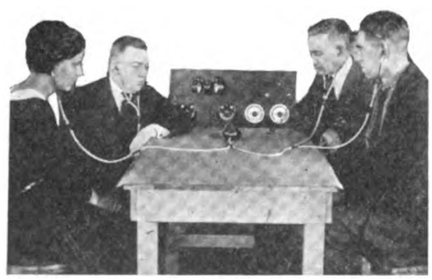
A new and most up-to-date radio manufacturing plant has just been constructed by The Wireless Shop of Los Angeles, which will better enable them to take care of the large demand for "Wireless Shop Variable Condensers" and other high grade apparatus which this company manufactures. This new plant is one of the finest of its kind and only the most modern machinery will be found in this new daylight factory. The mechanics employed are the best obtainable.

With a complete die making shop the company will turn out all of their own dies for stamping metal and Formica parts which are used in their products. Limited space has made it necessary to have part of this work performed on the outside in the past, but with the greatly increased floor space now available, everything will be manufactured in the new shop.

A retail store and offices are built into the front of the new factory, and a complete radio phone and CW set will soon be in operation.

PHONOSCOPE NOW ADAPTED TO RADIO

The Phonoscope, an instrument made for use on telephones, and recently placed on the market, has been adapted to use with radio receivers. The Phonoscope resembles the doctor's stethoscope in size and shape and consists of a nickel plated binaural with properly fitting ear tips, attached by special rubber tubing to a "Y" piece and by another tubing to the special bowl. The radio receiver is laid in this bowl and the sound is transmitted through the orifice in the bowl thence through the tubing and binaural to both ears. The bowl holding the receiver is lined and insulated so that no sound of the message is lost and outside sounds are not collected or heard. Thus the message can be heard distinctly in places where there may be noise from conversation, typewriters, machinery, or traffic. The construction of the Phonoscope is such that extra binaurals with the rubber tubing may be attached and a number of people can hear the message at the same time. The Phonoscope is made by the E. R. Benson Manufacturing Company of Portland, Maine.



Phonoscope As Used for a Radio Listening-In Party of Four

THE RADIOLA

The "Radiola," a radio concert receiving set de luxe, is a new product from the new shop of Wilson-McGuire Co., Inc., San Francisco, formerly the McGuire Radio Laboratory. In addition to its compact and beautiful assembly in the form of a mahogany phonograph cabinet, which makes it an ornament to any home, it embodies an intelligent application of radio engineering experience to produce an instrument that is at once simple and efficient.

The Radiola

The set has a range of from 180 to 3000 meters. It employs three stages of amplification and will, of course, reproduce concert music, radiophone press reports, and both spark and continuous wave radio telegraph messages. It is equipped with Weston ammeters, an eight-day, rim-wind, rim-set clock for time signals, a Tungar rectifier and 60 ampere-hour storage battery. Tuning is accomplished by a new and original method and the sound is reproduced by a Magnavox. All of the equipment is self-contained and of the highest grade.

An instrument exhibited at the recent Industrial Exposition at San Francisco has been installed in the office of Dr. J. M. Forrest of San Francisco.

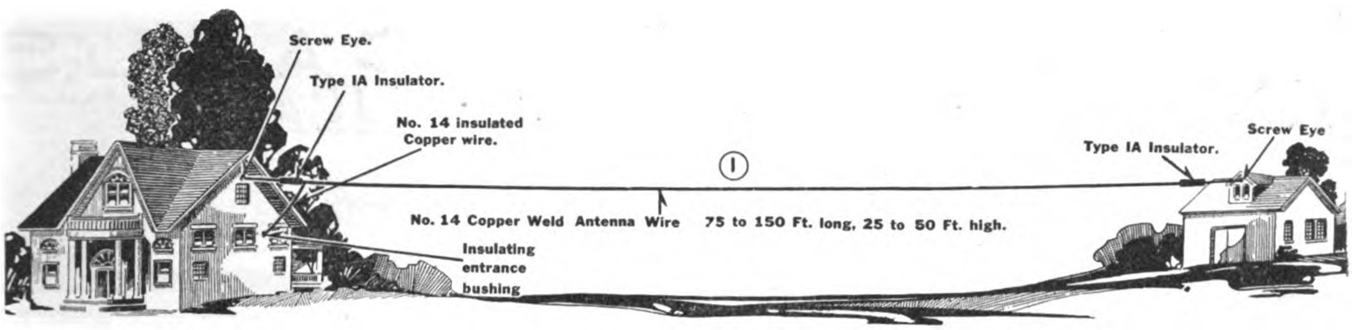


Fig. 1. General Arrangement of Antenna

DIRECTIONS FOR ANTENNA CONSTRUCTION

IN line with the recommendations of the Pacific Radio Trade Association that all radio equipment sold be accompanied by printed directions for its installation, the Westinghouse Electric & Mfg. Co. has published a poster to go with its Type AD receiving equipment from which the text and illustrations are herewith reproduced for the benefit of the radio amateurs. This equipment is sold complete in one convenient package and includes 150 ft. of No. 14 copper weld antenna wire; 50 ft. of No. 14 insulated copper wire; 50 ft. of No. 18 rubber covered ground wire; 1 Type PA antenna protective device; 1 insulating bushing; 2 Type 1A Micarta insulators; 2 screw eyes; 1 ground clamp; 3 porcelain knobs with screws; 1 connector, and 12 insulated staples.

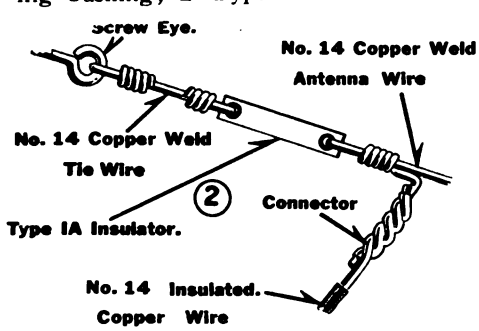


Fig. 2. Lead-In Connections

The directions state that the location for the antenna should be selected so as to be as free as possible from trees, buildings, towers, etc. Objects under antenna or in close proximity to antenna wire shunt part of energy to earth. Except at ends, antenna wire should not come closer than ten feet to any of these objects. Wire may be supported from buildings, poles, or trees. If trees are used, make tie wires long enough to permit type 1A insulator to clear branches by at least ten feet.

Uncoil Copper Weld antenna wire and lay along the ground between supports. Measure off about two feet from end nearest to room where instruments will be located and insert wire in one hole of type 1A insulator for about fifteen inches, bending back and twisting over as shown in Fig. 2. Approximately one foot of wire should be allowed for connecting to No. 14 insulated lead-in wire. Bend free end at right angles to antenna, clean with sand paper and insert into connector, allowing it to go entirely through. From opposite end of connector, insert skinned and cleaned end of No. 14 insulated copper wire, allowing it to extend entirely through connector. Now twist connector tightly with pair of pliers making good joint.

Attach screw eye to support (preferably gable of house) and fasten type 1A insulator to it using piece of Copper Weld wire.

Attach screw eye to distant support. Draw antenna wire tightly and measure off approximate length, allowing one foot for inserting through Type 1A insulator and twisting. If tree is used for distant support, be sure that end of antenna wire does not come closer than ten feet from branches when antenna is complete.

Attach type 1A insulator to end of antenna wire and insert piece of Copper Weld wire in other end sufficiently long to reach to screw eye when antenna is up. Antenna should not be drawn up too tightly but some slack should be allowed. Twist tie wire securely as shown in Fig. 3.

Bore hole in wall (if frame house) or through window casing using a 5/8 inch bit. Insert insulating bushing, run No. 14 insulated copper wire through bushing leaving a loop as shown in Fig. 4 so that rain will drip off. If lead-in must be run any considerable distance outside of house, it should be supported on porcelain knobs.

Attach type PA protective device to window casing or to some other convenient place using screws provided. Do not place protective device near inflammable material. Wire to radio tuner using diagram shown and run No. 18 rubber covered ground wire from protector direct to water pipe in the basement. Ground wire may be held by insulated staples.

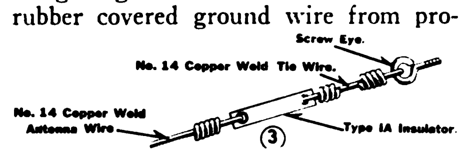


Fig. 3. Antenna Support Connections

Clean water pipe with sand paper. Adjust ground clamp to pipe size and tighten screw. Skin end of ground wire and clean with sand paper. Place under nut on ground clamp and tighten down nut securely.

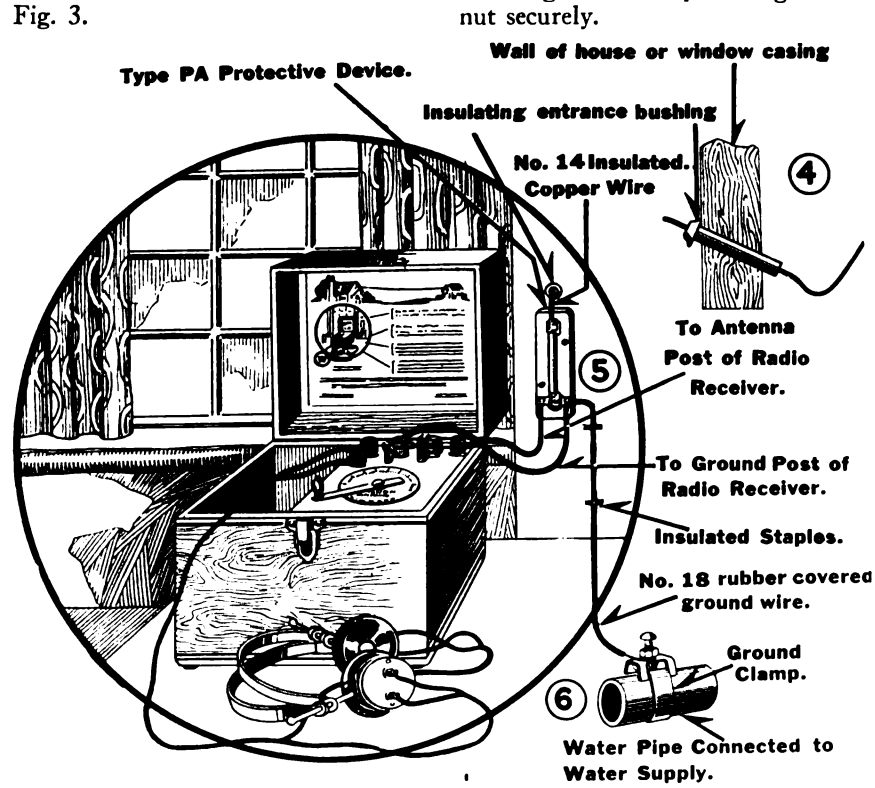


Fig. 4. Entrance, Instrument and Ground Connections

Calls Heard at 6AWP, Everett W. Thatcher. 407 West First St., Santa Ana, Calif.

OCTOBER

SPARK—5HK, 5IF, 5ZA, 6AE, 6AK, 6AR, 6AS, 6CH, (6DA), 6EA, 6EB, (6EC), (6EN), 6ER, 6EV, 6EY, 6FH, 6FK, (6FT), 6GE, 6GF, 6GI, 6GN, 6GP, 6GR, 6GT, 6GX, 6HM, (6HY), 6IC, (6IF), 6IK, 6IM, 6IV, 6JE, 6JY, (6KA), 6KC, 6KP, 6KS, 6KV, 6KY, 6LC, 6LU, 6MD, 6MH, 6MM, 6OC, 6OD, 6OH, 6OL, 6OM, 6PJ, (6PQ), 6QR, (6SK), 6TF, 6UH, 6UL, 6UO, 6VH, 6VV, 6VX, 6ZB, 6ZE, 6ZM, 6ZN, 6ZO, 6ZR, 6ZX, 6ZZ, 6AAH, 6AAU, 6AAW, 6ABM, (6ABP), 6ABX, 6ABZ, 6ACR, 6ACY, 6ADF, 6ADL, 6ADP, 6AEH, 6AEZ, 6AFN, 6AFO, 6AGF, (6AGN), 6AGP, 6AHK, 6AHO, 6AHP, 6AHQ, (6AHU), (6AHV), (6AIB), 6AID, 6AIO, (6AIU), (6AJH), 6AKL, 6AKR, (6ALK), 6ALJ, (6ALP), (6ALU), 6AMN, 6AMQ, 6AMW, 6APE, 6APH, 6ARK, 6ARW, 6ASQ, 6ATQ, 6ATV, 6AUS, 6AVD, 6AVR, 6AVT, 6AVD, 6AWF, 6AWH, 6AZU, (6BAC), 6BAF, 6BAU, 7BP, 7CB, 7CW, 7ED, 7FI, 7IN, 7KB, 7LY, 7MF, 7MO, 7MP, 7TJ, 7XD, 7ZA, 7ZL, 7ZP, 7ZS, 7ZU, 7ZY, 9BD, 9OP, 9AEG, 9AEY, 9AYU.

C W—(6EN), 6JE, (6KA), 6KH, 6MK, 6RR, 6XD, 6XG, 6ZN, (6AAG), 6ABG, 6ALE, (6AQT), 6AVY, 6AWT, (6XAD), 6XAK, 6ZAD, 9AMB, 9ZAF, any one hearing 6AWP SPK, or CW PSE QSL.

"7KP," Seattle, Wash., Sept. 1-Nov. 25.

Heard on one bulb, 27 nights during above dates.

CANADIAN—4CB-C.W., 5BR, 9BD, XEQ, XEV, 9AX.

SPARK—5ZA, 6AE, 6AH, 6AK, 6CO, 6CP, 6DP, 6EA, 6EE, 6FH, 6FN, 6GF, 6GR, 6GT, 6GX, 6HC, 6IC, 6IM, 6IV, 6KA, 6KC, 6KM, 6LC, 6LU, 6MZ, 6OC, 6OH, 6OP, 6OW, 6PJ, 6PR, 6QR, 6QT, 6TC, 6TU, 6VX, 6WL, 6WZ, 6ZB, 6ZU, 6ZX, 6AAR, 6AAU, 6AAW, 6ABM, 6ABX, 6ACR, 6AEG, 6AER, 6AEW, 6AEZ, 6AFN, 6AGF, 6AHM, 6AHV, 6AID, 6AIU, 6ALV, 6APE, 6APH, 6AQT, 6ARK, 6ATQ, 6AWH, 6AWT, 7AW, 7BA, 7BG, 7BH, 7BJ, 7BP, 7BR, 7CB, 7CE, 7CW, 7ED, 7EO, 7FI, 7GA, 7GJ, 7HI, 7HF, 7ID, 7IN, 7JF, 7JT, 7JU, 7JW, 7KB, 7KE, 7KG, 7KM, 7KS, 7LN, 7LU, 7LW, 7LY, 7MF, 7MO, 7MP, 7MU, 7MW, 7NC, 7NJ, 7NL, 7NN, 7OZ, 7PV, 7TJ, 7TO, 7TQ, 7XD, 7YA, 7YS, 7ZB, 7ZG, 7ZJ, 7ZK, 7ZM, 7ZS, 7ZT, 7ZU, 9AIF, 9AMB.

C. W.—6EN, 6KA, 6OO, 6WZ, 6AAT, 6ALE, 6AOZ, 6ASJ, 6ATQ, 6AUL, 6AWT, 6AWV, 6XAD, 6XAC-VOICE, 7CE, 7NC, 7XF.

Heard by 6AWT from October 25 to November 28.

6EA, 6EB, (6EF), (6KA-C.W.), (6KY), (6AGF), 6AQT-C.W., 6AOY-C.W., 7BA, 7BB, 7BJ, 7BK, 7BP, 7CE-C.W., 7ED, 7FI, 7GJ, 7HF, 7IN, 7JW, 7KB, 7KS, 7LU, 7MF, 7MP, 7OZ, 7RN, 7TJ, 7XD, 7XF-C.W., 7YA, 7YG, 7YJ, 7ZG, 7ZK, 7ZJ, 7ZM, 7ZP, 7ZU, (9BD Canadian), anyone hearing 6AWT PSE QSL.

6AUN Reports the Following Heard from October 21 to November 29, 1921:

5ZA (CW), 6DA, 6EA, 6EB, 6EF, 6FH, 6FK, 6FX, 6GF, 6GP, 6GR, 6GT, 6GX, 6HY, 6IC, 6IS, 6JS, 6JY, 6KA (CW), 6KC, 6KY, 6LC, 6MH, 6NL, 6OD, 6OH, 6OL, 6PJ, 6QK, 6QR, 6WI, 6ZB, 6ZU, 6ZX, 6ZZ, 6ACY, 6ADL, 6AEH, 6AEZ, 6AGC, 6AGF, 6AHP, 6AIE, 6AJR, 6AMV, 6AOY (CW), 6APE, 6AQV, 6AVB, 6AVD, 6AVV, 6AVY, 6XAK, (CW-Music), 6XAM, 7AD, 7BA, 7BB, 7BH, 7BJ, 7BK, 7BP, 7ED, 7FI, 7GJ, 7HF, 7IM, 7IN, 7JM, 7KB, 7KE, 7KS, 7LU, 7NN, 7MF, 7OZ, 7TJ, 7ZJ, 7ZK, 7ZM, 7ZP, 7ZU, 7YA, 7YG, 7YJ, 7YS, 7XF (CW), 9BD (Can.), 9ZAF (Voice-CW), 9PM (Would like to know who it was—calling 9AMB—) Will be on with C. W. first of year. Anyone hearing me PSE QSL. C. Messineo, 1730 Page Street, San Francisco, Calif.

Calls Heard by 6ASZ on One Bulb.

6AC, 6AI, 6CH, 6GC, 6MH, 6MM, 6MN, 6PJ, 6PO, 6SK, 6ATX, 6AVB, 6AWH, 6AWS, 6XAC, 7BK, 7ED, 7IN, 7JW, 7KJ, 7MF, 7TO, 7XD, 7ZK, 7ZJ, 7ZU.

Stations Heard at 6JX, 109 Greenbank Avenue, Piedmont, Calif., during November.

Less than 250 miles too numerous to list.

SPARK—6ED, (6EF), 6FK, 6LC, 6MH, 6OL, 6QR, 6ZB, 6ZU, 6ACY, 6ADL, 6AIF, 6AOA, 7BK, 7BP, 7HF, 7IS, 7KJ, 7KR, 7MF, 7TJ, 7YA, (9BD) Canadian.

C. W.—6BF, 6ER, 6ALE, 6AQT, (6AOY), (6AOZ), (6XAD), 6XAK, 7XF, 9ZAF.

Heard by 6GZ, Los Angeles.

The following were heard on an aerial 35 feet high at the lead-in and 8 feet high at the other. One stage of amplification was used:

5ZA, 6AK, 6AL, 6AS, 6AT, 6CP, 6CO, 6CV, 6CZ, 6EX, 6FH, 6FQ, 6GE, 6GF, 6GR, 6GX, 6HG, 6IC, 6IM, 6JE, 6JI, 6JX (CW), 6KC, 6KM, 6OC, 6PC, 6PJ, 6PR, 6QR, 6QT, 6VC, 6VG, 6VS, 6VX, 6WV, 6WZ (Music), 6XM, 6XV (CW), 6ZB (CW), 6ZU, 6ZZ, 6AAU, 6AEH, 6AEI, 6AGF, 6AHP, 6AID, 6AIP, 6AJH, 6AKP, 6ALE (Fone, CW), 6ALV, 6AOY (CW), 6APW, 6AQX, 6ARF, 6ARW, 6ATV, 6AVV, 6AWH, 6AWL, 6AWT (CW), 7BP, 7ED, 7GA, 7IN, 7KB, 7MF, 7MP, 7YA, 7YG, 7ZM, 7ZN.

Calls Heard at 7ZU G. E. West, Polytechnic, Montana from October 15 to November 15, 1921.

5AW, 5FO, (5HK), 5LA, 5XU, 6AAT, (6ABX), (6AEZ) 6AK, (6ALE), 6ALW, 6AOF, (6APE), (6AS), (6ASK) (6ATQ) 6ATZ, (6AWH), 6AWS, (6CV), (6DN), (6EA) 6EB, 6ED, 6ET, (6GR), (6IC), 6IR, (6IV), 6IY (6KA), 6LNcw, 6LZ, (6OC) 6OJ, (6SJ), 6TEZ, (6WV)phone 6XACcw and phone (6XADcw), 6XGcw, ph, 6XJ, 6ZA, 6ZC, 6ZM, 6ZN, 6ZR, (6ZU) (6ZX) (7ED), (7EG) (7EX) 7GO, (7IN) (7IM) 7JD, (7LU) (7LY) 7MO, (7MP) 7NL, 7RNcw, 7RY, 7TW, 7XFcw, (7YA), (7YJ) 7YL, 7YS, 7ZJ, (7ZK) (7ZM) (7ZO) (7ZP) 8DJ, 9ABUcw, 9AEG, (9AEY) 9AIF (9AIG) 9ALO, 9ALS, 9ALU, (9AMBcw), (9AMQcw) 9ANF (9ANG) 9APN, (9AQE) 9ASN, 9AUO, (9AVE) (9AXU) 9AY, 9AYE, (9AYV) (9AYW) 9DEH, 9DGE, 9DFC, (9DOC) 9DSG, 9DUD, (9DUG) (9DVAcw) 9EL, 9ETG, 9EW, 9FUcw, 9GR, 9HT, (9HM) (9HT) 9IC 9IG, 9JT, 9LW, 9MIG 9MS, (9NR) 9NX, 9OHB cw, 9OI, 9ON, (9PS) 9PU 9RNcw, (9RY) (9TI) (9WI) 9WL, (9WU) 9XI, 9XMcw 9YA, (9YAE) (9YAK) 9YAL, 9YM, 9YO, 9YR, 9YY, (9ZACcw) 9ZAFcw, 9ZC, 9ZH, 9ZJ, (9ZN) 9ZO.

Heard at Radio 6BM, 223 Lincoln St., Grass Valley, Cal., Oct. 15 to Nov. 21. Honeycombs and One Tube.

SPARK—5XB, 5ZU, 6AAU, 6ABM, 6ABP, 6ABX, 6ACY, 6AEW, 6AEZ 6AFN, 6AGF, 6AHP, 6AHU, 6AHV, 6AI, 6AIB, 6AID, 6AIK, 6AIO, 6AJH, 6AK, 6AKT, 6ALV, 6AML, 6ANP, 6APE, 6APH, 6ATH, 6ATQ, 6ATS, 6ATV, 6AVB, 6AVM, 6AVV, 6AWH, (6BBR), 6BW, 6CP, 6CZ, 6DA, 6DG, 6EF, 6EN, 6FH, 6FN, 6FT, 6GI, 6GP, 6GR, 6HY, 6ID, 6IF, 6IM, 6JE, 6KA, 6KC, 6KS, 6KX, 6LU, 6MK, 6OC, 6OL, 6PO, 6PJ, 6PR, 6QR, 6SG, 6SK, 6TF, 6TO, 6TU, 6VM, 6VV, 6VX, 6ZB, 6ZU, 6ZX, (7BH), 7BJ, 7BR, (7CW), 7ED, 7IN, 7GA, 7IW, 7JD, 7JU, 7JW, 7KB, (7KJ), 7LW, 7MF, 7MO, 7MU, 7MW, 7XD, 7YA, 7YG, 7YJ, 7YS, 7YG, 7ZJ, 7ZP, 7ZS, 7ZU, 9AX, 9YAL.

CW—5ZA, (6ALE), 6APO, 6ATG, 6AWE, 6AQT, 6AWV, 6EN, 6JE, 6WV, 6XAD, 6XH, 6ZA, 6ZN, 6ZZ, DDFV.

FONE—6ALE, 6JE, 6XAC, 6XC, 6XAJ, 6XAK, 6XD, 6XG, 7XF, 9ZAF, AG-1, WJK.

If you hear 6BM pse QSL—you'll get an answer.

Calls Heard by 7SN, Seaside, Ore., on one tube Nov. 1 to Dec. 1

SPARK—6AK, 6AM, 6AS, 6BM, 6CP, 6CZ, 6DR, 6EB, 6EX, 6FN, 6FH, 6GR, 6GX, 6GF, 6GO, 6HC, 6IM, 6IB, 6IC, 6KM, 6LU, 6OC, 6OH, 6PJ, 6QR, 6TU, 6UO, 6VX, 6VM, 6VK, 6WZ, 6XH, 6ZX, 6ZU, 6AAU, 6AAL, 6ABX, 6ABM, 6ABH, 6ACM, 6AEW, 6AEI, 6AFO, 6AFN, 6AFY, 6AGF, 6AID, 6AJW, 6AKT, 6ALW, 6ALV, 6ALA, 6AMZ, 6ANG, 6ANI, 6APH, 6APE, 6ARK, 6ATV, 6AVB, 6AVV, 7BK, 7BH, 7BS, 7BJ, 7BP, 7CW, 7FI, 7GJ, 7HF, 7IN, 7JF, 7JB, 7KE, 7KS, 7KB, 7MF, 7MP, 7NL, 7NJ, 7OZ, 7TQ, 7TJ, 7ZS, 7ZU, 7ZM, 7ZT, 7ZK, 7YL, 7YA.

CW and PHONE—4CB, 6ET, 6JX, 6SC, 6ZA, 6KM, 6XW, 6XH, 6XG, 6awT, 6AAT, 6ASJ, 6ZAD, 6AAK, 6AAT, 6XAC, 7RN, 7XF, "MC".

Calls Heard by 6GF and 6GR Sept.-Dec. 1921, Sacramento, Calif.

CANADIAN (9BD).

(5ZA) (6AH) (6AR) (6AS) (6AAH) (6AAU) (6AAW) (6ABM) (6ABR) 6ACH (6ACM) (6ACR) (6ACY) (6ADA) (6ADL) 6AEA (6AEH) (6AEI) 6AEL (6AEY) (6AEZ) 6AFO (6AGF) 6AGI 6AGK 6AGR (6AGP) (6AHP) (6AHU) (6AHV) (6AIB) (6AID) (6AIK) (6AIO) 6AIP (6AJH) (6AJW) (6AKL) 6AKT 6ALA 6ALD (6ALP) 6ALU 6ALV (6AMK) (6AMN) 6ANG 6ANI 6ANK 6ANP 6ANV 6ANW 6APE (6APH) (6AQT) (6AQU) 6ARE 6ARK 6ARP (6ARW) 6ASO 6ATB (6ATQ) (6ATV) 6AUH 6AUL 6AVD 6AVN 6AVR 6AVV 6AVY (6AWH) 6AWI 6BA 6BB 6BQ 6BW (6BAC) 6BAK (6BDS) (6CH) (6CP) 6CW (6CZ) (6DA) (6DP) 6DN 6DY (6EA) (6EB) 6EF (6EN) (6ER) (6EX) (6FK) 6FN (6FT) 6FX (6GI) (6GP) 6GT 6GZ (6HP) (6HY) 6IB 6ID 6IK (6IM) (6IS) (6IVS) 6JI 6JQ 6JX 6JY (6KA) (6KC) (6KE) 6KK (6KS) (6KY) 6KX 6LC (6LU) (6MH) 6NG 6OD (6OC) (6OH) (6OL) (6OM) 6OT 6PC 6PI (6PJ) 6PQ (6PR) (6QR) (6QS) (6QT) 6QAD 6RR (6SK) 6TS 6TU 6TV 6UV 6VE 6VJ 6VM (6VX) (6WI) 6WO (6WZ) 6ZE 6ZR (6ZU) (6ZZ) 6ZAF (7BH) (7BH) 7BJ (7BK) 7BR 7CW (7ED) (7FI) (7GA) 7HF (7IN) (7IU) 7IY (7JW) 7KB 7KD 7KE (7KM) 7LY 7LU 7LW (7MF) (7ML) 7MP 7MV 7NL 7OM (7OZ) 7QN (7TJ) 7TO 7YA (7ZM) 7ZS (7ZT) 9AYV 9HM.

C. W. CANADIAN 4CB.

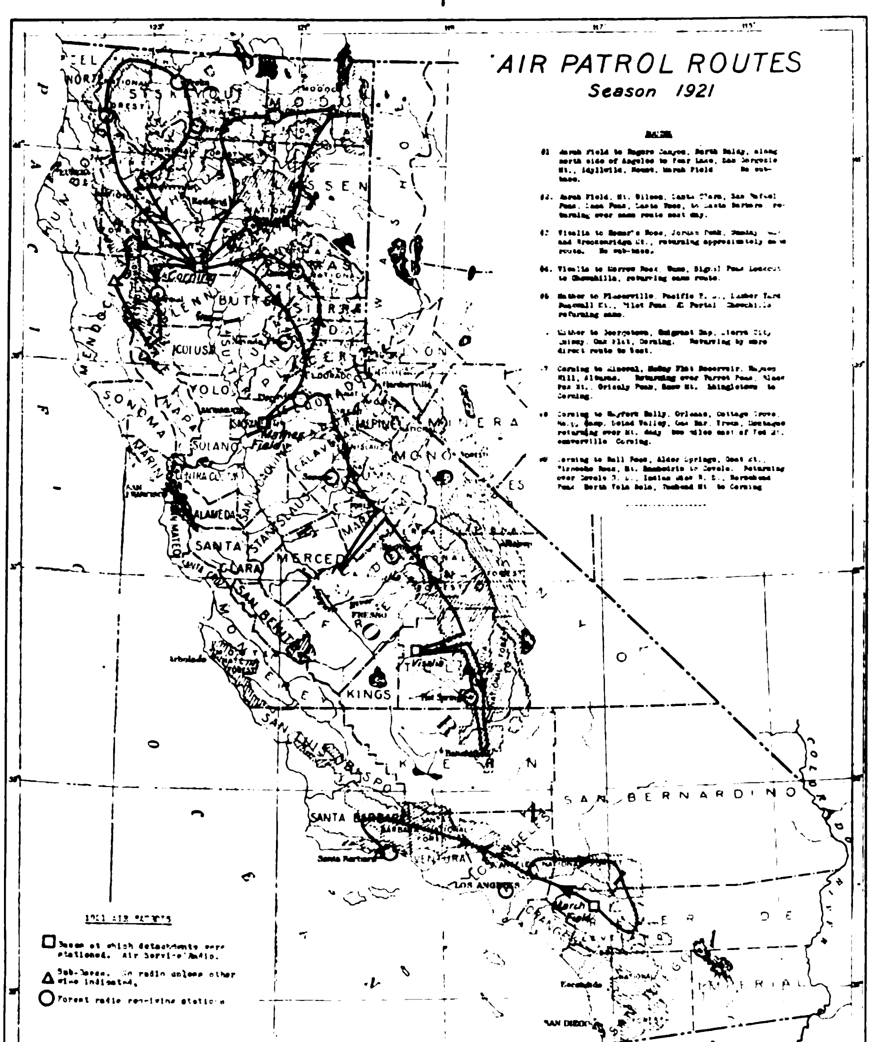
5ZA (6AG) (6EN) (6JE) 6MK 6OO 6SC (6WZ Buzzer) 6AAT (6ABG fone) (6ALE) (6ANJ fone) (6AOY) (6ARC) 6ASJ (6AWT) (6AWV) 6BAF 6XG fone 6XH 6XAC (6XAD) 6XAF 6ZA 6ZB (6ZN) 6ZZ (7XF) 9AMB WJK NCE.

FIGHTING FOREST FIRES WITH RADIO

Continued from page 6

"The radio has proved its efficiency as a medium of communication; and not only is it valuable for transmitting messages direct from the planes to the ground, but I believe we could make a very good use of it for communication between ground points where we do not have adequate telephone service. Of the fifteen forest stations in California this season, there are probably three or four that do not render satisfactory service, due to being located in canyons or other reasons that can be remedied next year. We have also found that we can get amateurs—boys and young men from 16 to 25 years of age—who are well qualified, ambitious, and interested in the work, for a reasonable salary for the summer period, and that if necessary they will furnish their own equipment.

"If desired, an emergency radio station can be established on the fire line, and direct communication may be had from the plane to the ground. All pilots are radio operators, so that if the forest officer who is flying as observer is not qualified in this respect, he can write out his messages and hand them to the pilot for sending."



Calls Heard at 6BF, Santa Paula, Cal.

5ZA, 6AK, 6BB, 6CZ, 6EA, 6EX, 6FD, 6FJ, 6GF, 6GP, 6GR, 6GX, 6IC, 6IG, 6IS, 6IV, 6JW, (6JX), 6KC, 6KM, 6KS, 6KY, 6LC, 6LU, 6MB, 6MH, 6MF, 6MZ, 6OC, 6OD, 6OH, 6OL, 6OM, 6OO, 6PD, 6PJ, 6PO, 6QC, 6QK, 6QR, 6QY, 6TF, 6TO, 6TU, 6UO, 6VX, 6WO, 6WZ, 6AAH, 6AAU, 6ABM, 6ACV, 6ACY, 6AEH, 6AEZ, 6AFN, 6AGF, 6AHP, 6AHU, 6AID, 6AIO, 6AIV, (6AKL), 6AKT, 6ALA, 6ALE, 6ALU, 6ANG, (6AOZ), 6APO, 6ARW, 6ASR, 6ATQ, 6ATV, 6AVB, 6AVV, 6AWS, 6BAK, 6BBR, 6BCJ, (6BCP), 6XA, 6XD, 6XG, 6XH, 6XAC, 6XAD, 6XAE, 6XAG, 6XAK, 6ZB, 6ZU, 6ZN, 6ZX, 6ZZ, 6ZAD, 7BJ, 7MF, 7XF, 7YA, 7YJ, 7ZU, 9BEX, 9XAF, 6WV.

Calls Heard and Worked by 6AMK, Los Gatos, Cal.

(6AE), 6AN, (6AT), 6AH, 6AS, 6AY, 6AO, 6AR, 6BB, 6BQ, (6BW), 6BU, 6CC, 6CO, (6CP), 6CQ (6CZ), 6CH, 6CD, 6CV, 6DD, 6DP, (6DR), 6DY, 6DN, 6EA, 6EB, 6EC, 6EJ, 6ED, 6EP, (6EX), 6EL, 6EN, 6FH, 6FK, 6FN, (6GF), (6GY), 6GP, 6GX(cw) 6GK, (6GF), (6GR), (6HC), 6HH, 6HP, 6IG, (6IO), 6IN, 6IM, (6IB), 6IK, 6JD, 6JR, 6JF, 6KP, 6KW, 6KA, 6KS, 6KF, 6KX, 6KY 6LC, 6LL 6LA, 6LE, 6LY, 6MK, 6MX, 6NG, 6NO, 6OC, 6OH, 6OW, 6PJ, 6PR, (6PO), (6QR), 6RN, 6RT, 6RQ, 6RE, (6RG), 6SK, 6SR, 6SV, 6SL, (6TU), (6TV) 6TF, 6UV(cw) (6UW), 6UM, 6UX, (6VM), (6VX), 6VE, 6VH, 6VD, (6VK), 6WM, 6WH, 6WZ, 6WG, 6XW(cw) 6XZ(cw) 6XAJ(cw) (6XFcw), 6XG(cw) (6XAG) 6XAC(cw) YA, 6YT, 6ZK, 6ZN, 6ZR, 6ZS, 6ZX, (6ZU), 6ZAA, 6ZAE, 6ZF, 6AAK, 6ACR, (6ALV), 6ACA, 6AQU, 6ACH, 6ABP, (6AEL), (6AGC), 6AIK, (6ACM), (6ACI), 6ACU, 6AOM, 6ABM, 6AGF, 6AKH, (6ANR), (6AOB), 6AAQ, 6APH, (6AATcw), 6AAR, 6AEV, (6AGT), 6ALA, (6ALM), 6ABU, (6AFI), 6AOC, 6AEY, 6ATO, (6AAU), 6AFC, (6AFK), 6ALX, 6AIH, 6AFN, 6ABW, 6ASH, 6AGJ, 6AOL, 6ABK, 6AOH, 6AUP, 6ANK, 6AQX, 6ASX, 6ADE, 6AWYcw, 6AGU, 6ALY, 6ABX, 6APE, 6ACY, 6BBK, 7BQ, 7CC, 7CW, 7FT, 7FI, 7IM, 7IN, 7HN, 7DP, 7OZ, 7HW, 7KW, 7NL, 7BW, 7LW, 7IW, 7YJ, 7KB, (7MF), 7BP, 7ID, 7KJ, 7DA, 7XFphone, 7XD, 7ZJ, 7ZS, 7ZT, 7ZA, 7ZU, 7ZM, 9YW, 9ALE.

Anyone hearing 6AMK, please QSL.

Calls Heard by 6EA, Sept. 25 to Nov. 25

HEARD—2FPicw, 6AK, 6AR-"NK", 6CH, 6CV, 6CZ, 6DP, 6FH, 6FN, 6GX, 6IM, 6JC, 6JXicw, 6KM, 6LU, 6MZ, 6OT, 6PR, 6QR, 6QT, 6SK, 6TU, 6UO, 6VK, 6WZ, 6ZB, 6ZU, 6ZX, 6AAH, 6AAU, 6ABM, 6ABX, 6ABYcw, 6AEZ, 6AFN, 6AGF, 6ALA, 6ANI, 6ANO, 6APE, 6ARW, 6ASJcw, 6ATQspark and icw, 6ATV, 6XAFicw, 7FI, 7HF, 7TO, 7XD, 7XFcw, 7YA, 7ZM, 7ZP, 7ZT, 9AMBcw, 9LR, 9ZAC and WJKicw.

WORKED—5ZA, 6AS, 6CP, 6EX, 6FK, 6GF, 6GR, 6GYcw, 6HC, 6IC, 6KC, 6OC, 6PJ, 6PO, 6QK, 6VM, 6VX, 6WO, 6WV voice and music, 6ZZ spark and icw, 6ABH, 6ABU, 6AJH, 6AKL, 6AOYicw, 6ALEicw, 6ALTicw, 6AVB, 6AWH, 6AWTcw and icw, 6XAD icw, 7BP, 7ED, 7IN, 7IU, 7TJ and 7ZU. Reported heard consistently by 9ZAC.

Calls Heard by 6EB:

6AI, 6AK, (6AR-NK), (6AS), 6BB, 6CO, (6CP), 6CV, (6CZ), (6DN), 6DP, (6EX), 6FH, 6FK, (6FN), (6GF), 6GRicw, (6GRspark), (6GX), 6GM, (6IC), (6IK), 6IM, (6JE-Ariz.), 6JXspark and icw, 6KC, 6KMspark and icw, 6LU, (6OC), 6OH, 6OOicw, 6OW, (6PJ), (6PO), 6PR, 6QK, 6QR, (6QT), (6SK), (6TU), (6UO), 6VK, 6VX, 6WO, 6WV voice and music, (6WZ), 6ZB, 6ZE, 6ZU, 6ZX, 6ZZ.

6AAH, 6AATcw, 6AAU, 6ABH, (6ABW), 6ABX, 6AEZ, (6AGF), (6AJF), 6AJH, 6ALA, (6ALEicw), (6AOYcw), 6APH, 6ARW, 6ASJicw, 6ATQ, 6ATV, 6AULcw, 6AVB, 6AVV, (6AWH), (6AWTcw and icw), (6AWVicw), (6XADicw), (6XAFicw), (6ZADicw).

AGlcw (vygsa), 5ZA, 5HK, 7BK, (7BP), (7ED), 7FI, 7HF, (7IN), 7JW, 7MF, 7MO, 7TJ, (7TO), (7XD), 7XFcw and icw, 7YA, (7YJ), 7ZM, 7ZP.

Calls Heard by 6EX, Berkeley, Cal.

NOVEMBER

SPARK—(6DA), (6EA), (6EB), (6EF), (6FK), 6FT, (6GP), (6GV), (6IS), 6IV, (6KA), 6KC, (6KS), (6KY), 6LC, (6LU), (6MH), 6OD, (6OL), (6QK), (6QR), 6SK, (6UO), 6VZ, (6ZU), 6ABX, (6ACY), (6ADL), 6AEW, 6AEZ, (6AGF), (6AHP), (6AIO), (6AKL), (6ALD), 6ALU, 6AMN, 6ARW, (6AVD), 6BCP, 6OH.

7BA, 7BJ, (7BK), (7BH), (7BP), 7BZ, 7ED, (7FI), 7HD, (7HF), 7HG, 7HN, (7IN), 7IW, (7JW), 7KB, 7KE, 7KS, (7MF), 7MP, 7NN, (7OZ), (7TJ), 7VO, 7YA, 7YG, 7YJ, 7YL, 7ZK, (7ZM), 7ZP, (7ZT), 7ZU, 7XA, Canadian (9BD).

CW—(6KA), 6ZN, 6ALE, 6AOY, 6AOZ, 6AQT, (6XAD), 7XF-voice.

Calls Heard at 6GZ, Los Angeles, during November.

2ZL (not verified yet) (cw) 5ZA(cw).

6AH, 6AK, 6AS, 6CZ, 6EX, 6FH, 6FK 6FN, 6GD (icw), 6GG(cw) 6GM, 6GT, 6GR, 6HT(icw), 6ID, 6IM, 6IS, 6JX(cw) 6KC, 6KM, 6LZ(cw), 6OC, 6OH, 6PJ, 6QK, 6QR, 6SK, 6ST, 6WV (music) 6VX, 6VZ, 6ZA(cw), 6ZU, 6ZZ (spark cw) 6AAT(cw), 6ABM, 6ABX, 6AGF, 6AGK, 6AHP, 6AKL, 6ALE (voice cw), 6AMK, 6AMX(cw), 6ANG, 6APW, 6ARW, 6ASE(icw), 6ASJ(cw), 6AUD, 6AVB, 6AWY.

7FI, 7HG, 7MK, 7IN, 7XF(cw), 7YA, 7ZJ.

9AMB, 9ZAF (both cw).

Calls Heard and Worked by 6FK, San Diego, Calif. from Nov. 1st to Dec. 1st, inclusive.

SPARK—5IF, (5ZA), 6AH, 6AK, 6AS, 6AU, 6AX, 6CG, 6CU, 6CV, (6DA), (6EA), 6EB, (6EF), 6EN, 6EX, 6FH, 6FN, 6FR, 6GF (6GM), 6GR, (6GX) 6IC, 6IF, (6IS) 6IV, 6JY, (6KA) (6KY) (6LC) 6LR, (6MH) (6OC) 6OD, 6OH, 6OL, 6PJ, (6PR) (6QR) 6SE, (6SK) 6TF, (6VX) 6WZ, 6ZA, 6ZU, 6ZX, (6ZZ) 6AAB, (6AAH) 6AAN, 6AAY, 6ABB 6ABG, 6ABP, (6ACY) 6ADF 6ADL, 6ADZ, 6AEW, 6AEZ, 6AFN, (6AGF) 6AGX, (6AHP) 6AHV, (6AIB) 6AIC, 6AIF, 6ALU, (6AMN) 6AMZ, 6AOY, 6ATF, (6AVD) 6AWP, 7BK, 7ED, 7GA, (7HF) (7IN) 7IW, 7KB, (7MF) (7TJ) 7ZJ, 7ZM, 9BD (Canada).

CW—5ZA, 6EN, 6GG, (6JD) 6JX, 6KA, (6KM) 6WV (voice and music qsa, very.) 6XA, 6ZA, 6ADK, 6ALE, 6ALU, (6AQT) 6AWT, 6AWV, 6XAD, 9AMB. 9BEX

MARTIN ROBBINS

Continued from page 13

musical *plash* of disturbed waters, the girl's very soul was stricken at the misery and hopelessness that had looked out at her from his earnest grey eyes.

* * *

THE crash sent him hurtling from his bunk, to the floor. He groped for the light switch, but nothing happened when he turned it. Shouts drifted to him from somewhere for'ard. He found one of his sticks and pulled himself to the door. It was jammed, and try as he would, his feeble strength could not open it. But he managed to drag down the wooden shutter of his window. He peered out.

Darkness and fog. So thick that he could not discern the staunchions that he knew were a scant three feet from him. Footsteps came tearing along the deck.

"For God's sake, Sparks, Cap'en says send an SOS! We're sinking fast—some damned steamer, going full speed, has cut us 'most in two!" a hoarse voice shouted. And the figure that had loomed as a black wraith before him was gone.

Without a thought of self, Martin Robbins groped to his apparatus, and threw the send switch.

"Fool!" he muttered. "No lights, no power, of course!"

Painfully, as moving without his supports wracked his harassed body, he managed to find and connect the auxiliary storage batteries, and pressed the key. Sputtering harshly, the old-fashioned spark gap crackled in thin, jagged blue incandescence, its glow causing his face to be of a strange pallor.

"*S-O-S!*"

The call of dire distress went out into the blackness.

No one had thought to give him the exact position of the ship, but so many trips had he made that he knew, to within a very short distance, where the *Bloomton* wallowed crazily on the heavy ground swell that hove down from the northeast.

"*S-O-S*"—and his position. Again and again, unhastily—very carefully—the message disturbed etheric space unto the four quarters of the world.

* * *

THE operator on 600 metres at NPG (San Francisco) was contentedly pondering the fact that his relief would come on in ten minutes—when a strange, very feeble, stuttering signal came to his ears. Instantly he was alert.

"*SOS!*" he called sharply—and everyone within hearing was instantly silent.

The *Bloomton's* position and situation received, he opened up on his fullest power "to all ships within 500 miles S. and S. W. *de* NPG"—repeating that which he had caught. Then he sent a cheering message to the *Bloomton*—and the great land station was on the *qui vive*.

"TEN-THIRTY! Lord, but it's a thick night!" grunted the operator on watch on board a trans-Pacific liner, bound for San Francisco from Far Eastern ports, and Honolulu. He peered outside, and then cocked his feet again on the operating table, and his eyes fell once more to the pages of a magazine. He settled the phones more comfortably over his ears.

Suddenly he sat up with a jerk. The magazine flew from his hands, and he bent forward, head almost touching desk, phones pressed to his head, straining to hear.

And he got it. Rapidly he copied the *SOS*, called a quartermaster, and sent him scurrying to the bridge with the message, while he called the *Bloomton* over and over again, giving him *"R's"*, the liner's position—and re-broadcasting the *SOS* for any vessel that might be nearer the sinking ship.

* * *

UNUSED to quick maneuvering of life boats, and their launching at sea, the heterogeneous crew of the *Bloomton* made a sorry mess of getting the larger of the two boats into the water—the smaller one having accidentally been badly stove' in by a timber falling on it, some time previously, and never repaired.

Water-logged, with a huge gash that cut her from water line nearly to keel, the awkward craft was almost on her beam ends, and nearly awash, when the Captain, Elsie, and the crew of seven men pulled away. So thick was the fog that at two boats' lengths the vessel was entirely invisible.

* * *

AND Martin Robbins had heard them go!

Not a cry for help had he uttered. Crouching at the steep-slanted operating table, he methodically sent his *SOS*. He had heard NPG answer him—and he had also heard the liner's prompt response. He had tried to call out to the others not to row far from the *Bloomton*, as his distress signals had been received and help was on the way. But the crews of lumber schooners are not sailors. Frantic haste—fear-driven—put everything else from their minds, and Robbins' voice was lost in the clamor of shouts and oaths, to whose accompaniment the larger life boat had, at last, been got to the water, crowded with the living—and hurriedly rowed away.

"I don't cut much ice—alive, so I suppose they forgot all about me!" Robbins whispered—but not with bitterness, for there was not an iota of it in his twisted frame.

Steadily the *SOS*, and position, went forth.

Then, from the impenetrable fog, he heard the girl's cry. It rang sharply:

"Martin Robbins! Where is he?"

"She's sunk—long ago!" a gruff voice answered.

"Cowards!—to leave a helpless cripple—while you save yourselves! Let me go — I —— "

Silence.

A wan smile played about his lips, and a feeling of warmth crept round his tired heart.

"She didn't forget the cripple!" he said—very softly.

* * *

THE batteries — never of the best, and in a worn condition—had expended their last strength. Nothing came of his pressing the key.

Outside, the muffled surge and grumble of rolling waters was almost flush with the deck, and from below came ugly, sodden sounds.

"Once a 'ham'—always one!" Martin Robbins said aloud, throwing the ancient switch to receive, and tuning down to 200 meters.

Only some 100 miles lay between the sinking ship and the shore. Memories of youth's enthusiasm at his first, home-made, receiver came to him as he heard amateur stations working—from the usual: "How do I cum in tonite OM?" to more pretentious stations, American Radio Relay League men, getting their night's messages through.

He listened.

The *Bloomton* rolled more heavily and he heard the water splash up against the wall of his cabin, outside.

Then Operator Martin Robbins looked upward. He did not see the dingy, low cabin ceiling. His eyes saw—beyond. Saw the stars glistening above the pall and fog of earth's creation. And Martin Robbins spoke aloud:

"I never dared suicide, God—for there was mother to think of," he said slowly, as though to a human entity. "And I have done my best. I am glad that"—his voice shook—"that the time has come for me to—to go, for this life holds nothing for me. I have always believed on You, and I know that You will look after—mother, otherwise You would have let me stay on here. I am not afraid—for I have done my best. Please, O Father, to whom mother taught me to pray—please take care of her—*Amen.*"

He felt entirely at peace, and his fingers idly moved the condenser knobs on the receiver. The sound of music came faintly. He tuned it in sharply, and he heard some jazz record being played. It stopped, and a voice from the living came to him, who was about to cross the Golden Threshold:

"The next, and last, record this evening will be Victor Record No. ...., 'Tosti's *Goodbye,*' sung by Geraldine Farrar."

A scratching sound, and the singer's voice floated to him with crystal purity and sweetness.

The 1922 Model Type "RS 1-24" Receiver

The New Type "RS 1-24" Receiver is the LAST word in Radio tuning devices. Although our first model was a complete success and proved absolutely satisfactory to all our purchasers, still, continued experimentation has made it possible to combine features in the new model FAR EXCEEDING anything yet developed.

While ALL features of the original model are incorporated in the improved model of the "RS 1-24," still some NEW and very ESSENTIAL qualities are added to take care of the increasing demand for a REAL C.W. AND TELEPHONE RECEIVER. For this work, a special combination of tuning is provided which makes the "RS 1-24" an absolutely "fool proof" Receptor for such work. This is accomplished through a newly developed method of regenerator which permits the vacuum tube to be kept in a CONSTANT state of oscillation, or semi-oscillation, over a wide range of wavelengths.

The New "RS 1-24" incorporates both Inductive and Conductive tuning with two regenerators; one for use up to 3,000 meters and a second for wavelengths up to 24,000 meters.

The Inductive or "Three Coil Circuit" covers a range of from 100 to 3,000 meters and gives exceptionally sharp tuning, permitting of the elimination of practically all interference.

The Conductive Circuit is divided into two groups: 100 to 3,000 meters and 3,000 to 24,000 meters.

Both circuits give PERFECT regeneration ON ALL wavelengths covered.

The circuits are so arranged that "dead-end" effects are overcome, resulting in a remarkably efficient receiver.

A FEW PERTINENT FACTS ABOUT THE "RS 1-24" RECEIVER:

There is absolutely **no sacrifice of efficiency** on **any** of the wavelengths covered.

The **RADIO SHOP Short Wave Receiver** is the most highly efficient short wave receiver on the market. **The "RS 1-24" is equally efficient on amateur wavelengths, if not more so.**

Tuning is accomplished **quicker**, and in a **cleaner** manner, than in any other receiver ever built. **There are no faulty "combinations."** Note the simplicity of controls. Only three dials and two switches are in use on any of the three groups of tuning.

Absolutely no "holes" in the tuning range. **A consistent and mighty oscillator** and **capable of instant non-oscillation when so desired.**

Simplicity of connection to the vacuum tube control. Only four leads required, two to the grid input and two to the plate circuit.

Same vacuum tube suffices for long as well as short waves due to the **remarkable flexibility** of oscillation control.

The elimination of all plugging in and out of coils. Absolutely no other accessories required except the vacuum tube and its attendant controls.

Will enable you to hear commercial ship and marine land stations that were heretofore unheard. **The 600-meter section is equally efficient as the short and long ranges.**

Has a "stan-bi" position that will enable you to "find" stations that you missed entirely before.

No element of "luck" necessary for the successful operation of the "**RS 1-24.**" It is a **positive** receiver designed by practical radio engineers who **knew what was wanted.**

Interior construction that is right, and in keeping with the **exterior** appearance. **No Seals.** We want you to **know your set.**

Produced and sold at the lowest possible price consistent with the best of materials and a fair profit, by systematic workmanship.

Last but by no means least, **licensed under Major Armstrong's regenerative patent (Patent No. 1,113,149, and U. S. application serial No. 807,388), and applying his unapproachable circuit to its utmost effectiveness.**

MECHANICAL AND CONSTRUCTIONAL POINTS OF SUPERIORITY:

Grained Formica panel; plentifully Gorton engraved and filled in with brilliant white.

Large, true running dials with an easily manipulated knob.

Genuine hand wound **bank windings** in connection with special form concentrated inductances that utilize every iota of the incoming energy.

Heavy "bus bar" wiring of hard bare copper **reducing resistance** to the minimum and insuring **permanence.**

Balanced type variable condensers constructed especially for the "**RS 1-24.**" As non-shorting as a condenser can be made.

Genuine Oak or Mahogany cabinets as desired. Hand rubbed finish.

All exposed metal parts satin nickel plated.

Over-all dimensions 7x7x25 inches. Shipping weight approximately 30 pounds.

The installation of the "**RS 1-24**" receiver will end **all** of your receiving troubles. You will have an instrument that will enable you to cover the **entire** wavelength range with **a greater ease and efficiency** than is possible with any other tuning arrangement you can buy or build. It will be the best investment you ever made from a financial as well as an efficiency standpoint.

Full instructions and blue prints accompany each receiver. In ordering **be sure and specify whether oak or mahogany case is desired.**

1922 Model Type "RS 1-24" Receiver f.o.b., San Jose, $125.00.

DEALERS

We can make you an interesting proposition on this new Receiver. Write us.

The first lot of this new model "RS 1-24" will be ready for shipment January 1, 1922. Place your order NOW and be assured of PROMPT delivery.

See this New "RS 1-24" and other Radio Shop Products at the Radio Show, December 29th and 30th, in San Francisco.

San Jose **The Radio Shop** **California**

As the last note faded away, the *Bloomton* lurched over. Operator Martin Robbins did not struggle against the furious inrush of waters. Rather did he again look up, as they rose round him, and the ship lunged forward:

"Goodbye—world of pain! I am free—at last!"

* * *

THE newspapers, two days later, carried this:

"On the night of the 16th, the steam lumber schooner Bloomton was struck by an, as yet unknown steamer, while on her way to San Francisco from San Pedro, and sank soon after. The Captain, his daughter, and the crew got away in a life boat and were picked up by the S. S. ...., whose operators had heard the SOS of the stricken ship. Martin Robbins, the radio operator on the Bloomton, stuck to his apparatus until the last minute. As he was a cripple it is reported by the Captain that he must have been injured and fallen overboard in the fog and darkness while trying to reach the life boat."

The End.

NEW RADIO CATALOGS

Catalog No. 5 from Detroit Electric Company, 434 Shelby Street, Detroit, Mich., is devoted to Radio Telegraph and Telephone Equipment for Reception and Transmission. This is a complete illustrated price list of material from all manufacturers, carefully arranged for reference. It includes the code, conventional signals and list of abbreviations.

Signal Electric Manufacturing Company, Menominee, Mich., has issued a new catalog of High Class Wireless Apparatus to meet the requirements of all classes of users. It covers both spark and CW equipment.

The Benwood Company, Inc., St. Louis, Mo., is distributing a handsome folder giving description and prices of Benwood Apparatus, including synchronous motors, batteries, battery charges, rotary quenched synk and spark gaps, rotary discs and stationary electrodes. This company has also published an interesting price list and specifications for a radiophone transmitter giving 2 amps. with two 5 watt tubes on 200 meters.

Bulletin No. 6 from the H. H. Eby Manufacturing Company, Philadelphia, illustrates and describes "The Leader" binding post for radio equipment and laboratory use.

Bulletin No. 60 from the France Manufacturing Company shows their new ⅛-h.p. synchronous motor for synk gap dx work. The motor is equipped with ball bearings and is designed for continuous service at 1800 r. p. m. on 110 volts.

Confucius has said = "Only two classes of men never change — the wisest of the wise and the dullest of the dull." The owner of a Grebe Receiver will never change it — he is the wisest of the wise.

Doctor Mu

The Grebe CR-5 Receiver

NEW BREAK-IN SYSTEM

An improved method of enabling a transmitting operator to listen-in while communicating with another station is shown in the accompanying diagram. The method of short-circuiting the receiving equipment when the transmitting key closes the primary circuit of the power transformer has met with good success. The use of a 150 ohm relay and a carbon lamp shunted across the relay windings to prevent short-circuiting of the relay battery, is the latest addition to the break-in system.

It will be seen from the diagram that the carbon lamp is not brought into play until the 3 P. S. T. switch is thrown into the operating position. This switch also acts as a precautionary method in the prevention of probable depression of the key while receiving is in progress.

Two contacts are mounted on the main transmitting key, one on the key lever and the other on the key base. These contacts operate the 150 ohm relay with every action of the key. When the key is in the upper, or receiving position, the relay contacts are open, but every time that the key is depressed the relay is closed and the receiving set short-circuited, thereby preventing damage to the equipment.

The ordinary relay contacts will suffice to short the receiver, but if the relay is used for breaking any part of the transmitting circuit, larger contacts must be substituted. The wiring diagram shows the use of the relay to short the receiving equipment only. It is evident that a separate receiving aerial must be used. By the use of a separate transmitting aerial it will be possible to use one of short length, a method so successfully used by many operators.

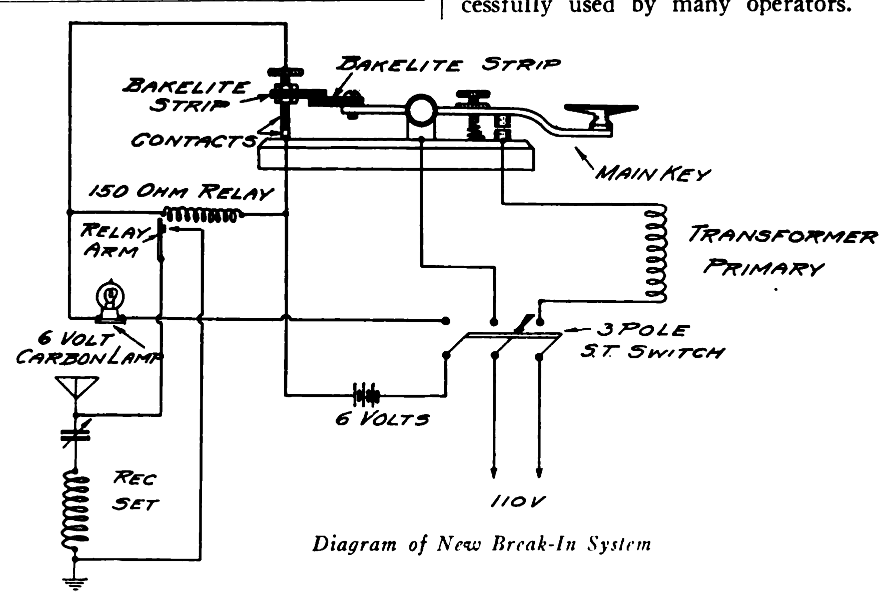


Diagram of New Break-In System

Prices Reduced on
Eveready Wireless B Batteries

Eveready Wireless B Batteries, the long-lived, moisture resistant batteries that are designed and made especially for radio uses, are now offered at better prices. All of our wireless B Batteries are included in the reduction.

The new prices, effective immediately, are:

No. 774—A 43-volt Battery with 6 positive terminals, allowing a range of from 18 to 43 volts in steps of 4½ volts $4.50

No. 766—A 22½-volt Battery with 5 positive leads, giving a range of from 16½ to 22½ volts in steps of 1½ volts $3.00

No. 765—A 22½-volt Battery with one positive terminal. A dandy Battery for beginners $2.00

No. 746—The big 108-volt Battery for amplification $15.00

These batteries have made good. Amateurs and seasoned operators may specify Eveready Batteries with an assurance that they will be found equal to every demand.

National Carbon Company, Inc.
599 Eighth St., San Francisco, California

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SIGNAL LABORATORIES continue to bring forth more modern and efficient radio equipment, yet there is no let-up in the demand for earlier popular SIGNAL instruments such as have helped make wireless history.

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Described in the new Bulletin

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STATE ....

RADIO

TEAR OUT AND START THIS COUPON NOW

Signal Electric Manufacturing Co.
Menominee, Michigan

Questions and Answers From the Radio Inspector

Continued from page 21

Question: Please give me data on the new government call books. When will they be ready for distribution?—H. E., Los Angeles, Cal.

Answer: The book "Commercial and Government Stations of the U. S." is just off the press, and can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 15c per copy. The list of amateurs' stations is understood to be nearly ready for distribution, and probably will be out by the first of the year. It will probably be the same price, and can be obtained from the same place.

(Note—Stamps NOT accepted for these books.)

Question: How old must an amateur be to apply for license?

Answer: No age limit. Anyone can apply, and if successful in passing the examination, they can be licensed, that is, assuming they are American citizens.

Question: Why did 2QR use up to 600 meters when he was heard in Scotland on radiophone? He has no special license.—E. B.

Answer: This office has no information concerning this. It seems probable, however, that he had special permission to use this wave length, for this test only.

Question: How may I get into communication with Guglielmo Marconi by mail?—E. B.

Answer: If you address him care Marconi's Wireless Telegraph Co., Marconi House, Strand, London, England, it is believed you will reach him, and if not, the letter will be forwarded from there.

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No. UV-200 Radiotron, Detector	$5.00
No. UV-201 Radiotron, Amplifier	6.50
No. UV-202 Radiotron, 5 Watt tube	8.00
No. UV-203 Radiotron, 50 Watt tube	30.00
No. UV-204 Radiotron, 250 Watt tube	110.00
No. UT-501 End-mountings for UV-204	2.50
No. UT-502 End-mountings for UV-204	2.50
Per pair	4.50
No. UR-542 Porcelain Socket	1.00
No. UP-552 Bakelite Socket	1.50
No. UT-541 Porcelain Socket for UV-203, and UV-217 "Kenotron" tubes	2.50
No. UV-216 20 Watt "Kenotron" tube	7.50
No. UV-217 150 Watt "Kenotron" tube	26.50
No. UP-1368 325 Watt C. W. Trans.	25.00
No. UP-1016 750 Watt C. W. Trans.	38.50
No. UL-1008 Oscillation Transformer	11.00
No. UT-1343 Magnetic Modulator, ½ to 1½ Amps.	9.50
No. UT-1357 Magnetic Modulator, 1½ to 3½ Amps.	12.50
No. UT-1367 Magnetic Modulator, 3½ to 5 Amps.	17.00
No. UP-1626 Filter Reactor, 160 MA.	11.50
No. UP-1627 Filter Reactor, 300 MA.	15.75
No. UP-415 Plate Circuit Reactor	5.75
No. UC-1631 Filter Cond., ½ MFD, 750 volts	1.35
No. UC-1632 Filter Condenser, 1 MFD, 750 volts	1.85
No. UC-1634 Filter Condenser, ½ MFD, 1750 volts	1.50
No. UC-1635 Filter Condenser, 1 MFD, 1750 volts	2.00
No. UP-1719 Trans. Grid leak, 5000 ohms	1.10
No. UP-1718 Trans. Grid leak, 5000 ohms for UV-203 and UV-204 Tubes	1.65
No. UM-530 Hot Wire Meter, 0-2½ Amps.	6.00
No. UV-533 Hot Wire Meter, 0-5 Amps.	6.25
No. UQ-809 Sending Key for C. W. Trans.	3.00
No. UP-414 Microphone Transformer	7.25
No. PR-535 Filament Rheostat for UV-200, 201 and 202 tubes	3.00
No. PT-537 Filament Rheostat for UV-203 and UV-204 Tubes	10.00
No. PX-1638 Rotary Grid Chopper	7.25
Shaft Bushings for 1/4" or 5/16" Motor Shafts, each	.20
No. UC-1015 Antenna Series Condenser, 7500 V., .0003, .0004, .0005 MFD, 3 values	5.40
No. UC-1014 Plate and Grid condenser, 3000 V., .002 MFD	2.00
No. UC-1803 Special Condenser, 10,000 Volts, .000025 MFD	5.00
No. UC-1806 Special Condenser, 6000 Volts, .002 MFD	7.00
No. UV-712 Amplifying Transformer	7.00
No. PR-536 "A" Battery Potentiometer	2.00
No. UC-567, .00025 MFD Grid and Plate Condenser	1.20
No. UC-568, .0005 MFD Grid and Plate Condenser	1.35
No. UC-569, .001 MFD Grid and Plate Condenser	1.50
No. UC-570, .0025 MFD Grid and Plate Condenser	2.00
No. UP-509 to UP-527 Grid leaks, .05 to 5 megohms, each	.75
No. UX-543 Grid leak mounting	.50
Note—Radio Corporation's C. W. Instruction Book giving hook-ups and complete information	.25

GREBE APPARATUS

No. RORH Audion Control panel in cabinet with tickler connections	$17.00
No. RORK Two step amplifier with automatic filament control jacks	55.00
No. RORD Det. and two step amplifier with automatic filament control	75.00
No. CR-3 Regenerative receiver, 175-680 meters, "Relay Special"	65.00
No. CR-3A Reg. Receiver, 175-375 meters, complete set, knock-down	19.95
No. CR-5 Reg. Receiver, 150-3000 meters, complete set, ideal for phones, music and time signals	80.00
No. CR-6 Reg. Receiver, 175-680 meters with 2 step amplifier self contained, complete set, splendid unit	200.00
No. CR-7 Reg. Receiver, 500-20000 meters, complete set, ideal for arcs	210.00
No. CR-8 Reg. Receiver, 175-1000 meters, "Relay Super-Special," complete set	80.00
No. CR-9 Receiver, 150-3000 meters, with 2 step amplifier self contained, complete set. Grebe's latest	130.00
No. ROCC Fixed mica condenser, .0002 MFD	1.00
No. ROCD Fixed mica condenser, .0005 MFD	1.20
No. ROCE Fixed mica condenser, .001 MFD	1.60
No. ROCF Fixed mica condenser, .005 MFD	3.80
No. ROCA Grid cond., .0002 MFD and ½ Meg. leak	1.20
No. ROCB Grid cond., .0002 MFD and 3 Meg. leak	1.20
No. RPDB Crystal Detector, dustproof	2.75

Grebe apparatus always in stock.

WESTINGHOUSE APPARATUS

No. RA Short Wave tuner, 180-700 meters, very selective and desirable unit	$65.00
No. CB Loading Coil, for use with Short Wave Tuner for time signals	5.00
No. DA Detector and 2 step amplifier, for use with Short Wave Tuner	65.00
No. RC Short Wave tuner and Det. and 2 step amplifier, complete set	125.00
No. DB Double crystal detector	5.00
No. DE Spare crystals for above detector.	1.00
No. DD Spare crystals for above detector.	1.00
No. RE "Aeriola" JR., Crystal Receiver, complete set, ideal for music	25.00
No. ME Motor-generator set, 100 Watts, 110 Volts, 60 cycle, AC motor, 500 Volts DC Generator	85.00
No. MH Motor-Generator set, 250 Watts, 110 Volts, 60 cycle AC motor, 1000 Volts DC generator	145.00

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In order to accommodate our ever increasing business we take pleasure in announcing the opening of OUR NEW STORE at PROVIDENCE, R. I., in the WOOLWORTH BLDG., at 193 Westminster Street, the very heart of the business section.

Mr. H. H. Tilley, an experienced member of our organization, will be in charge. His experience is wide and diversified, having in turn been an Amateur, Commercial Operator, Engineer, Instructor and Sales-Manager. You are cordially invited to visit our new store and experience real SERVICE.

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VACUUM TUBE TRANSMITTING CIRCUIT

Continued from page 10

ing the coupling between input and output without materially changing the period of oscillation of the circuit.

The standard Heising circuit found in practice is shown diagrammatically in Fig. 9. It will be observed in this figure that only two movable contacts on the inductance are necessary as compared to three in the case of Hartley's circuit. This simplifies the design to a certain extent. It may be well to state in passing, that admirable as this circuit is for low powered installations, it is not so well adapted to installations requiring great flexibility at high powers—this by virtue of the facts, that the inductance is all "hot," and that

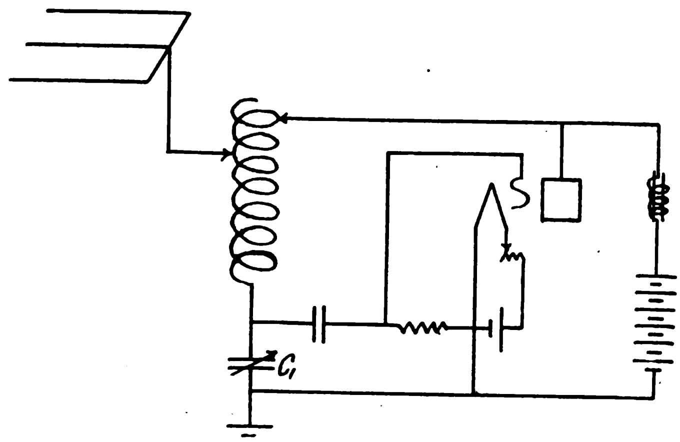


Fig. 9. Heising Circuit in Practice.

it is difficult to design a continuously variable capacity such as the one required at C without resorting to oil for the dielectric.

The Heising circuit employed by the Western Electric Company in the much used CW 938 sets is shown in Fig. 10. Here one finds that instead of connecting the negative side of the plate supply circuit to earth as in Fig. 9, it is connected to earth thru the capacity C_2. This is a protective

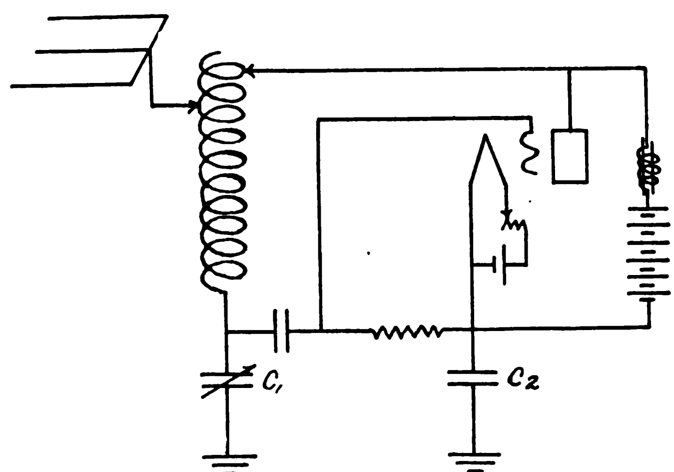


Fig. 10. Heising Circuit as Applied to the 938 set.

measure since in Fig. 10, if either the antenna becomes grounded or the capacity C_2 breaks down under an electrostatic or mechanical strain, the generator supplying the plate potential will not become short circuited. The condenser, C_2, should have a capacity in excess of 0.2 micro-farad.

To be continued

REGENERATIVE RECEIVER

Continued from page 11

loading coil was tapped at the 1st, 6th, 12th, 18th, 30th, 42d, 60th, 78th and the 95th turn, the three-bank winding starting in with the 43d turn.

The primary of the vario-coupler is wound single layer with 34 turns tapped at the 3d, 8th, 12th, 17th, 22d, 28th and the 34th turn, using No. 18 double cotton-covered copper wire. A primary switch of 16 points is mounted as shown in Fig. 1, giving a very large overlap in tuning this circuit. The secondary of the vario-coupler is wound with 20 turns of

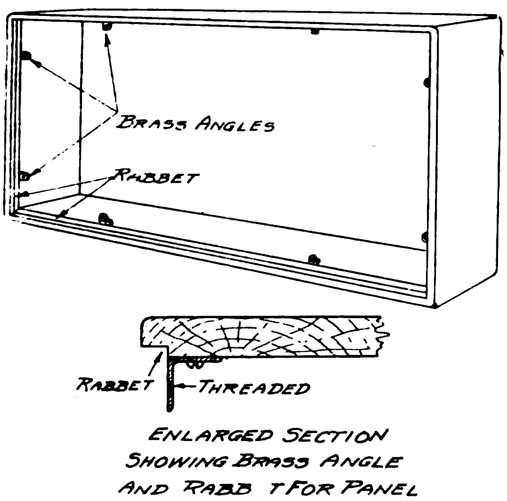


Fig. 3. Cabinet Construction

No. 20 double cotton-covered copper wire and it is found that this gives ample coupling even on the upper range of this receiver.

The series parallel switch and the short and medium wave switch are of the anti-capacity design, which were found to be very satisfactory for this work.

All units are mounted on a panel 11 by 22 by 1-4 inches, after it was polished in the following manner: It is grained by first sandpapering the surface with a piece of fine sandpaper and oil, in long even strokes the full length of the panel. Then steel wool and oil is used in the same manner until the surface is perfectly smooth. Next the panel is wiped off dry and then given a final polish with a clean piece of soft cloth. This will remove all scratches and roughness so common in the material on the market today.

The box can be built in many different ways, but it is suggested that it be made with a rabbet cut in the edge so that the panel can be made flush with the box. Fasten small pieces of angle brass by wood screws to the inside of the box as in Fig. 3. The panel is then secured to these by flat-head brass machine screws countersunk in the panel. This construction allows the panel to be removed from the box without disturbing the box if it is secured to the table or by other apparatus is mounted on the top or sides.

RADIO CENTRAL

Continued from page 7

The magnetic amplifiers installed at Radio Central meet these exacting requirements by providing a non-arcing control with a minimum current in the key circuit and by taking within themselves only a small proportion of the total antenna output. Briefly, the instrument may be called a variable impedance connected with the external circuit of the radio frequency alternator. This function is to reduce the voltage of the alternator and to detune the antenna system when the sending key is opened and to perform the opposite function when it is closed. Thus, when the sending key is opened, the magnetic amplifier short circuits the alternators and detunes the antenna system, thereby reducing the antenna current to a negligible figure. When it is closed, the output of the alternator is fed to the antenna system.

THE HAMBURGER RADIOPHONE

The radiophone installation at Hamburger's Department Store, Los Angeles, is broadcasting press and concerts from 4 to 5 p. m. daily and from 8 to 9 p. m. on Monday, Thursday and Saturday. This equipment is operated by the Leo J. Meyberg Co. under the direction of Hall Berringer, manager of their Los Angeles store.

The installation is a duplicate of the 5-watt set operated by the Meyberg Co. at the Fairmont Hotel, San Francisco. Two 50 ft. poles erected on the roof of the store support a 60 ft. "T" aerial leading to a special radio room especially built for this purpose.

Some excellent long-distance work has already been accomplished, two of the Pacific Mail steamers reporting that it was heard at Panama. It was also heard 1800 miles west of Los Angeles by S. S. *West Nixton,* and 1500 miles out to sea by the operator on S. S. *Richmond.*

An important and novel service furnished in addition to the usual broadcasting from this station is a free school of instruction for radio amateurs. This school has accommodations for fifty students, there being individual booths for each student. Three hundred students are enrolled, they being given instructions once a week. Mr. G. A. Helmer, an old time commercial operator, is in charge.

NEW RADIO BOOKS

Quiz Book—By James E. Smith, 107 pages, 6 x 9, 81 illustrations, paper cover, published by National Radio Institute, Washington, D. C., for sale by RADIO, Pacific Bldg., San Francisco. Price, $1.

This excellent compilation of practical questions and answers is just what is needed for study by the man intending to take the examination for a radio operator's license. While it is by no means a text-book, it systematically reviews the operating principles, constructive features, diagrams of connections, maintenance and repair of radio equipment used in commercial stations. Its contents also include the essential laws governing radio communication, together with useful formulæ and tables used in the solution of radio problems. Questions 1-13 are devoted to measuring instruments; 14-107 to spark transmitters; 108-113 to impulse transmitters; 114-137 to arc transmitters; 138-147 to tube transmitters; 148-172 to damped wave receivers; 173-175 to undamped wave receivers; 175-207 to radio laws and regulations; 208-214 to the radio compass; 215-244 to storage batteries, and 246-250 to miscellaneous matters.

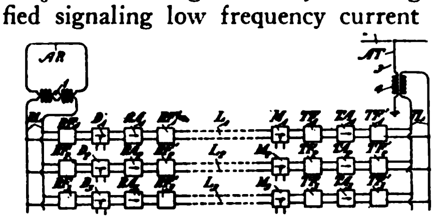
RECENT RADIO PATENTS

Continued from page 22

be made much sharper than with ordinary open circuited systems. The apparatus may also be used for directive signaling.

L. Espenschied, 1,397,093, Nov. 15, 1921. Radiorepeating system.

A multiplex repeating system is described, so arranged that there should be minimum interference between the received and transmitted signals. One manner in which this may be effected is by making the receiving antenna AR of loop form, with its plane perpendicular to the line drawn between the receiving and transmitting antennæ. A plurality of lines, L_1, L_2 and L_3 are used for transmitting the several signals simultaneously received. Filters RF_1, RF_2 and RF_3 are used for separating the several frequencies into their proper channels. Detectors D_1, D_2 and D_3 of special construction may be used to transmit only the low frequency signals and not any of the high frequency carrier. Amplifiers RA_1, RA_2 and RA_3 are used to amplify the signals, and filters RF_1', RF_2' and RF_3' for insuring that only the magnified signaling low frequency current is



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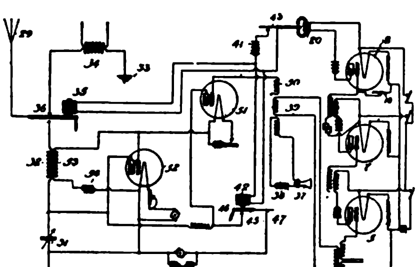


1,397,432

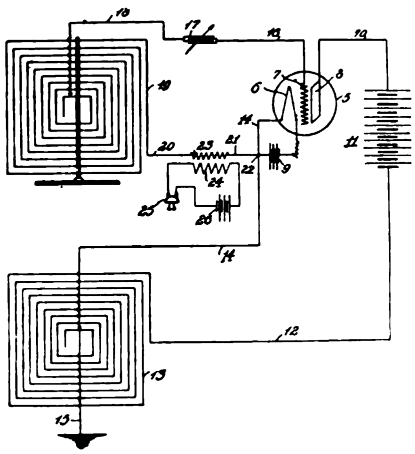
transmitted. In order further to reduce the interference between the two antennæ, there are provided modulators M_1, M_2 and M_3 for translating the frequency of the signals. Amplifiers and filters TF_1, TA_1, TF_1', etc., may also be used at this point. Due to the change in frequency of the signals, and the construction of the antennæ, but a very small amount of energy is impressed from the transmitting antennæ TA upon the receiving antenna RA.

C. V. Logwood, 1,397,432, Nov. 15, 1921. Signaling system.

A 3-stage thermionic amplifier including tubes 5, 7 and 8 is utilized to control a polarized relay 20. This is effected by allowing the last audion 8 to become "paralyzed" due to the accumulation of a negative charge on the grid of this audion. The circuits controlled by relay 20 are so arranged that the antenna 29 may be used either for reception or transmission, depending upon whether the audion 8 is paralyzed. In the conditions shown the antenna is connected to a receiver circuit 33, 34, the relays 20, 35 and 42 being energized. Upon transmitting audible signals to the telephone transmitter 37, the audion 8 is paralyzed, relay 20 opens its contact at 43, and relays 35 and 42 drop their armatures. The antenna is then connected to the transmitting circuit including audions 51 and 52, and may radiate signals transmitted through transmitter 37 and coil 50.

Henry K. Sandell, 1,391,855, Sept. 27, 1921. Wireless transmitting system.

A transmitting system is described, in which the oscillations are produced by an electron tube 5. The main feature of this patent is the manner in which this tube is made to oscillate, consisting of



inductively coupling the input and output circuits of the tube. This coupling is effected by the looped antennæ 13 and 19, placed near each other and located respectively in the output and input circuits. Both loops are adjustable so far as length is concerned, and loop 19 is furthermore rotatably adjustable, to obtain the best effect. Signaling may be effected in any well-known manner; for example, by varying the current in the input circuit by means of the telephone transmitter 25 inductively connected to it.

6XAD was heard Dec. 11 by 8LX, Crafton, Pa. Full results and announcement of reward in prize contest will be published in February RADIO.

C.W. TRANSMITTER AT 6BAK

Continued from page 6

The antenna consists of a five wire inverted "L," spaced 2½ ft. and 70 ft. long, mounted on iron supports on top of the old Post Road Garage. It is 40 ft. above the counterpoise, which is placed under the floor on insulators. It is made up in the shape of a wheel and the lead-in is taken from the center.

Some great distance work has been done both on phone and C. W. and all reports are very little QSS and very QSA.

Music has been heard in Chicago when the set was only radiating .8 ampere.

The high frequency choke coil in each of the secondary leads of the filament heating transformer keeps the high frequency out of the ground system. When one realizes that we are only radiating from .8 to 1 ampere and that stations in the 8th and 9th districts report our signals very QSA we certainly are to be congratulated on this transmitter.

ALLOCATION OF FREQUENCIES

Continued from page 15

As present information on the spacing of waves does not justify present action it is recommended that the paragraph concerning spacing waves in Article LXXXII of the Washington draft be suppressed.

Allocation of Long Waves to Fixed Stations

As a general rule, the lower frequency waves should be used for the longer distances and the higher frequency waves for the shorter distances. For ranges below 4,000 kilometers no wave length above 12,000 meters should be used and for ranges above 4,000 km. no wave length below 8,000 m. should be used. For distances above 1,500 m. the wave length in meters should not exceed three times the range in kilometers.

Each nation should use only the smallest possible number of wave lengths necessary to carry out its radio communications, and this number should be based on its traffic requirements. Radio telegraph stations are bound to exchange traffic with the minimum of radiated energy necessary to ensure good communications. Waves emitted should be as pure and as uniform as possible, and especially as free as possible from harmonics.

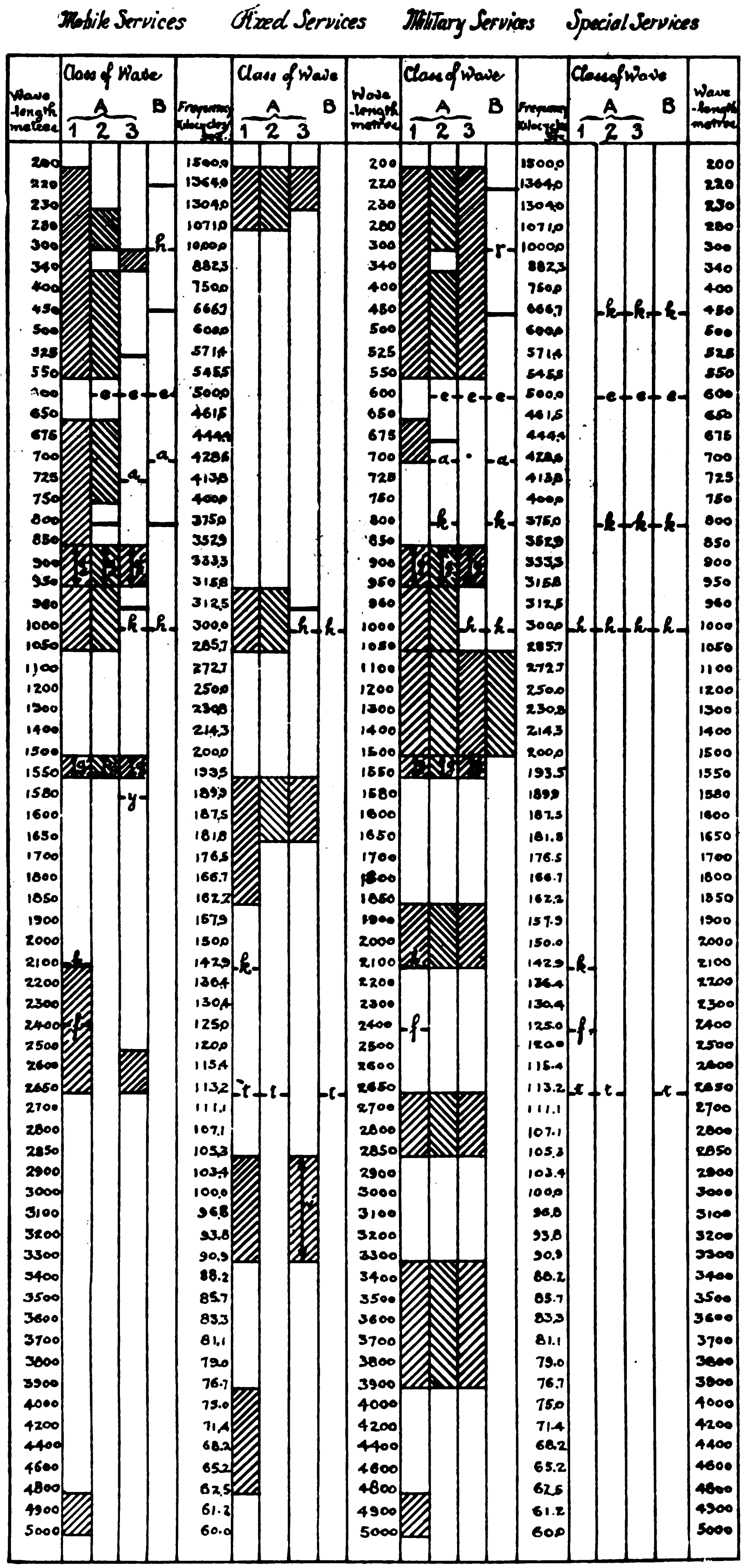
It is desirable that some equitable distribution of frequencies below 105 kc/s (wave lengths above 2850 m.) should be made. In order to permit the study of the world needs for these each nation should furnish its representatives to the next International Conference with a table, giving the data, relative to each station on its own territory in actual operation, or to be placed in operation during the subsequent period of five years.

A nation, before employing a new frequency, should endeavor to utilize the directional properties of radio, whereby its communications may be increased by employing the same frequency a plurality of times.

Distribution of Wave Lengths

The distribution of frequencies and wave lengths to the various services is graphically shown in the accompanying diagram. Note *a* in the diagram refers to the fact that the 429 kc/s (700 m.) damped wave should not be used by ships because of its liability to interfere with 600 and 800 meter damped waves and with 700 meter continuous waves. Its use was not prohibited but left for the decision of the receiving land station as to whether the 725 or 700 meter wave be used if it is not interfering with other traffic.

GRAPHICAL REPRESENTATION SHOWING DISTRIBUTION OF FREQUENCIES AND WAVE LENGTHS TO VARIOUS SERVICES



Note *e* refers to the fact that the 600 meter wave may be used only for calling distress or radiogoniometric service.

Note *f* is to emphasize the fact that the band from 2100 to 2650 meters is a calling wave for mobile and military services only. Note *g* likewise calls attention to the fact that 850 to 950 meters are reserved for aircraft services only; note *h* that 960 to 1000 is reserved for beacons which should not exceed a range of 10 nautical miles for mobile radio beacons, 30 nautical miles for fixed radio beacons and 200 nautical miles for long range radio beacons.

Note *k* refers to reservation of 700 to 850 meters for radiogoniometric service; note *r* to the suppression of 300 meter damped waves after Jan. 1, 1923; note *t* to reservation for time and metereological signals. The bands "w" and "y" may be used as shown if they do not interfere with communications of fixed stations using a wave of type A1.

It is recommended that 300 to 340 meters be used for radio telephony in general; that 725 meters for mobile services; that 1500 to 1550 meters for radio communication between fixed stations and that no radio telephony be permitted for trans-oceanic service on waves between 7000 and 8000 meters, although experiments may be conducted thereon if they do not interfere with normal radio services.

After a date yet to be fixed, it is recommended that the 600 meter wave shall not be employed for time signals, metereological bulletins and warnings to navigators except by mobile and land stations for telegrams of an urgent character involving the safety of navigation.

The Administration concerned may determine whether radiogoniometric coast stations should give bearings to ships on 450, 600 or 800 meters. All such stations must be able to receive bearings on 600 meters.

BROADCAST OF RADIO NEWS

Continued from page 23

The Central California Radio Association of Fresno opened its club activities for 1921-1922 with a lot of QRM and static at its first meeting of the season held a few weeks ago. A large attendance helped to make the meeting a success. Walter Lauritzin, 6OH, was elected president; Henry Craig, vice president; John Avery, secretary-treasurer, and Lloyd Martin, 6ZU, inspector. A membership campaign was planned and later adopted. Several valuable pieces of radio equipment were offered as prizes. A club set was planned and means for raising the funds were discussed. A permanent home for the club was also discussed and several central downtown halls were offered.

The Westinghouse Electric and Manufacturing Company has announced a plan of covering the entire United States with a service to the home that will allow anyone, anywhere in the country, to enjoy the many benefits of radio.

In order to cover certain parts of the country not reached by this station, and to intensively service other parts, the Westinghouse Company has laid out a complete program, and it already has four stations: at East Pittsburgh, station KDKA; at Springfield, Mass., station WBZ; at Newark, N. J., station WJZ, and at Chicago, Ill., station KYW. Although operating a full year, station KDKA continues to interest more people as time progresses. The service started with the transmission of presidential election returns in November, 1920, and has progressed through the broadcasting of phonograph music, entire church services, speeches of prominent men, acts from theatres, musical recitals, reports of boxing contests, results of baseball, football and basket ball games, complete minstrel shows, Government market reports, New York stock market reviews, national and international news from the station at East Pittsburgh. At Springfield, Mass., in addition to many of these features, there is a periodical talk to farmers about market and stock conditions. A feature of the Newark, N. J., broadcasting station has been bedtime stories for the children, marine information, and talks on radio. The complete transmission of grand opera from the Chicago Opera Company productions has been the feature of the recently established station on the Commonwealth-Edison building in Chicago.

SUNSET RADIO CLUB

SAN DIEGO, CALIF.

With the adoption of new traffic regulations which coincide with those in effect throughout the southern counties, San Diego is now organized as never before for the successful handling of traffic. Station 6JI has resumed operation after a lapse of several months and still seems to produce the same old jazz.

The appointment of 6FK, S. P. Trimm, as deputy radio inspector, was announced and his selection was unanimously endorsed by the club in a letter to Major Dillon. 6FK has installed a brand new station at his new residence and is now reaching out better than ever.

6MZ is putting the finishing touches onto his synchronous spark set, having installed a liberal counterpoise and most ingenious home-made gap and condenser. From all reports 6MZ is to be the real long distance unit in this section.

6AJH, who has an enviable location for both reception and transmission, suffered during the recent high wind by the loss of his mast. He will shortly be in the game again.

The new traffic committee consisting of

VARIABLE CONDENSERS
AND
THE WIRELESS SHOP
A. J. EDGCOMB

are only a few ordinary words, but the combination of the two means a whole lot when speaking of quality instrument work. AND—more and more every day the two subjects are mentioned as one —"Wireless Shop Quality Variable Condensers," is the way they are known to most every amateur throughout the world.

Mr. Amateur—Isn't this quality worth something to you? Isn't this what you are really always looking for when you buy wireless apparatus? BUT—Do you always get it? YES—IF YOU BUY FROM THE WIRELESS SHOP. Why not be sure when you buy.

Mr. Radio Dealer—Are you aware of the ever growing demand for these QUALITY instruments, or are you letting the business go elsewhere because you cannot supply them? If you have not already written for our proposition, do so at once, as there is a lot of good business you are missing. Other dealers are taking advantage of this proposition. WHY NOT YOU?

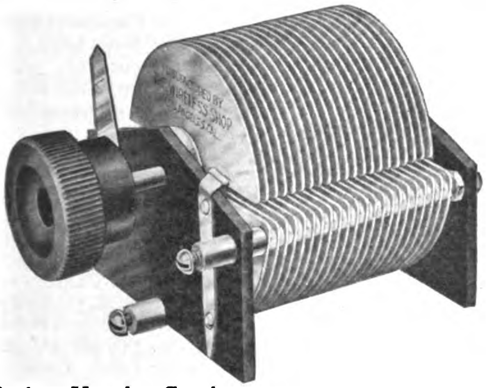
RADIO MEN

The following dealers now carry "WIRELESS SHOP VARIABLES" in stock. If your dealer doesn't stock them, order direct from this ad, and send us his name, if he is a live one:

Atlantic Pacific Radio Supplies Co., 638 Mission St., San Francisco, Cal.
Cal. Electric Supply Co., 643 Mission St., San Francisco, Cal.
Carter Electric Co., 63 Peachtree St., Atlanta, Ga.
Central Radio Co., 575 Grand Ave., Kansas City, Mo.
Detroit Electric Co., 434 Shelby St., Detroit, Mich.
Electric Shop, Fort & Beretania Sts., Honolulu, Hawaii.
Federal Tel. & Tel. Co., 1738 Elmwood Ave., Buffalo, N. Y.
J. C. Hobrecht Co., 1014 Sixth St., Sacramento, Cal.
Ideal Apparatus Co., 1901 E. Louisiana St., Evansville, Ind.
Paul F. Johnson, 32 W. Colorado St., Pasadena, Cal.
Kilbourn & Clarke Mfg. Co., Seattle, Wash.
Manual Arts Radio & Elec. Shop, 4154 S. Vermont Ave., Los Angeles, Cal.
Leo J. Meyberg Co., 428 Market St., San Francisco, Cal., and 950 S. Flower St., Los Angeles, Cal.
Northern Radio & Electric Co., 418 Union St., Seattle, Wash.
Northwest Radio Service Co., 609 Fourth Ave., Seattle, Wash.
Pacific Radio Supply Co., 638 Mission St., San Francisco, Cal.
Reynolds Radio Co., 613 Nineteenth St., Denver, Colo.
Harry A. Snyder, 337 F St., San Bernardino, Cal.
Stubbs Electric Co., 6th at Oak St., Portland, Ore.
H. C. Tafel Co., 236 W. Jefferson St., Louisville, Ky.
Taft Electric Co., Taft, Cal.
Warner & Linden, 350 Market St., San Francisco, Cal., and 22nd & Telegraph Ave., Oakland, Cal.
Western Radio Electric Co., 550 S. Flower St., Los Angeles, Cal., and 274 Twelfth St., Oakland, Cal.
Winner Radio Corp., 1710 Glenarm Place, Denver, Colo.
Wireless Mfg. Co., Canton, Ohio.

SERIES "T"

Three-inch stationary plate. For receiving circuits. Easy to mount back of your panel. Fitted with knob and pointer.

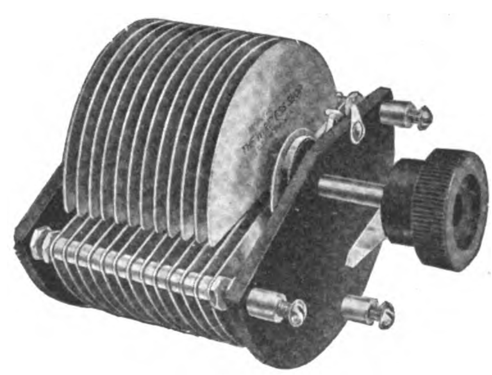


No. 20 2-plate Vernier Condenser $2.00
No. 70 7-plate, approx. .0001 m. f. maximum capacity... 2.35
No. 130 13-plate, approx. .0002 m. f. maximum capacity. 2.75
No. 170 17-plate, approx. .0003 m. f. maximum capacity. 3.15
No. 230 23-plate, approx. .0005 m. f. maximum capacity. 3.60
No. 310 31-plate, approx. .0007 m. f. maximum capacity. 4.30
No. 430 43-plate, approx. .001 m. f. maximum capacity.. 5.25
No. 630 63-plate, approx. .0015 m. f. maximum capacity. 7.50

Include postage for one pound to your postal zone and insurance.

SERIES "CW"

Four-inch stationary plate. Wide spacing for "CW" work. Fitted with knob and pointer. Solid Formica end supporting plates.



No. 1500 15-plate, approximately .0004 m. f. maximum capacity $6.00
No. 2500 25-plate, approximately .0006 m. f. maximum capacity 7.50
No. 3500 35-plate, approximately .0008 m. f. maximum capacity 9.00

Include postage for two pounds on No. 1500 condenser, and for three pounds on No. 2500 and 3500 and insurance to your postal zone.

And, Remember, That Quality Will Always Predominate With

1262 West Second St. **The Wireless Shop** **Los Angeles, Calif.**

6EV, 6KC and 6AJH are kept busy enforcing and obeying local traffic regulations!

? ! ! * ! — — . . — —

6KC has done very creditable work on his set which is entirely home-made.

6AKL has increased his distance in the last month almost double, recently working 5ZA without difficulty.

6ZB, in addition to the old spark set, is again in the field with C. W. By request of the club, concerts are broadcasted on 200 meters Sundays and Wednesdays from 7:30 to 8:30 p. m. ZB is demonstrating the new Surdam Gap on the spark set and claims it is the best ever. CWD is on 375 meters.

6VL, having been overhauled, is to be placed promptly on the map by the Boy Scouts during the coming winter.

6IZ and 6AL of Coronado will be in the air during the coming months after a silence of many moons. 6AL will make the most of his Clapp-Eastham outfit. 6IZ is devising a new spark combination and will rebuild his antenna.

The old license 6AG has been reissued to Dr. A. B. Wessels, Timken building, San Diego. The station has been equipped with complete Grebe short wave 2 step and magnavox and a most elaborate ½-kilowatt panel using Acme transformer and Dublier condenser. Station photographs will be forthcoming shortly.

6AHS with one Ford coil reaches out better and has a better note than many ¼-kilowatt stations boast, having worked 6SK at Laguna Beach, some mileage for a Henry!

Station 6BAZ, our solamente Y. L. "ham" in these parts, with her ¼-k.w. Thordarson on an 80-foot antenna puts 3 amps on the wire and is reported QSA at unbelievable distances. Her QRA is Mrs. Mary Houston, Box 58, San Diego.

On the evening of November 19, the Sea Scouts of San Diego with the portable station 6ANH camped at the Coronado Islands and established communication with San Diego, using a 12-volt storage battery for power. Even with a water ground this is going some. Figure it out for yourself. The transmitter is 2 Ford coils in parallel.

Another epidemic of 500 cycle hams struck town recently. With a buzzer one could work a station giving a call listed hundreds of miles away. The conversation usually ended with "What ship are you on, is she in the harbor or my backyard?" The Club feels that these fake calls should be eliminated.

The Club extends Christmas Greetings and Best Wishes for the New Year to all Pacific Coast clubs and amateurs, and particularly to its out-of-town members, 6XAD, 6ZK, and old 6BS, who is now attending university in Oregon.

The Radio Club of Hawaii has been organized with the following officers: President, Donald Larnach; vice president, Dr. A. Romberg; secretary and treasurer, C. E. Warriner; traffic chief, K. A. Cantin; sergeant-at-arms, N. Asahina; board of directors, Prof. C. O. Smith, R. A. Carlyle (Marconi), Mr. Cook (Mutual), Mr. Worley (U. S. N.), Mr. Hall, Mr. Denham, Lieut. Cameron (U. S. A.), Mr. Lee, Mr. Ching. The membership of seventy-five includes seniors, who are licensed amateurs, or professionals and juniors, who must qualify for seniorship in one year's time. Meetings are to be held monthly.

Calls Heard by KOZR (Former 6AIW, Roseville), on motorship "Culburra," while at anchor off Nanoose, B. C., 140 miles north of Seattle, between 8 and 10:15 p. m., Dec. 2 and 3, 1921:

2FD (calling 8AY), 2FP (calling 9TL), 2AWL (calling 8AJW), 2EH, 4CB, 5FT, 6AAB, 6AAT, 6AFN, 6ALE, 6AQR, 6QR, 6XG, 6XW, 6ZX, 6XAD, 7BH, 7BK, 7LY, 7MP, 7KS, 7MF, 7MY, 7SC, 7TJ, 7VZ, 7XF, 7AR, 8APT, 8AWP, 9AW, 9DWJ.

Resonance Charts for Quick Tuning

A Helpful Article for the Novice in Radio Practice

By Chas. K. Fulghum

FEW amateurs have a definite procedure for tuning. To see some of them "juggling" the dials about on the panel of their receiving set would give an operator worthy of the name the "willies." In the old days when it was possible to hear that little Ford coil on anything from 50 to 700 meters these "static hounds" would have been in their glory, but with the advent of C. W. and the sharply tuned spark set, they are feeling a bit miserable. Give one of them the wave length of a particular station and ask him to get it for you. As a rule, after a period of ten minutes of the usual tactics, he will announce that they are not transmitting or else he will have had good luck, meaning that in the course of his wrist work he has succeeded in picking them up.

To attempt the practical operation of a station on such lines is not in keeping with the present day practice and at the same time is very unsatisfactory. The tuning of a set for C. W. reception is a matter of patience and the operator not possessing such is doomed to disappointment when he wants to pick up that "concert by XYZ or the press from ABC." Only the proper manipulation and care in handling will bring in these sharply tuned stations and often the blame is placed on the tuner when by proper working the desired results could have been obtained.

Often the question that the amateur asks is "why don't they calibrate their sets?" A little thinking on this matter will bring to light some facts that perhaps have not before seemed of much importance to the questioner. Suppose you were to mark an ordinary regenerative set, with wave length calibration. It would be necessary for the manufacturer to know the capacity of your antenna and the ground that you would use and the surrounding conditions that affect the wave length of the antennæ. How many of you are prepared to measure the wave length of your antenna?

Few have the apparatus and knowledge that is required to measure to any degree of accuracy the constants of their antennæ and then one cannot be sure that the results obtained will remain so. I have had under my observation ships whose natural wave length varied as much as 25 meters under various proximities to surrounding conditions.

Considering that the average regenerative set requires at least three separate adjustments, it is readily seen that the calibration of three dials would be necessary and that changes affecting the calibration would not affect each one of the adjustments alike. It is only with the invention of a practical receiver that has single control that the marking of a set in wave lengths will be feasible.

There is one practical and easy way out of the "muddle," and that is merely a systematic usage of the common practice of noting the adjustments of your set when receiving from some station from which it is possible to obtain the wave length that they were transmitting on. Many amateurs try this but few put it on a practical basis.

The placement of this on such a basis is best done by preparing a set of "resonance" charts for your set. This method is feasible with any type of receiver and may even be extended to the transmitter although it is not the object of this article to include that portion of the station. The method of procedure is the same with all sets and the outline below should give the amateur a working basis that will enable him to prepare a set of these charts for the receiver he possesses.

The set given as an example is the usual regenerative receiver consisting of a grid and plate variometer, a tapped vario-coupler and a variable condenser in the secondary circuit of the same. In such a set there are five adjustments to make, i. e., grid V., plate V., primary of V. C., secondary condenser of the V. C. circuit, and the filament temperature. Should you be the possessor of a variable B battery there is that to be considered as well. It is assumed that the receiver covers a wave length range of 75 to 500 meters. Two types of these charts will be described, and the reader may choose between them. The procedure for preparing and using both is the same.

The chart that is first described is the one that will be more convenient for the average amateur to use. It can be framed and hung over the operating table where it can always be easily referred to. The other is in notebook form and having to hunt through it for the settings rather detracts from its usefulness.

For the first chart a piece of Bristolboard or other similar white paper may be used. It should measure about 10 by 15 inches. It is ruled with six spaces of an inch in width parallel to its longer dimension and with twenty spaces of a half inch in width parallel to the shorter dimension. Each of these is marked with a wave length, the total of which covers a range of 100 to 500 meters. This will allow the markings to be made in steps of 20 meters, which should be neatly done on one side of the chart. The six spaces of the other dimension are for the various instruments. It is convenient to have these run in the order the adjustments are made, should you use a regular method of tuning. The chart is then ready for calibration, and considerable care should be used in the process.

To calibrate the chart, carefully tune in a station that is transmitting and when a maximum signal strength is obtained the adjustments of the various instruments noted. If the wave length of this station is on hand and it falls on one of the wave lengths that the chart covers, the settings of the various instruments are noted in their proper columns, opposite the wave length they have been made for. It is always well to verify these adjustments once or twice before they are marked on the chart. Should you be in doubt as to the wave length that the station transmitting was using, and that is often the case, they will as a rule be glad to let you know if you drop them a card. Since sharper tuning is required on C. W., it is well to calibrate the chart on that reception as a rule. Of course if the set is not for C. W. reception that is out of the question. In case a station transmits on a wave length which lies between two on the chart, either may be marked or the chart extended to accommodate it.

The other set of charts consists of separate charts for each instrument, the curves for the various wave lengths being plotted in a manner similar to that in the preceding paragraphs. It is often more convenient to prepare this chart first and then to make the other, using the curves in order to mark the adjustments. If a friend that has a wave meter and a C. W. set that can easily be adjusted to any wave length happens to be near, the making of such a chart is easily simplified.

Once such a chart is in use the amateur who is the possessor of it will feel repaid for the time and work spent on it. In case the set that you have is desired to be used by others than yourself, they can easily do so without any troublesome and unnecessary adjustments.

One thing is to be noted. If you are using an ammeter to adjust the filament temperature, don't forget to include a column for its readings. Often the failure of C. W. and 'phone is traceable to inaccurate adjustment of the filament temperature. It is well worth the while to provide your filament rheostat with a dial if it has none, and then to use it.

The Northwest Radio Service Company, formerly of 609 Fourth Avenue, Seattle, has moved to new quarters at 1637 Westlake Avenue, in the heart of the retail district. They are distributors for the A. H. Grebe Company and the Atlantic-Pacific Radio Supplies Company. They have installed a radiophone at 7XC, the experimental station of Vincent I. Kraft. This station broadcasts concerts each Tuesday, Thursday and Saturday evenings, from 8 to 8:30.

STATIC STATISTICS

By Squawk McGuff

Shhhh, this is going to be good. Don't tell anybody. You see it was told to me and they told me not to tell so I'm telling you and I know you won't tell. Keep it dark.

Well it's like this. The steamer *Buford* has an operator that can work POZ.

Shhhh—shhhh—not so loud.

Well this guy called POZ for the weather because somebody told him to.

Shhhh—shhhh. For the love of mike keep quiet.

Well he called POZ from Honolulu last week, and—

Shhhh—shhhh—this is rich.

Well, he didn't get POZ. But he had nerve enough to try it.

Shhhh, shhhh, shhhh, ain't that the Turtle's pajamas?

Don't tell anybody. Shhh, shhh, shhh.

6OC had a little pig. He named him INK. Because he run out of the pen. This way out, please.

INSPECTOR: So you're qualified for a license, are you?

HAM: Yes sir, no sir, yes sir.

INS.: What determines the voltage of a storage battery?

HAM: Voltmeter—and they let him live!!!

His sidekicker, who also wished to adorn the walls with a certificate, was next.

INSPECTOR: What is the law regarding superfluous signals?

HAM: August, 1912. Holy smoke, what yuh radiatin'.

INSPECTOR: Explain this two-circuit dingus with this lead coming in and that lead going out.

HAMBITIOUS ONE: Why, that's as clear as mud. Just like my one-circuit pocketbook, except that nothing comes in and it all goes out.

Dear Squawk:

Being my first little epistle seemingly pleased you, here is another:

Buck sez:

When it comes to hash, I don't know which has the best of it, a Greek restaurant or an A. C. radiophone.

The saddest record I've heard concerted was a little song entitled: "Forty Volts on the Filament"; music by B. Battery, words by Oper Ator.

Whenever I hear Tavers say: "Just a minute and we'll have another one," I want to shout: "Make mine Scotch!"

Who will head a subscription list to buy 7ZU a new omnigraph record to replace the CQ one he is using now?

There was a ham in Crockett
  Whose tube got turned in its socket.
When he turned on the juice
  She smoked like the deuce,
Now isn't that H—— on his pocket?
  Come again, Woodland, we like your style.

TACOMA

The Radio Club of Tacoma has given much time and thought to the idea of "Amalgamation." Amalgamation is, we think, the password to success. Mr. Halloran's idea of a sort of convention in San Francisco in January to form plans for such an amalgamation appeals to us strongly and if such a thing happens we promise that we will have a representative there.

7BC reported at the last meeting he would be off the air for a few days as he was moving. Say, Woody, is this the fourth or fifth time this month? It surely must be cheaper to move than pay rent.

Was that really 7CE we saw out on the roof last week shaking the nine inches of snow off his aerial so the messages wouldn't freeze?

Olympia has re-organized a club now and is reported growing every day. Next Wednesday night the Radio Club of Tacoma is going to take its saxaphone quartet, a keg of cider and a raft of doughnuts and go down and surprise them. Arrangements have all been made for the use of one of the big social halls in Olympia and dancing and a program of singing and clog-dancing will be featured.

The Radio Club of Tacoma held election of officers at their last regular meeting. The new officers as elected are: President, Howard Reichert; Vice-President, Karl Weingarten; Secretary, Winifred Dow (re-elected); Treasurer, Neville Benoit; Press Agent and Ass't Secy., Alvin Stenso. The past officers believed a banquet given them wouldn't be at all out of order!!!

The Radio Club of Tacoma sends its Christmas greetings to all its friends and wishes them the greatest possible success in radio for the coming year.

The Kuebler Radio Company of Toledo, Ohio, are the successors to the retail department of the Marshall-Gerken Company.

The Pacific Radio Exchange, 439 Call Bldg., San Francisco, are marketing a new and unique preparation in the form of a liquid known as "Resistohm" for making grid leaks and resistance units of any desired resistance.

Western Radio Electric Co., of Los Angeles and Oakland, Calif., have issued the fifth edition of their Stock Bulletin and Price List of Radio Telephone and Telegraph Apparatus.

IMPORTANCE OF KNOWING V.T. CHARACTERISTICS

Continued from page 19

rents, and this is generally the case in the home made receiver. The operation of the filament is determined by its brilliancy, or in the case of the soft detector tube, by the point where the tube begins to hiss. The filaments may be operating at 25 per cent or more above normal current consumption without appearing abnormally bright, and yet the amateur wonders why he burns out his tubes so easily. If jacks were provided in the filament circuit of each tube, an ammeter could be temporarily inserted in the circuit and the filaments adjusted to their proper values. The argument is immediately raised that this adds to the cost of the set, and the amount of apparatus, which is all very true. However, when one considers the saving that will result when the tubes show a large increase in their life, due to having been operated at or slightly below the rated operating value, the addition of this equipment is certainly justified. The jacks may be wired in accordance with Fig. 1 and an ammeter having a scale of 0 -1.5 amperes will cover the range of filament currents of those tubes which are on the market at this time.

Some advocate the use of a voltmeter to read the voltage drop across the filaments instead of reading the current, and in the case of transmitting tubes, which consume a considerable number of watts, this is the best method, but for receiving tubes with small current consumption, an ammeter should be the most reliable.

The use of a milliammeter as a regular adjunct to a receiving set may not be so obvious as that of an ammeter and perhaps the best example of its usefulness in vacuum tube circuits is in the telephone industry. Here many thousands of tubes are in service in every conceivable type of circuit, including radio receiving and transmitting apparatus, wire repeaters, multiplex telephone and telegraph apparatus and loud speaking equipments. In all the above, milliammeters are either permanently wired in the plate circuits of the tubes, or arranged with a flexible cord and plug for insertion in jacks which are provided in series with the plate circuits. Daily observations are made on the plate current values, and certain standards are maintained, by which the operating personnel may reject tubes showing low plate currents, or excessively high values. If the tube is being overloaded by too much input current, this is indicated on the milliammeter by a violent agitation of the needle, and remedial measures are taken to reduce the input current to a proper value. This use applies to the amateur receiving tubes as well as for commercial purposes, and with a milliammeter available, the amateur could soon learn how to detect distortion in his amplifiers, and

be determined without dismantling the receiving set, or setting up the testing apparatus separately. The variable grid battery shown in the sketch, range 0-15 volts, consists of ten ordinary dry cells, of 1½ volts each, or small flashlight cells of the same voltage will serve the purpose. To insert this battery in the grid circuit of the tube to be tested, remove the four prong base from an old discarded tube, and by means of flexible leads, connect the terminals of the base to the four terminals of an extra tube socket, which may be mounted loosely near the receiving set.

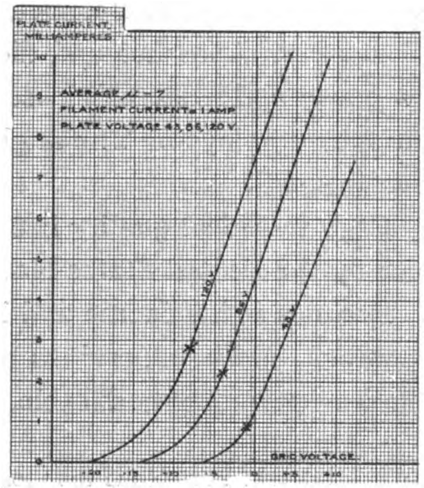


Fig. 2

The tube to be tested is inserted in the extra socket, and the base with its flexible connections can then be plugged into one of the sockets of the receiver, preferably one of the amplifier tube sockets. The variable grid battery can now be inserted in the grid lead without opening up the set, by placing it in series with the flexible wire leading from the spare socket to the extra base mentioned above. If the filament current is adjusted to the proper value, and the grid voltage varied in steps of 1½ volts, a corresponding change in plate current will be noted on the milliammeter, for each value of grid voltage.

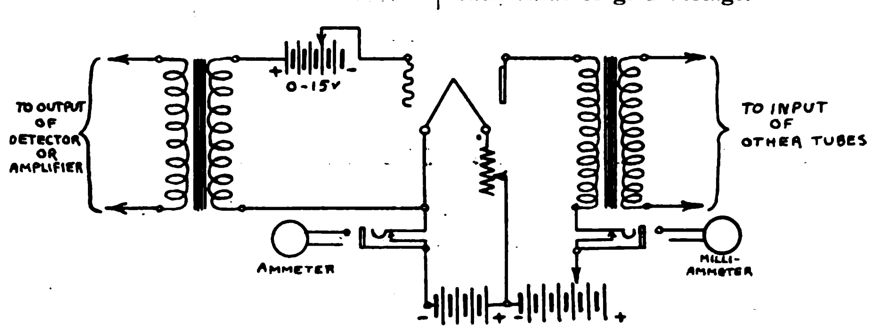


Fig. 1. Hook-Up for Testing Tubes

thereby greatly improve the reception of radiophone music and speech.

This shows that meters should be a part of the regular equipment of a receiving station. Fig. 1 shows how the characteristics of any receiving tube may

By plotting these values of grid voltage and plate current, a curve such as is shown in Fig. 2 will result. From this curve the proper value of negative grid voltage for a given plate voltage may be selected. The tube used in the curves shown in Fig. 2 was selected only because it was conveniently available. The

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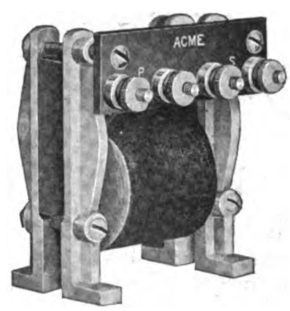
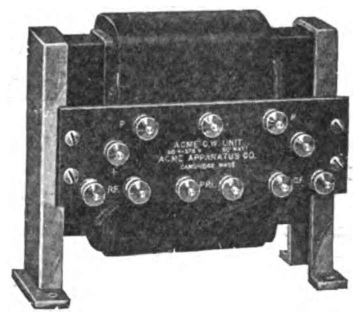


Amplifying Transformer



C. W. Power Transformer

Announcement
The New
DeForest
Catalog
is now ready and includes cabinet receiving sets, panel sets, C. W. transmitters, radiophones and parts, for amateur use. Sent upon request and receipt of 10c in stamps.

RADIO TELEPHONE AND TELEGRAPH APPARATUS
DeFOREST WIRELESS SYSTEM

Announcement
The New
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Receiving Sets
will be described and illustrated in this magazine next month. Do not buy until you see February issue.
DeForest Radio Tel. & Tel. Co., New York City

The "QSA" Line of Equipment

COMBAT

A Storage Battery especially designed for Radio work. The only Battery with non-corroding binding posts. Write for particulars and incidentally get your name on our mailing list to receive our monthly bargain sheets.

Here is one of the many items listed for December:

Dry Cell B-Battery 45 volts $1.85 ea.

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SAN JOSE, CALIF.

small crosses on these curves indicate the correct value of grid voltage for 43, 86 and 120 volts, which are the voltages commonly used.

This point must be selected so that, when the maximum alternating current voltage the tube is supposed to receive is applied, the grid will neither become positive with respect to the filament during the positive half of the wave, nor force the plate current too near to zero during the negative peaks. The proper point will generally fall on the straight line portion of the curve, just before it commences to slope in the form of an arc, towards zero.

If no negative grid potential were used, then no matter how small the input alternating current voltage, distortion would result, since the grid of the tube would become positive, and rectification would take place. Other characteristics, such as the filament current-plate current curve and the plate voltage-plate current curve may be obtained with this apparatus, but the grid-voltage-plate-current curve is deemed the most important.

If, when the amateur purchases a new tube, he will perform this test, and find out for himself the right value of grid voltage, or "C" voltage as it is sometimes called, he will eliminate distortion in his receiver, and obtain much satisfaction in the knowledge that there are no unknown quantities in his circuits.

SIGNIFICANT LETTERS

Continued from page 18

As I have stated in a previous communication to you, it is the intent and ambition of the editors of RADIO to further amateur effort in every legitimate way in order that there may be a highly efficient citizen-operator reserve, that the Government can call upon, in case of need—and be reasonably sure of having a wealth of good material for the defense of the nation.

But—as Rulings are now fixed—the congestion is so severe that GOOD results are difficult—nay, almost impossible, to be got at!

If you, sir, could see your way to allocating unto Continuous Wave transmission a set of wave lengths solely for CW effort you would —pardon my temerity in presuming to advise you—be GREATLY assisting amateur progress.

It is a fact that the Department has not, at its beck and call, sufficient funds to pay the salaries of more Inspectors. This is to be regretted, as the officials now holding these responsible positions have so much territory to cover—aside from ship inspections, on the part of Inspectors at coastal ports—that heedless, and wilfully negligent amateur operators "get away" with various infringements of the law—excess power, illegal wave lengths, non-signing of calls, persistent—and selfish—interference—and so forth.

At the rate that is now apparent, unless something is done to relieve the jamming on 200 meters, there never WILL be any progress in amateur effort—the whole thing resolving itself into an infernal riot of sound—above, and through which only the most powerful spark stations will carry—and this, of course, leads conclusively to the evil that I have mentioned: the sly increasing of power, so as to BE heard!

And, after all, this is but human nature! No one wants to be an "also ran!" What would you suggest, sir?

Cordially yours,
Lawrence Mott.

Calls heard at Radio 6AOZ, Santa Paula, Cal., Nov. 5th to 9th: 6AK 6AAH 6AAT 6ACY 6AEH 6AEI 6AFN 6AGF 6AHV 6AIO 6AKE 6ALE(CW) 6AOL(FONE) 6AOY(CW) 6APE 6AVV 6AVY(CW) 6BCP(CW) 6BF 6BM 6BX 6CL 6EN(CW) 6FN 6GEN 6GR 6JX(CW) 6KM 6LAD(CW) 6LU 6MF 6OH 6PE 6PJ 6QR 6RA(CW) 6RF 6SC(CW) 6UO 6VM 6VR 6VY 6VX 6VZ 6WL 6WV(CW) 6XAD(CW) 6YA 6ZL 6ZU 6ZA(CW) 6ZN(CW) 6RZ 7AF 7FT 7MF(CW) 7RA(CW) 7RF 7YA 7ZO 9ZAF(CW).

Stations heard and worked at 6AIB, Long Beach, Cal.: 5IF (5ZA) (6AK) (6AR) 6CH 6CV 6CP 6DP (6FH) (6FK) (6GF) (6GR) (6OC) 6OH 6PJ 6PO (6QR) (6RP) 6TU 6TV 6UO 6VM 6VK 6VX 6WO (6ZB) (6ZU) 6ZX 6ZZ 6AAU 6AAH 6ABH 6ABM 6ABR 6ABU 6ABW 6ABX (6ADA) 6AEI (6AEH) 6AEZ 6AFN (6AGF) 6AID 6AIW (6AJH) (6AKL) (6ALE-CW) 6ALP (6ANG) 6APE (6ARW) 6ATQ 6AUN 6AVV 6AWH (6AWT-CW) 7BH 7BK 7ED 7FI 7GA 7HW 7IN (7IW) 7IU (7KB) 7HF 7MF 7OZ (7XD) 7YA 7ZB (7ZJ) 7ZM 7ZS 7ZT 7ZU 9AMB 9AYV.

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Number		Mounted	Unmounted
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"	35	1.40	.50
"	50	1.50	.60
"	75	1.50	.60
"	100	1.55	.65
"	150	1.60	.70
"	200	1.65	.75
"	250	1.70	.80
"	300	1.75	.85
"	400	1.80	.90
"	500	2.00	1.00
"	600	2.15	1.15
"	750	2.35	1.35
"	1000	2.60	1.60
"	1250	3.00	2.00
"	1500	3.50	2.50

Mounted coils are fitted with Remler "Ezy Plug" Bakelite plugs with water-proofed fiber strap.

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THE coil is impregnated by an exclusive Remler process with a special celluloid enamel. There is no varnish to "ooze out" in hot weather, no fiber to absorb moisture in damp weather. This results in an extremely low distributed capacity and an absence of leakage or shorting. The exclusive Remler process of waterproofing guarantees the fiberoid strap against moisture.

The plug mountings are molded by Remler from genuine Bakelite, highly polished. The plug terminals are slotted twice at right angles to insure easy plugging and good contact. All coils are wound on a substantial impregnated tube 2" in diameter with 1" face or width.

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PACIFIC COAST PRICES

MP-200 de Forest one step amplifier equipped with transformer of the latest type to insure maximum efficiency, price **$18.80.**

MP-100 new de Forest Audion Control Panel designed especially for "soft" detector tubes now considered standard. Price **$14.30.**

MT-100 de Forest perfected short wave tuner. Range 150 to 600 meters. Ideal for Radiophone broadcasting. Price complete **$45.50. MT-200,** range 150 to 25,000 meters, **$50.00.**

OT-3 de Forest Midget Radiophone, designed to work on any source D.C. or A.C. supply up to 500 volts. Uses three 5 watt transmitting tubes, price **$106.**

For the best book on Radio ask your dealer or write us direct for "Elements of Radio-telegraphy," by Lieut. Ellery W. Stone, U. S. N. Written in simple, understandable terms and profusely illustrated with charts, diagrams and photographs. Price $2.50.

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Henry M. Shaw, President

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National Distributors for

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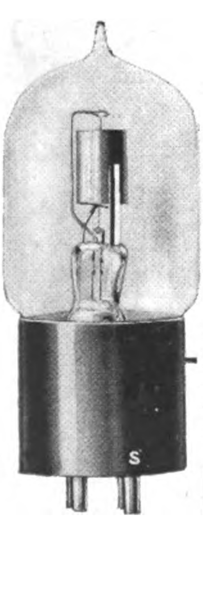
C. BRANDES, INC.	Radio Head Receivers

DEALERS WRITE FOR PROPOSITION



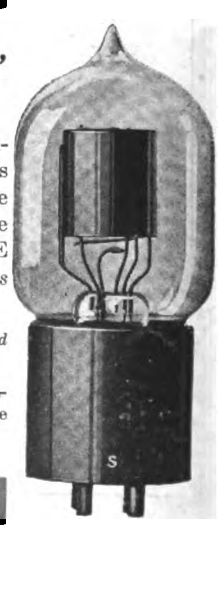
—and "use A-P tubes for efficiency"

A-P tubes were chosen by PAUL F. GODLEY for the supreme test of International Radio communication between England and the United States. The new MAGNAVOX Power Amplifiers are designed for use with A-P tubes exclusively. The A-P VT Amplifier Oscillator is the tube used by the U. S. NAVY. In the Westinghouse receiver cabinet at W J Z, the new Westinghouse High-power Radio Telephone Broadcasting Station at Newark, N. J., the WESTINGHOUSE Company are using A-P tubes *exclusively.* In *your* set "use A-P tubes for efficiency," *the tubes that are used by those who know.*

A-P tubes are licensed by the Radio Corporation of America under de Forest Audion and Fleming patents for amateur and experimental use in Radio communication.

The A-P VT Amplifier Oscillator—the Amplifier used by the U. S. Navy. "Use the tube the Navy uses." Price **$6.50.**

The A-P Electron Relay—the most sensitive detector of spark signals known to the radio art. Price **$5.00.**



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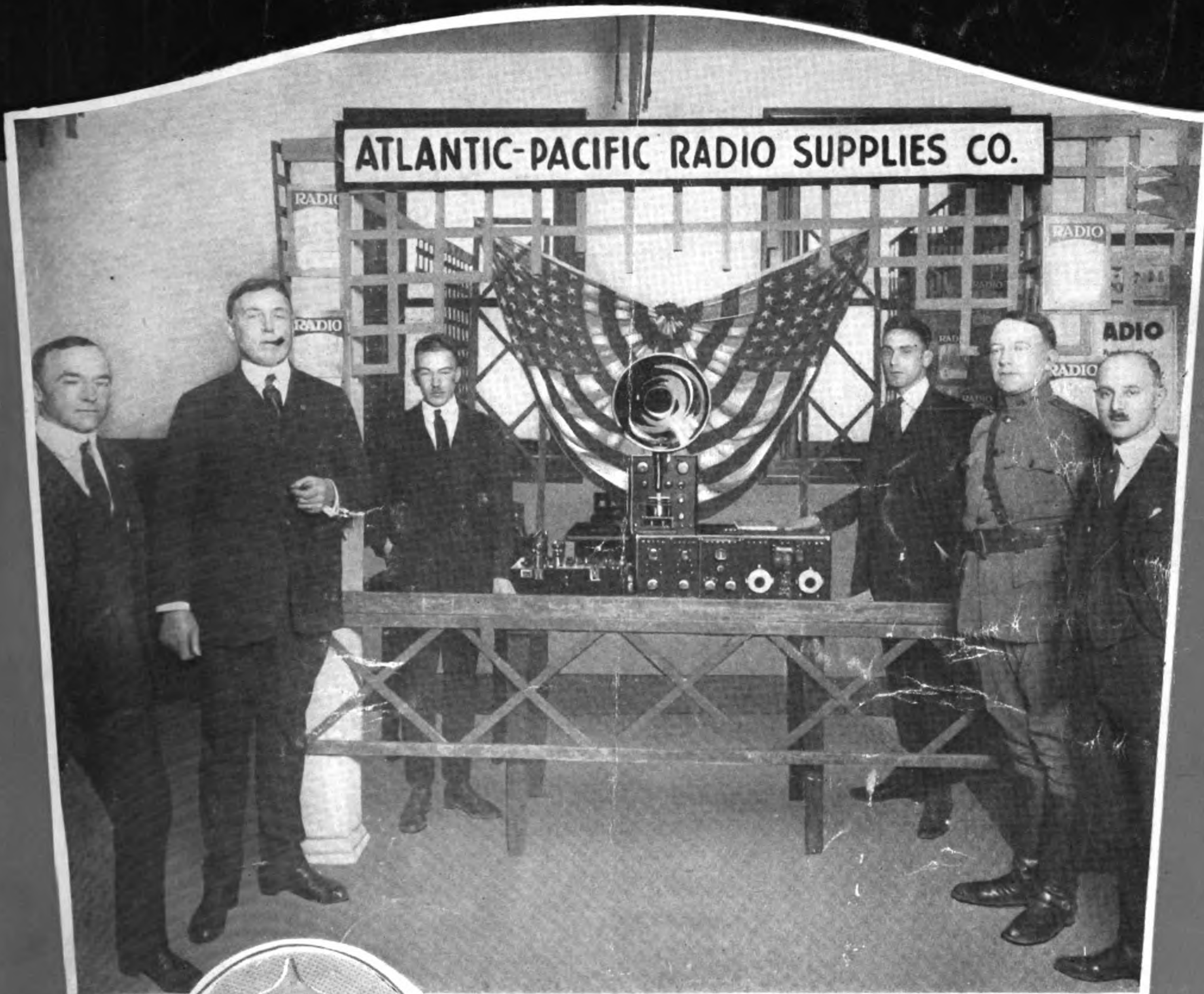

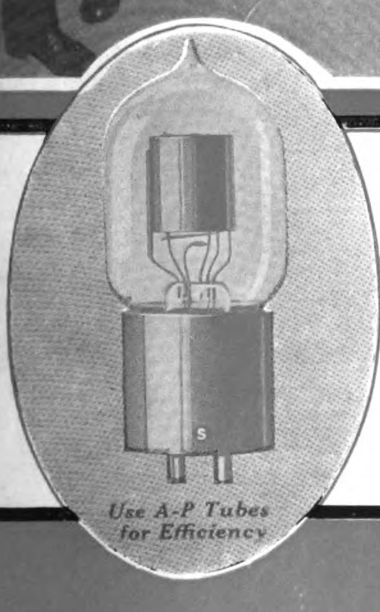

A-P Opens Pacific Radio Convention

Photograph shows Club Officials, Radio Officers and members of the A-P staff receiving the opening address by radio with A-P tubes used in de Forest inter-panel equipment and Magnavox amplifying and loud speaking apparatus. "The tubes that are used by those who know."

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Henry M. Shaw, President

RADIO

Established 1917 as Pacific Radio News

Volume IV *for* FEBRUARY, 1922 *Number 2*

CONTENTS *for* FEBRUARY, 1922

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Issued Monthly, 20c a copy. Subscription price $2.00 per year in the U. S., $2.50 per year elsewhere. Instructions for change of address should be sent to the publisher two weeks before the date they are to go into effect. Both old and new addresses must always be given.

Entered as second-class matter at the Post Office at San Francisco, Calif., under the Act of March 3, 1879.

Forecast of Contributions for March Issue

Jennings B. Dow, Ensign U. S. N., and Author of "The C. W. Manual"

Jennings B. Dow, Ensign, U. S. N., author of the series of articles on C. W. practice running in these columns, will treat on the design and construction of a five-watt radiophone in the next installment. These series will eventually be reprinted in book form as "The C. W. Manual."

D. B. McGown, assistant radio inspector, is the author of some practical instructions for making a good receiver for 175-2500 meters. This will be illustrated with photographs of a set built in accordance with the instructions.

Another good constructional article will be one of the contributions to the prize contest for all-wave receiving sets, the first prize winner being published in this issue.

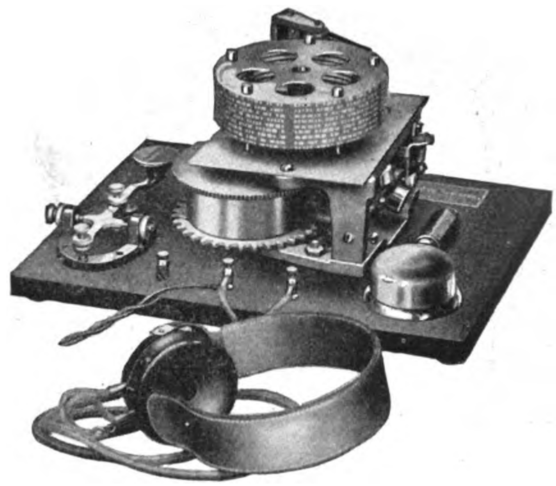
Hugh R. Sprado will have some excellent suggestions on elimination of interference by means of directive reception. R. E. Lake will discuss Vacuum Tube Circuits. B. F. McNamee, in the course of his excellent radio articles in ideas of one syllable, will tell about crystal detectors.

Lawrence Mott has a fine radio story entitled "The Small Person," which will bring a thrill to every operator.

Of course there will be some fine material in all the regular departments, including more complete announcement regarding proposed activities of the C. W. Association of America, together with a goodly supply of radio humor. The present issue may be regarded as setting a standard which will be maintained during the year to come.


Confucius has said:
"The accomplishment of great things consists In doing small things Well"
Perfection of detail makes the Grebe Receiver What it is—
The Grebe CR-5 Receiver
GREBE RADIO
Doctor Mu.

Let the Natrometer Give You Sending and Receiving Speed in Half Usual Time



Don't be cut off from other advanced amateurs because you do not know how to handle the code, or be held back because you don't know how to send and receive fast enough. Get the full pleasure from your outfit. Listen-in on and understand all the commercial stuff too. There's no fun in hearing a lot of dots and dashes. You want to know what they are saying. The Natrometer will teach you quicker than any other known method.

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Employing the Natrometer is like having the assistance of an expert operator to help you learn the code; an expert who can send to you accurately at any speed, slow or fast at your command any hour, day or evening. The Natrometer will do that and it never gets tired. Sends with perfect accuracy, and the speed is instantly adjusted with a small thumb-screw, from three to thirty-five words a minute. Six hundred different messages can be sent with a single dial. When you exhaust your message dial, you can exchange it for another one without cost. The Natrometer's powerful motor allows it to run for twenty minutes. The sending is as clear as a bell. No bother with static interference and no choppiness.

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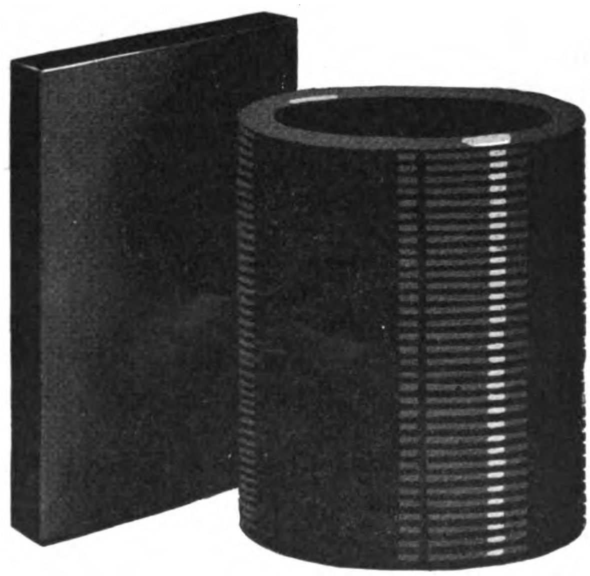

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The Formica Insulation Company

4614 Spring Grove Avenue, Winton Place

CINCINNATI, OHIO

February, 1922 RADIO Vol. 4 No. 2

Radiotorial Comment

AN unexpected indication of the tremendous popular interest in radio concerts is found in the annual report of one of the phonograph manufacturers wherein increased sales of radio concert receivers are ascribed as a cause of decreased sales of phonographs. With the manifold advantages of radio concert reception and the increased ease of manipulation by the layman, the dream of a radio set in every home may yet become a reality. Meanwhile radio continues to boost the sale of phonograph records introduced by its aid.

MUSH is all right for breakfast, but as a steady diet it takes a hardy race like the Scotch to survive it. When served day and night in the form of radio harmonics it is insufferable. Hence the news that the Navy has found a means for suppressing "mush" from its arc stations is most welcome. Details are not yet available for publication, but fifty-seven varieties of harmonies are claimed to have been eliminated in the case of one of the San Francisco Bay stations.

TO the boy who chafes under the restraint of being obliged to stop sending during the radio concert broadcasting hours we suggest that he utilize this opportunity to interest his parents in his radio set. Ask dad to listen to the press reports and the grand opera stars while he is smoking his after-dinner cigar. Show mother how to tune in for the afternoon or evening concerts so that she can provide novel entertainment for her guests. And as a result it will be a lot easier to get that extra ten-spot or so to purchase that long-coveted piece of equipment. Thus can you combine personal profit with the satisfaction of realizing that you are giving due consideration to the greatest good to the greatest number. Thus also you can avoid an unpleasant call from the local traffic officer, who under the new "Pacific Plan" will be backed up by the radio inspector in his demand that you stay off the air when you are liable to interfere with concert reception.

WITH pardonable pride do we announce the adoption of the Pacific Plan for the regulation of radio traffic. This suggestion, first made in December RADIO, met with the hearty endorsement of all western radio clubs, most of whom sent delegates to the convention at San Francisco. These delegates admirably assumed the responsibility of codifying the ten commandments of the air, commandments graven not on stone, but on the eternal ether. Fortunate were they in having a Moses to lead them out of the wilderness in the person of Major J. F. Dillon, universally loved and respected in radio circles. The fabled confusion of tongues at the building of the tower of Babel was not a circumstance compared to the confusion of arc, spark and tube that has been interfering with radio work. Be it especially noted that the new rules have teeth in them and are to be enforced by the authority of the radio inspector. Well known is the fact that responsibility without authority, like authority without responsibility, is doomed to failure. But where responsibility and authority are conjoined success is assured. The responsibility for enforcement rests with the local clubs to whom the radio inspector has delegated his authority.

THE past month has produced some remarkable long distance records in amateur radio transmission. There are several well authenticated cases of transcontinental reception, twenty-six messages—twenty of which were C. W.—were received by Mr. Godley in the A. R. R. L. trans-Atlantic test, and fourteen stations were reported as being heard in Hawaii, 2100 miles across the Pacific. 'Tis greatly to be desired that immediate arrangements be made for a real trans-Pacific test, a task which might well be undertaken by the new C. W. Association of America.

FOR a reputable newspaper to publish an article such as recently appeared on the front page of one of the San Francisco dailies with regard to the National Radio Company, is the cause of surprise and regret to those who know the facts. While the news of the purchase, if true, will be welcome to those who have been holding the bag of this financial fiasco for several years, its suggestion of perfected radio telephone developments is premature. Radio telephony is wonderful enough in its present day accomplishments without undue coloring by a publicity agent who sees a Sahara Desert in a grain of sand and the Pacific Ocean in a drop of water. Transcontinental wireless telephony will undoubtedly be accomplished in the near future. Transcontinental radio telegraphic communication is an established fact. But this has been done by means of continuous waves, generated by 3-electrode electron tubes, which are more efficient than the antiquated and expensive methods hitherto used by the National Radio Company. Nothing but harm can result from such sensational playing up of fiction masquerading as fact.

Some of the Delegates to the Pacific Coast Radio Convention

Radio Convention Adopts Pacific Plan

A Pacific Plan for regulation of amateur radio traffic was unanimously adopted at a convention representative of 25 radio clubs on the Pacific Coast held at San Francisco on Dec. 29th and 30th. This plan, which is published in full herewith, received the full indorsement of Major J. F. Dillon, radio inspector for the sixth district. It is to be effective after Feb. 1, 1922, throughout the territory west of the Rocky Mountains.

The convention was formally opened Thursday afternoon, Dec. 29, by a wireless address from the Meyberg station at the Fairmont Hotel introducing Mr. Sidney J. Fass as chairman of the convention committee. Mr. Fass turned the meeting over to Major Dillon as the presiding officer. Proposals submitted by the various radio clubs were read by Mr. H. W. Dickow, president of the San Francisco Radio Club, and then referred to the accredited delegates, who used them as the basis for formulating the final plan.

Adjournment was taken while the plan was being discussed so that the radio show could be inspected. After a banquet in the evening the show was opened to the public until the following night, when the convention was closed with a radio ball where many couples danced to radio music.

The exhibitors at the radio show were the Colin B. Kennedy Co., the Radio Corporation of America, Leo J. Meyberg, Radio Shop, Levy Electric Co., Warner & Linden, Pacific Radio Exchange, Heintz & Kohlmoos, Newberry Electric Co., RADIO, Atlantic-Pacific Radio Supplies Co., and California Electric Supply Co.

"PACIFIC PLAN"

1. There are five divisions of operating hours each day, as follows:

6:30 A. M. to 6:30 P. M.—Free air, work of any kind except D. X.

6:30 P. M. to 7:30 P. M. (or to concert time)—For local traffic only, using a minimum of power.

7:30 P. M. to 9:00 P. M.—Restricted to concerts in such districts as concerts are broadcasted, or in districts where there will be interference with concert broadcasting by 200 meter stations. This is to be under the control of the individual clubs, within their own sections.

9:00 to 10:30 P. M.—Period for long distance testing and messages, to L. D. stations only. Stations working this period cannot work again until after 12 A. M.

10:30 to 12:00 P. M. (midnight)—Long distance messages, ONLY for stations having regular traffic, except those who have worked during previous period.

12:00 A. M. to 6:30 A. M.—Long distance testing and long distance free air.

2. Local work shall be defined as transmission to stations up to a distance of 50 miles. All distances over 50 miles to be considered as long distance work.

3. After 9 p. m., a station desiring to operate shall listen for a period of three minutes before transmitting, to determine if any traffic is being handled, and then, if none is heard, the signal NA is to be given *once*. If answered by the signal IM, the calling station shall stand-by until the station giving the signal IM has finished, and this station shall then indicate his having done so by giving the signal CLR.

4. All radiophone and C. W. transmitters are considered as radio transmitters, and come under these regulations at all times, except that C. W. stations may work during the concert hours.

5. Each radio club shall appoint one traffic officer, and assistants, whose purpose it shall be to supervise traffic regulations in the vicinity wherein the radio club is located. The traffic officers shall be persons who are familiar with amateur operating conditions, and shall be indorsed by the Radio Inspector, after being appointed by the club.

6. Traffic officers shall use the sign TO. No station shall dispute an order given him by radio. If there is any misunderstanding, or question, use wire telephone, or make written report to the chief traffic officer.

7. The traffic officers, and their assistants, shall co-operate to the fullest extent with the U. S. Radio Inspector, and the traffic officers shall be recommended for recognition as semi-officials of the Department of Commerce. All violations of traffic ordinances shall be reported by the traffic officer to the radio club of which the offender is a member, and the club shall take immediate steps to remedy the difficulty, but shall report the matter to the Radio Inspector, if the efforts of the traffic officer, and club, fail.

SUGGESTIONS

1. Messages should be brief as possible, omitting unnecessary words, etc., and shall use cable count, and give check and origin in preamble of message.

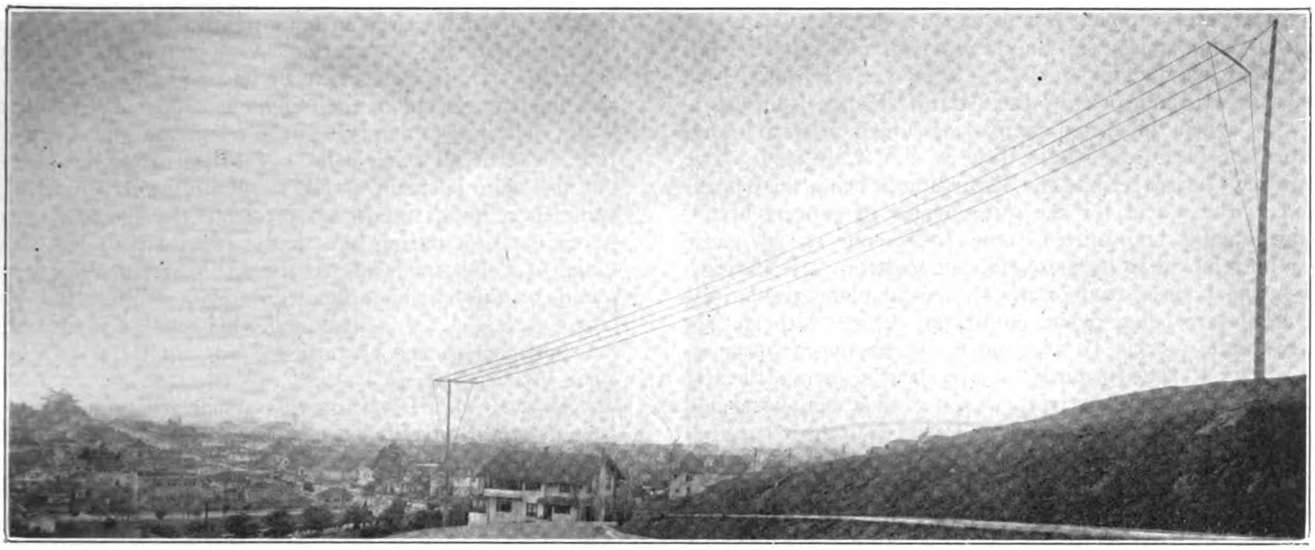
2. Requests for QSP must be brief.

3. Complaints, suggestions, etc., shall be submitted to the clubs in their districts.

Altho not read as part of the traffic rules, the following are assumed to be self-evident, in the handling of various kinds of traffic, and were agreed in committee, without dissension.

a. Clubs shall have complete jurisdiction over all matters within their own zone, which are not covered by traffic rules. For example, if the concert schedules do not start

Concluded on page 12



View of Radio Masts and Antenna at KZY

KZY—A Record Installation

By Ellery W. Stone

PROMPTLY at midnight, on the morning of Christmas Day, the Atlantic-Pacific Radio Supplies Company formally placed in commission its new high power radiophone broadcasting station at Rockridge, Oakland, Calif. This station is located at the residence of Mr. Henry M. Shaw—the president of the Atlantic-Pacific Radio Supplies Company, the Moorehead Laboratories, Inc., and the Shaw Insulator Company, of Newark, N. J.—where it is planned to make extensive experiments in the broadcasting of music. Mr. Shaw's residence and the location of the radio equipment therein are excellently adapted for this purpose, the radio room opening onto a large music room on the lower floor which will permit the holding of vocal and instrumental concert numbers.

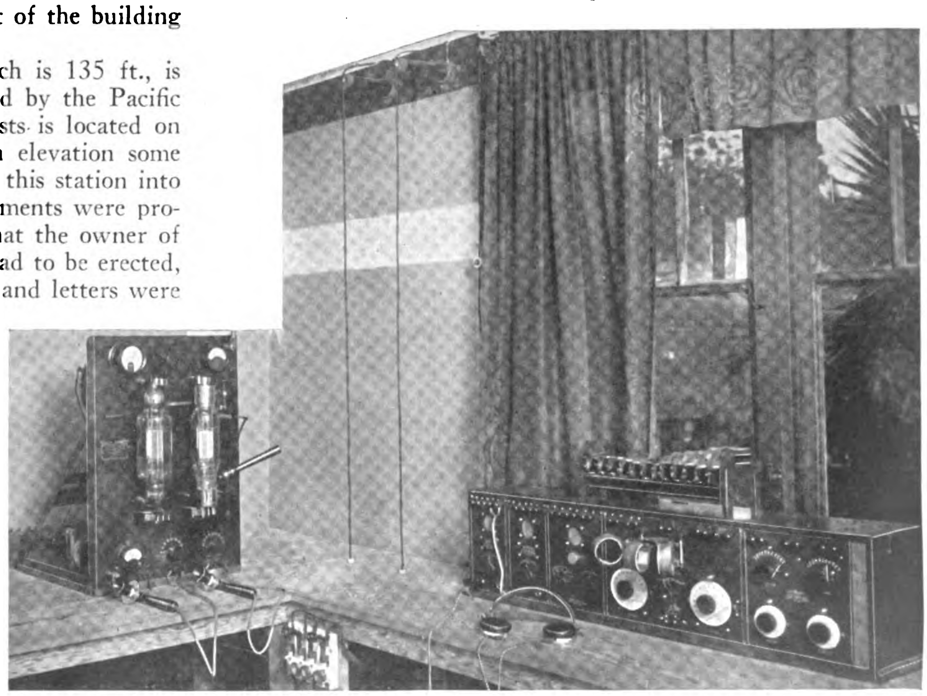
While the radio world heard this new station come into commission exactly as Christmas Day dawned, it was not aware of the strenuous efforts which were required to put this station into commission at that time, and it is believed that our readers will find this short account of the building of KZY of interest.

The antenna, the active length of which is 135 ft., is suspended between two 75 ft. masts, erected by the Pacific Gas & Electric Company. One of the masts is located on Mr. Shaw's property and the other on an elevation some distance away. It had been planned to put this station into commission on Christmas Day, and arrangements were progressing satisfactorily when it was found that the owner of the property on which the "far end" mast had to be erected, was residing at Santa Barbara. Telegrams and letters were sent him, but as he was on a vacation trip, it was found impossible to reach him.

Accordingly, Mr. Fred Anderson was sent to Santa Barbara on the evening of December 16th to endeavor to locate the owner of the property. Upon his arrival at Santa Barbara, Mr. Anderson discovered that he was in Los Angeles, and motored to Los Angeles, arriving there late that evening. The owner of the property signed an agreement giving permission to use the property for the antenna. Mr. Anderson was able to return on the train from Los Angeles that evening, arriving in Oakland on the 18th. On Monday, the 18th construction work was started on the antenna by the Pacific Gas & Electric Company, thru the co-operation of Mr. Lee Newbert, division manager, and Mr. Worthington, construction engineer. The weather during the week preceding Christmas was very stormy and considerable difficulty was encountered in erecting the masts and laying the counterpoise ground.

While the antenna was being constructed, work had been started on the interior installation of the radio equipment.

The equipment consists of DeForest apparatus throughout, the transmitting equipment being the standard DeForest ½ kw. set and the receiving equipment comprising the latest DeForest multiwave tuner, detector and two stage amplifier Interpanel receiving equipment. In conjunction with this receiver are employed the Magnavox loud speaker together with two-step power amplifier. The transmitting tubes are DeForest ½ kw. Oscillions, and the receiving tubes, including those employed in the Magnavox power amplifier, are the standard A-P detector and amplifier tubes.



Interior View of Radio Station at KZY, *Showing DeForest ½ kw. Transmitter, and DeForest Interpanel Receiver.*

Part of this equipment was formerly used at the California Theatre radio station in San Francisco, 6XC. The old station was installed in April, 1920, by Lee Deforest, Inc., and was later taken over by the Atlantic-Pacific Radio Supplies Co., when the latter company assumed western representation of DeForest Radio Tel. & Tel. Company. The California Theatre set had the distinction of being the pioneer station in the world for the sole purpose of concert broadcasting, having transmitted some 1500 concerts by radio before its removal to its more efficient location at Rockridge.

For the transmission of music, special phonographic arrangements are being made, employing devices hitherto not used for radio work. In addition to the phonograph, equipment similar to that formerly used at the California Theatre has been installed for the transmission of chamber, vocal and instrumental music. As noted above, this equipment has been installed in the music room adjoining the radio room and wires are led from this apparatus into the radio station.

Despite the short time available for the erection of this station, the first tests were held on the afternoon of December 23rd, just four days after construction had been started. Preliminary tests were kept up until the official opening of the station on Christmas morning, on which occasion Christmas carols were sent over the air by a trio, consisting of the Misses Aida, Vivian, and Barbara Baxter, daughters of Mr. A. A. Baxter, one of the directors of the Atlantic-Pacific Radio Supplies Company. This trio was accompanied by Miss Helen Culver, well known in San Francisco musical circles. Following the rendition of "Silent Night" and other Christmas carols, Mrs. W. A. Divoll, soloist at St. Peter's Episcopal Church of Rockridge, sang "O, Little Town of Bethlehem" and additional Christmas songs. The concert was closed with a formal announcement of the opening of the station and the extending of the Season's Greetings by the Atlantic-Pacific Radio Supplies Company to its radio audience.

Experiments were carried on during the week, and on the holidays of January 1st and 2nd special news reports and concerts were sent out. In the first few days of its operation, reports were received by letter and telephone, from at least two hundred radio enthusiasts who had heard these concerts.

The number of responses by telephone was so great that the telephone lines were soon congested in handling this traffic. In fact, some of the radio enthusiasts reported that they had been kept waiting over an hour to voice their appreciation of the opening of the new station. One man in the outlying districts had tried to reach KZY by telephone for over four hours and finally resorted to the ingenious expedient of getting his Chief of Police to demand of the telephone supervisor a clear line ahead of all other calls. Needless to say, he succeeded, but the radio operator at KZY, who must have had a guilty conscience, hasn't recovered yet from the shock of the telephone operator telling him that she had a rush call from the Chief of Police for him. As the result of the tremendous demands on the telephone facilities previously installed, the Pacific Tel. & Tel. Co. rushed in another trunk line so that KZY may now be reached by calling Piedmont 8778 or Piedmont 7768-W.

At the time of writing this article, the station has only been in operation a little over a week, and reports have already come in showing reception over a distance up to 1400 miles, the *U. S. S. Vigilant* having reported, by radio, receiving the concert while off Baja California, Mexico. Reports have been received from all points in California and in Oregon, and it is expected, when sufficient time will have elapsed, to receive reports that even greater distances were covered.

Special arrangements have been made with the San Francisco *Call* and the Oakland *Post-Enquirer*, affiliated publications, to render an up-to-the-minute news service to KZY in order to carry out its news schedules.

KZY will operate on the following schedules, comprising part of the joint schedule drawn up by the Pacific Radio Trade Ass'n, and approved by Major J. F. Dillon, U. S. Radio Inspector of the Sixth Radio District.

Every afternoon except Sunday, 3:30 to 4:30 p.m.—Concert.
Every night except Sunday, 7 to 7:10 p.m.—News Service, Sports and Foreign.
Sunday, 3 to 4 p.m.—Concert.
Wednesday, 2:30 to 8:15 p.m.—Concert.
Saturday, 8:15 to 9 p.m.—Concert.

The construction of KZY at the Rockridge home of Mr. Shaw was performed by the following engineers, under the supervision of Lieut. Ellery W. Stone, general manager of the Atlantic-Pacific Radio Supplies Company: Fred Anderson, exterior construction; B. F. McNamee and Edward M. Sargent, design and interior construction; Earl Bowen, J. W. A. Legge-Willis, S. A. Sollie, and Wm. Morelli, interior installation.

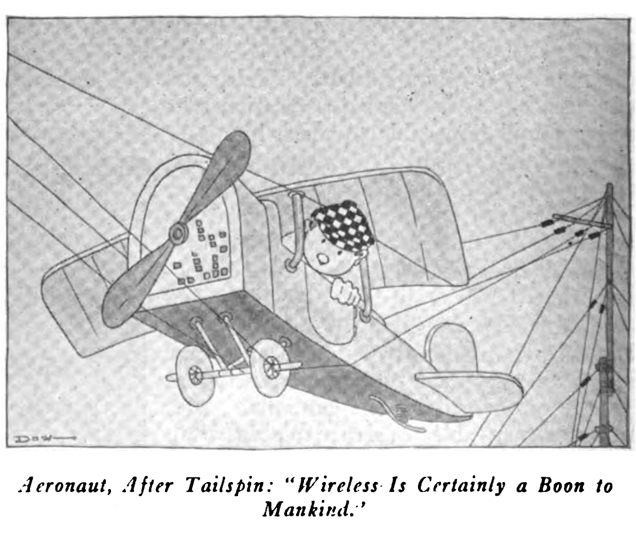
PACIFIC PLAN

Continued from page 10

until 8 p.m., in certain localities, the club may authorize the extension of the local period from 6:30 until 8 p.m., or they may subdivide the long-distance periods into directional periods if found necessary, etc., etc.

b. Special stations on 375 meters do not come under the traffic rules, except that they shall not transmit during the concert periods. When they are using the 200 meter wave for ordinary correspondence, they shall be governed by the same rules as all other stations on 200 meters.

c. No stations shall transmit concerts, or music of any kind on any wave but 360 meters, and then only during the hours provided for this class of work. No matter to be transmitted by the broadcasting stations, except music and the necessary conversation relating thereto. No 200 meter stations shall broadcast music at any time.



Aeronaut, After Tailspin: "Wireless Is Certainly a Boon to Mankind."

Construction of a Radio Frequency Amplifier from Standard Parts

By G. M. Best

AN article on the Armstrong Super-Heterodyne, by A. K. Aster, which appeared in the December number of RADIO, described the principles and operation of a home made radio frequency amplifier. So many questions with regard to this amplifier have been received that the following description of one of these sets will perhaps clear up a few of the questions, and show how such an amplifier may be constructed for a very small amount of money.

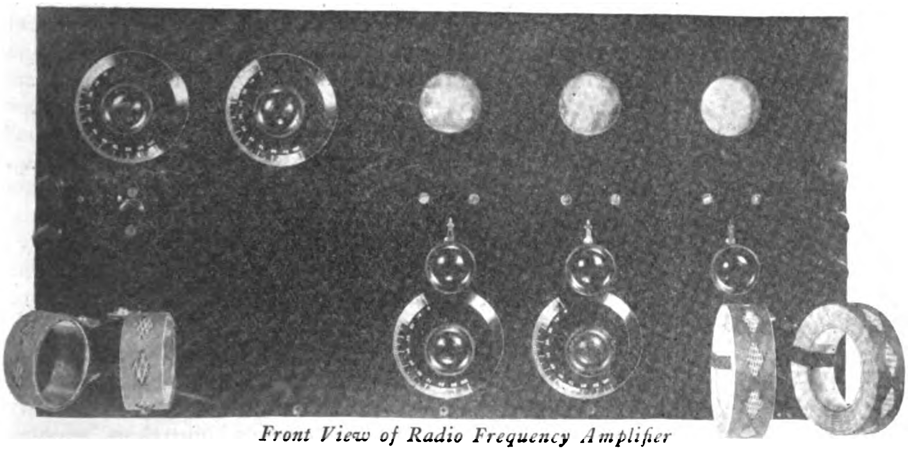
The set described by Mr. Aster involved winding a number of coils, and included a detector and one stage of audio frequency amplification. As the writer already had a detector and several stages of audio frequency amplification, it was desired to construct the radio frequency amplifier separately, and to connect it by means of a flexible cord and plug to the regular detector connections. With this idea in mind, the panel shown in the accompanying photographs was assembled, all of the materials being of the kind that are readily obtainable at any well stocked radio supply house. Four air condensers, an antenna series-parallel switch, two movable and two fixed honeycomb coil mountings, three V. T. sockets, three rheostats, condenser dials and miscellaneous parts were used, and all mounted in as compact a unit as was possible.

The panel is divided into three sections: antenna tuned circuit, heterodyne oscillator, and two stage radio frequency amplifier. Each section is separated at the back of the panel, when it is completely assembled, by a wooden partition, not shown in the illustrations. These partitions and the back of the panel, are covered with a shield of thin copper sheeting, which is connected to ground. This shield can easily be held in place by means of small brads, holes for which can be drilled in the panel, using a very fine drill, of a gauge considerably smaller than the brads. If the brads are No. 60 size, then a No. 65 drill must be used. Unless this shield is firmly held in place, it may bulge, and ground some part of the circuit. Care should be taken to cut large enough holes in the shield to clear all apparatus that is mounted on the panel.

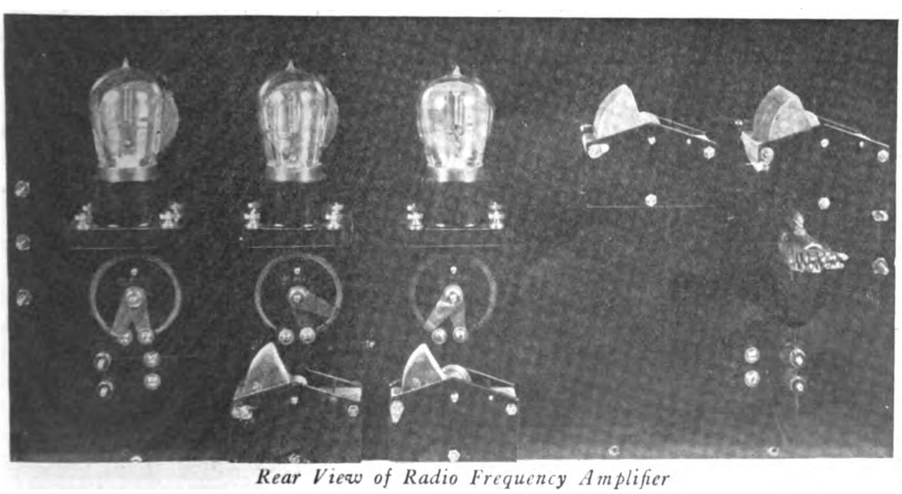
The antenna tuned circuit consists of two honeycomb coils, with their mountings, an antenna series-parallel switch, and two small air condensers. The tuning of this part of the set is in no way different from that of any ordinary tuned circuit, and should present no difficulty to the novice.

The heterodyne oscillator section occupies the center part of the panel, and consists of a vacuum tube, socket, rheostat and air condenser. A 1 mf. paper condenser, and two honeycomb coils necessary for the operation of the oscillator are not shown in the illustrations, as they are mounted on the partitions, which were removed to show the entire layout of the apparatus on the panel.

The two stage amplifier, with the 50,000 cycle tuned circuit consists of two tubes with their sockets, two rheostats, an air condenser, fixed condenser, and two 500 turn honeycomb coils with their mountings. Binding posts are furnished for the A and B batteries, as well as the antenna and ground connections. The final output of the amplifier is a two conductor flexible cord, with either two terminals to connect the binding posts on the regular detector, or in the case of a honeycomb coil set, a plug can be used to connect the radio frequency amplifier to the secondary connection of the detector.



Front View of Radio Frequency Amplifier



Rear View of Radio Frequency Amplifier

The circuit shown in Fig. 1 is not a great deal different from the one shown in Mr. Aster's set, the main difference being that there is no detector shown, the two arrows indicating where the detector is to be connected. Excellent results were obtained using only 80 volts in the plate circuit of the tubes, this voltage being obtained from two 43 volt dry cell units.

The physical dimensions of the panel are 11 in. by 22 in. by 3/16 in., of either bakelite or formica, and a cabinet of the same dimensions should be provided, to house the apparatus. The inside of the cabinet should also be shielded, grounding the shield the same as was done on the panel. Use bare copper wire in making connections, and solder everything thoroughly. The cabinet should be provided with a lid, in order to replace tubes, and make slight adjustments on the honeycomb coils in the heterodyne oscillator circuit.

As Mr. Aster has already pretty well covered the operation of this type of amplifier, no particular discussion is necessary here. Some criticism is bound to result from the use of honeycomb coils in the outfit described in this article, but contrary to the opinion of a great many ama-

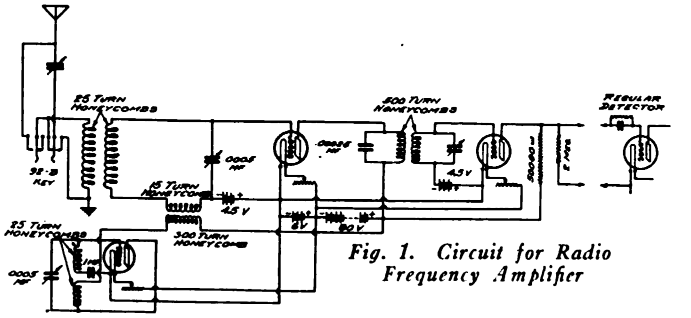


Fig. 1. Circuit for Radio Frequency Amplifier

teurs, honeycomb coils can be made to operate very efficiently on short wavelengths, if handled properly, and the results obtained by using them in connection with the Armstrong Super-Heterodyne prove that they are very well adapted for that sort of work. Not only are they more convenient than a number of hand wound coils, but the fact that they can be changed easily, and coils covering other wavelengths substituted, gives the amateur just what he wants, namely, a radio frequency amplifier that is flexible, and is not confined to a narrow band of wavelengths.

A 150-25000 Meter Receiver

The Winner in the $25.00 Prize Contest

By I. A. Weihe

A RECEIVER that will detect, regenerate, and oscillate over the entire wavelength range is something that will be appreciated by any radio enthusiast, and is possessed by comparatively few.

The cost of a short wave regenerative set, for amateur waves, and of the honeycomb or duo-lateral coil sets, for the longer waves, is prohibitive for the average amateur.

The description of the combined long and short wave set that follows will be of special interest to the amateur with the slim pocketbook, as it can be easily made, and at a very moderate price. Anyone making this set, and taking pains with it, will find that it will compare favorably with the standard short wave sets on the market today, and the long wave set is as good as a set using honeycomb coils. The signal strength on both sets is practically the same, the only difference being in selectivity. The set described lacks the selectivity of the other sets, but otherwise they are practically the same.

This receiver consists of two separate sets, the use of either being controlled by a four-pole double throw anti-capacity switch, which is located directly above the condenser, or center dial.

The short wave part of this set has a wavelength range of 150 to 700 meters with the .001 mfd. (43 plate) variable condenser in series with the aerial, and from 400 to 1700 meters with the same condenser in shunt with the coil. The long wave part has a range of from 1800 to 14,000 with series condenser, and 4000 to 25,000 with shunt condenser. The position of the condenser is controlled by a series-parallel switch, which is located directly under the condenser.

A single coil tuning circuit is used, with direct coupling for primary and secondary circuits, and the tickler coil is used to produce oscillations, for the reception of C. W., or for regenerative amplification of spark and fone signals. The ease and rapidity with which signals can be tuned in more than compensate for the lack of selectivity. This is one of the best circuits for the reception of C. W.

The only variable part for wavelength control is the variable condenser, it being only necessary to vary the condenser to receive anything within the wavelength of the tap used.

The following parts are needed, and can be had for about $15.00 (no doubt most amateurs will have most of the parts around their shop, thereby reducing the cost): One panel 1/4 in. x 6 in. x 14 in. of Bakelite or Formica; three dials and knobs, three inches in diameter; one Murdock .001 mfd. variable condenser (No. 3660); one series-parallel switch; one four-pole double throw anti-capacity switch; twenty-four switch points; two switches with 3/4 in. knob and 1 in. radius; two switches with 3/4 in. knob and 1 1/4 in. radius; one piece cardboard tubing 4 in. in diameter and 3 in. long; one piece cardboard tubing 3 1/2 in. in diameter by 1 1/2 in. long; one coil of 15,000 turns and one coil of 500 turns. The coils may be honeycomb, duo-lateral or qsa inductances, or if equipped to do so the amateur can wind his own coils, and make another saving on the set. Screws make good bearings, and if you haven't any the following will answer: six 6/32 thread 1 in. or 1 1/2 in. long brass machine screws and six 10/24 thread 1 in. or 1 1/2 in. long brass machine screws and nuts.

No dimensions are shown for the holes in the panel, as

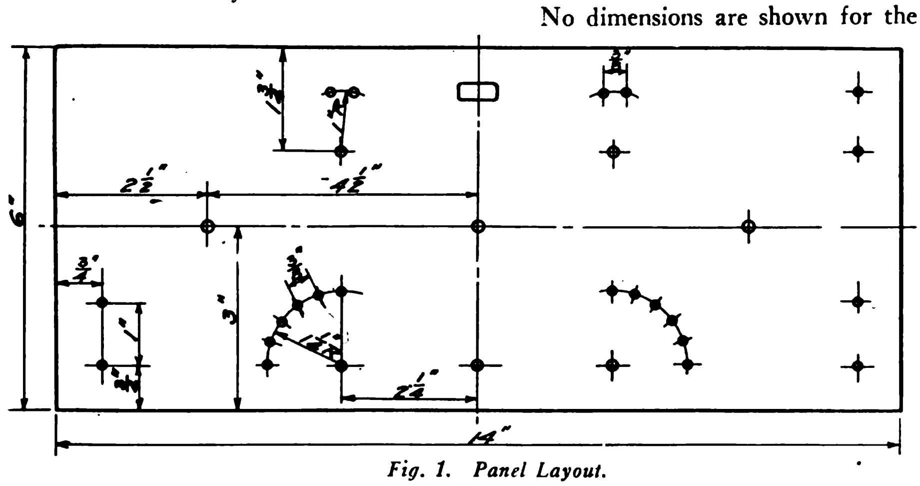


Fig. 1. Panel Layout.

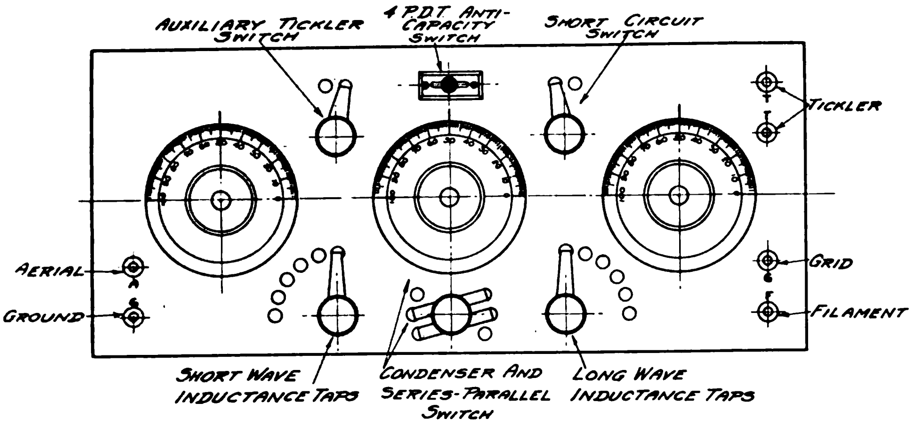


Fig. 2. Completed Panel.

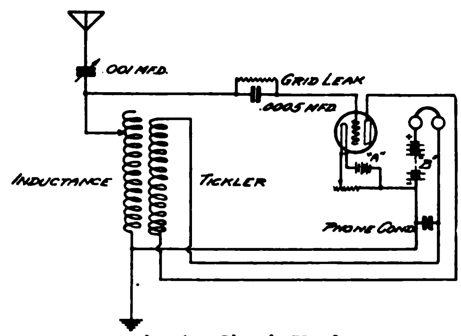


Fig. 4. Circuit Used.

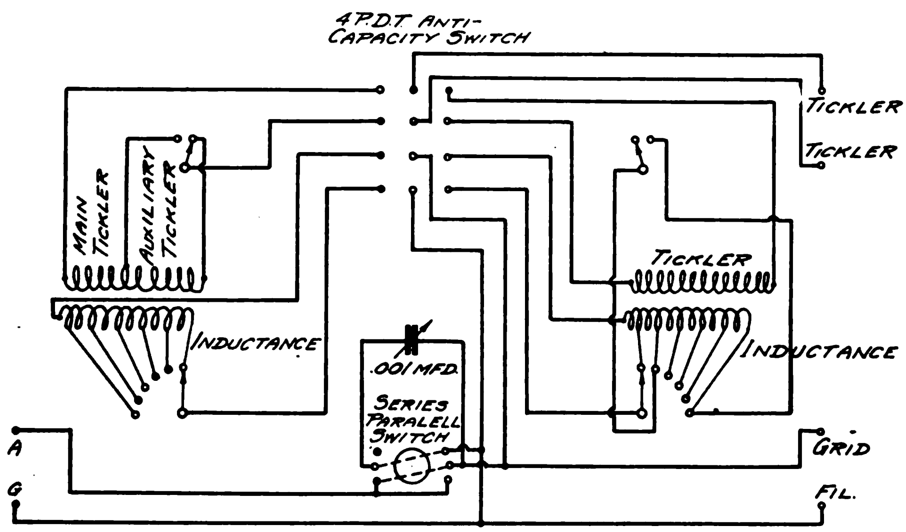


Fig. 5. Complete Wiring Diagram

they will vary for the apparatus the builders may have on hand.

The short wave part of the set, which is on the left, is nothing but a short-wave vario-coupler, with the rotor used as a tickler. To construct this, take the piece of cardboard 4 in. in diameter and 3 in. long and wind on it 60 turns of No. 24 s. c. c. wire. Start winding about ¾ in. from the top, and take off a tap every ten turns. The easiest and best way to do this is to make a small loop, and after the coil is finished remove the insulation and solder on wires of sufficient length to reach the switch points.

The tickler consists of 36 turns of No. 26 s. c. c. wire on the 3½ in. cardboard tube. Leave ¼ in. space in the center for the 10/24 thread screws, which are to be the bearings. Solder the ends of the tickler to the heads of the screws, which come thru the large tube about ⅜ in. from the top. Then solder flexible leads to the screws where they come thru the hole in the stationary coil. The stationary coil can be mounted by cutting a disk of soft wood that will just go in the bottom of the tube, and glueing it in, and putting a couple of screws thru the disk to the sub-base.

The dimensions of the tickler given are correct when the condenser is in series, but with shunt condenser it will not cause the circuit to oscillate, so an auxiliary tickler of 20 turns is placed in the bottom of the stationary coil permanently, and connected so it can be cut in or out as desired by the small two-point switch, as shown in Fig. 5.

For the long wave set, tap the 1500 turn coil at six approximately equal points, and mount as near as possible to the end of the panel, allowing clearance for the binding posts. Cut a plug to fit the center of the coil and screw two pieces of brass to it of sufficient length to reach the panel. Use flat head machine screws for mounting and countersink so dial will cover screw heads.

The tickler is mounted in a similar manner except that the bracket must be offset so the tickler will come as close as possible to the large coil, and yet not touch it.

When receiving on waves from 1800 to 3000 meters it is necessary to short the unused part of the large coil, which is done by a small two-point switch which shorts from the second to the sixth tap, as shown in Fig. 5.

The above set has been in use at the author's station and has given excellent results, in fact much better than expected. For example, see the following list of calls heard:

"CALLS HEARD" BY 6ANK, BOX 846, SPARKS, NEVADA

Spark—6as, 6aah, 6aau, 6abh, 6abx, 6acy, 6aew, 6aez, 6afn, 6agf, 6agp, 6ahn, 6ahp. 6aio, 6aid, 6ajh, 6akt, 6ala, 6alv, 6anp, 6ape, 6ars, 6aso, 6avb, 6avr, 6awh, 6bm, 6cl, 6cz, 6da, 6ea, 6ef, 6ex, 6fj, 6gr, 6hc, 6ic, 6is, 6iv, 6ka, 6kx, 6lv, 6mh, 6ng, 6oc, 6ol, 6pj, 6qk, 6qr, 6tu, 6un, 6vv, 6vx, 6wh, 6wz, 6zb, 6zf, 6zu, 6zx, 6zz, 7bp, 7in, 7jd, 7ke, 7lu, 7ly, 7mf. 7mo, 7mp, 7nw, 7tj, 7vo, 7yg, 7yj, 7yl, 7ys, 7ze, 7zf, 7zk, 7zu, 9ht, 9yal.

C. W.—6abg, 6ale, 6aoy, 6aqt, 6atm, 6awv, 6cu, 6en, 6gy, 6km, 6my, 6oo, 6wv (U. S. Army, Denver, Colo.), 6wz, 6xac, 6xad, 6zad, 6zak, 6zn, 6zz, 7go, 7rn, 7xf, 8jl, 8uj, 9amb, 9bd (Canadian), 9dva, 9wd, 9zac, 9zaf, WJK.

Phone—6wv (U. S. Army, Denver, Colo.), 6xac (daylight), 6xaj, 6xak, 6xd, 6xg, 6xw, 7xf, WJK, 9zaf (Denver, Colo., 870 miles air-line).

All of the above calls were heard on a home made receiver, and one audio-tron bulb.

(See page 56 for details of cabinet.)

The CW Manual

Second Installment

By J. B. Dow, Ensign U. S. N.

Modulating Systems

Fig. 11 illustrates the power modulator method of controlling an oscillating vacuum tube at voice frequencies and represents one of the most successful though not the most efficient method of accomplishing this. For a single tube oscillating circuit employing a tube rated under 100 watts and for multiple tube circuits employing two or three smaller tubes, this method of obtaining modulation at voice frequencies is recommended. With larger single tube circuits and circuits in which more than three small oscillator tubes are used, one of the various other methods of modulation should be used to promote overall efficiency.

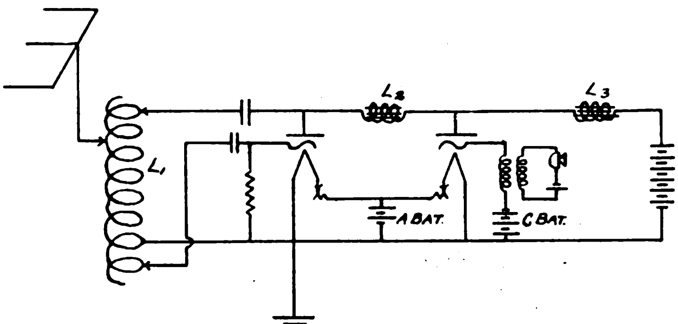


Fig. 11. Power Modulator Method of Control for Hartley Circuit.

The power modulator circuit of Fig. 11 is due to Heising and it is here used to control a Hartley oscillating circuit. In a similar manner control of a Heising oscillating circuit may be had, as in Fig. 12. In the above mentioned circuits L_1 is the low resistance inductance in the oscillating circuit, L_2 is a radio frequency choke so constructed as regards distributed capacity between turns as to prevent radio frequency currents from entering the modulator tube circuit. At the same time, this choke must offer little impedance to currents at voice frequencies. These latter currents, though pulsating in nature, behave much the same as alternating currents, in large

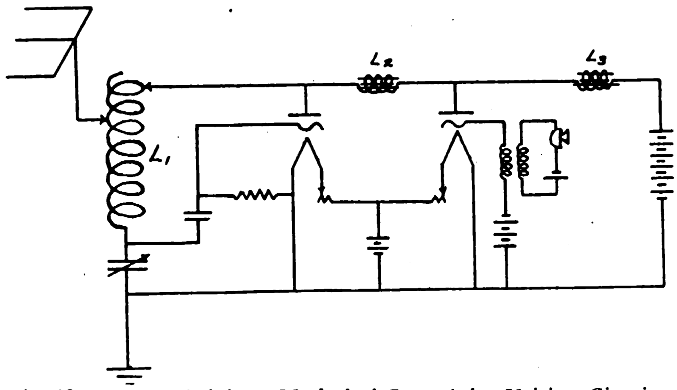


Fig. 12. Power Modulator Method of Control for Heising Circuit.

inductances. L_3 is an audio frequency choke which is placed in series with the generator supplying the required power to the plates of the oscillator and modulator tubes to insure that the current supplied by the generator will be as steady as possible. Theoretically, with a choke of the correct value for this purpose, and with other circuit constants of good proportions, the supply of current by the generator will be constant and the currents in the plate branches of the network will merely shift between the tubes. This condition is rarely found in practice, however. This may appear somewhat misleading to the layman who inserts an indicating device such a milliammeter in the generator circuit and notices fluctuations in the current evidenced by a swaying needle. The frequencies which cause this swaying are harmonics of audio frequencies or other disturbances below the lower limit of true audio frequencies. Such an indication is however a reasonable test of modulation, though not a true indication of voice modulation.

It will be observed in Figs. 11 and 12 that a battery is placed in the circuit at C to obtain the necessary negative grid potential. The capacity grid leak resistance method of bringing about a negative potential cannot be used here as in the case of the oscillating tube.

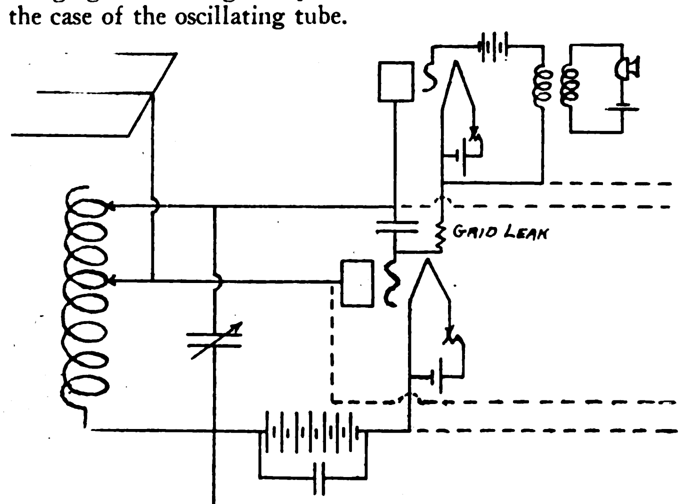


Fig. 13. Grid Leak Method of Control

In the circuits explained above the secondary of the modulation transformer is directly in series with the grid. The grid potential then is dependent upon the ratio of turns in primary and secondary, and the rate of change of current in the primary. If the potential variations thus produced on the grid are excessive or insufficient, poor modulation will result.

Fig. 13 shows another method of controlling an oscillating tube circuit at audio frequencies. This is known as the

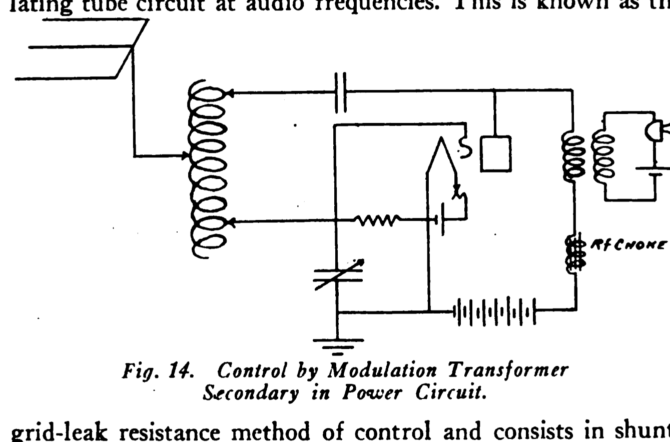


Fig. 14. Control by Modulation Transformer Secondary in Power Circuit.

grid-leak resistance method of control and consists in shunting the grid leak resistances of the oscillator tubes with the variable resistance path between plate and filament of a separate three electrode valve. The manner of controlling this latter valve is the same as that previously explained. This is a very simple method, but care must be taken in selecting the grid leak resistance values for the oscillators. By connecting several oscillators in parrallel and using grid condensors and grid-leaks, one small tube may be made to control the combined output of several power oscillators. The dotted lines in Fig. 13 illustrate the method of connecting the several oscillator tubes.

In Fig. 14, control is accomplished by inserting the secondary of the modulation transformer directly in the power supply circuit. Using a simple receiving tube as an oscillator the author has obtained remarkable results with this system. It is not well adapted to the control of large power tubes, however.

Alternating Current C-W Circuits

Of late, vacuum tube transmitters designed primarily for telegraphic purposes have been utilizing the easily obtained high potential alternating currents for the necessary power supply. This is because high voltage direct current generators require considerable care and attention and are expensive.

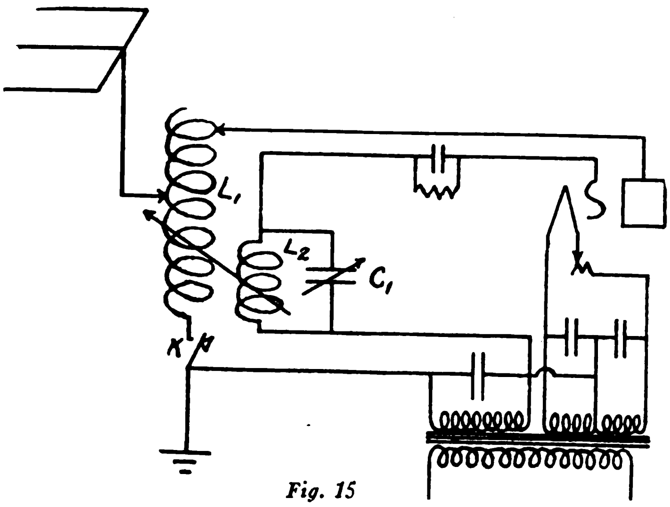


Fig. 15

One of a number of circuits employing alternating current for both plate and filament supply is shown in Fig. 15. Here a single transfomer having two secondaries is used. The mid-point of the filament winding is tapped to eliminate the "hum" which would be caused by connecting the grid to one end of the winding. The transformer secondaries are bridged as illustrated in the diagram by small condensers designed to withstand the impressed electromotive forces. The correct values of these capacities will be found to be approximately .002 micro-farad in the case of the one bridging the plate supply secondary and almost any value greater than that in the case of the others. Care must be exercised in using capacities across a supply of high potential alternating current, as a power circuit involving high currents is liable to result. These currents while termed "wattless," result in large copper losses in the windings. The circuit of Fig. 15 illustrates the method referred to earlier in this chapter, of obtaining the required grid input by a variable coupling device having a fixed amount of wire in the circuit at all times. L_2 is the input inductance and is coupled to L_1 by either the sliding tube or variometer method. It is bridged with a capacity C_1 to facilitate adjustment. The conventional capacity grid leak resistance method of maintaining a negative grid potential is used. This circuit may be termed an ideal one in so far as simplicity is concerned. It oscillates easily, and is very efficient, but it possesses the disadvantage of utilizing only one-half of the alternating current cycle. During the part of the cycle when the plate is negative no oscillations are produced. This circuit will be considered in detail later.

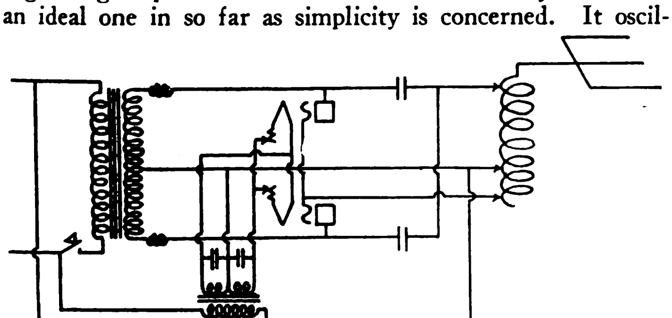


Fig. 16

A circuit utilizing both sides of the cycle is illustrated in Fig. 16. This is a simple Hartley circuit using two tubes. The inductances L_2 and L_3 are radio frequency chokes placed in the circuit to prevent absorption of the high frequency oscillations in the distributed capacity and resistance of the transformer T. Their use is imperative in this circuit. The capacities C_1 and C_2 should be quite large, preferably in excess of .005 micro-farad each. Without these, the transformer secondaries supplying the high voltage to the plates

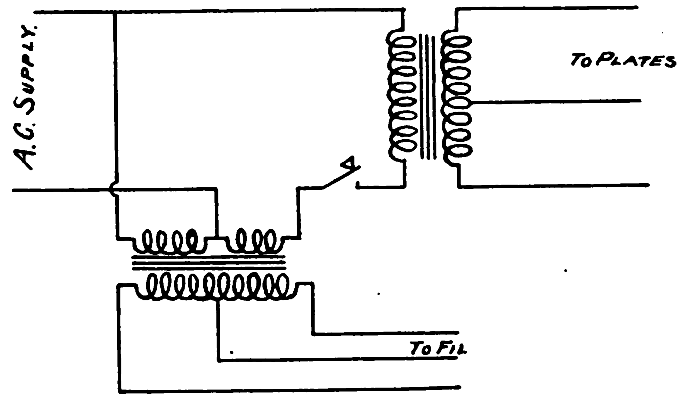


Fig. 17

would be short circuited by the inductance L_1. The use of these is also imperative in this circuit. With a transmitting circuit of this kind using two 50 watt tubes, the author has obtained an overall efficiency of 45 per cent.

If the key is placed in the circuit at B, the life of the filaments is impaired considerably by the continuous shock to which they are subjected in transmitting. See Fig. 17 for method of lessening this shock, where it is proposed to have the filaments heated at all times, but only at their operating temperature when the key is pressed. This should meet with great favor among experimenters whose supply of tubes is limited. Since the core of the filament transformer is active at all times, the high voltage transformer must be a separate one. The filament transformer has two primary coils, one of which is connected across the alternating current supply and provides a sufficient potential difference in the secondary to heat the filaments of the tubes, the other being paralleled

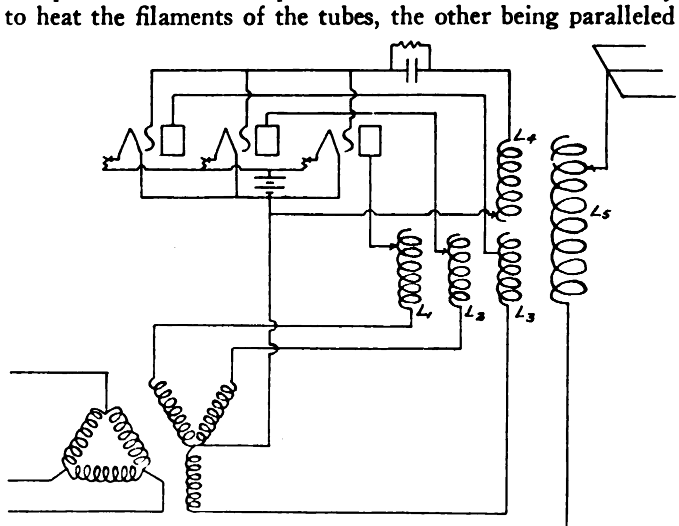


Fig. 18

with the former through the primary of the high voltage transformer when the key is held down. The currents in the two filament transformer primaries are not exactly in phase owing to the difference in impedances of the two windings, but this should cause no trouble, since the capacity of this transformer is quite low and magnitude of these currents is small.

Polyphase C-W circuits have made their *debut* into the curriculum of the experimenter of late and up to the present time, have given every indication of remaining. By the use of multiphase currents many things are gained—the low frequency note is eliminated and greater output may be obtained with less straining of the tubes. See Fig. 18 for a circuit employing three phase alternating current. In this circuit only one side of each cycle of each phase is used and instead of a disadvantage as in the case of single phase supply, this feature presents a decided advantage as the tubes are idle during a portion of the time and consequently have an opportunity to dissipate the heat generated. In the single phase circuit this idleness resulted in a low frequency hum which was objectionable, particularly when attempting to control the output telephonically. In Fig. 18, the so-called series power feed circuit is employed, which eliminates the use of radio frequency choke coils. The three inductances L_1, L_2 and L_3 are in the plate circuits of their respective tubes only and as a result only a unindirectionally pulsating current flows. This rising and falling unindirectional current induces in the inductance L_5 the radio frequency current used as the carrier wave. L_4 is coupled inductively to L_5 to obtain the necessary grid input. Separate grid condensers and grid leaks should be used for best results, although one grid leak and grid condenser will be found quite satisfactory. Overall efficiencies of 50 per cent may be obtained with such a circuit as the one outlined above, and, as will be found below, a three phase alternating current may be employed to supply the necessary plate potential for tubes controlled telephonically.

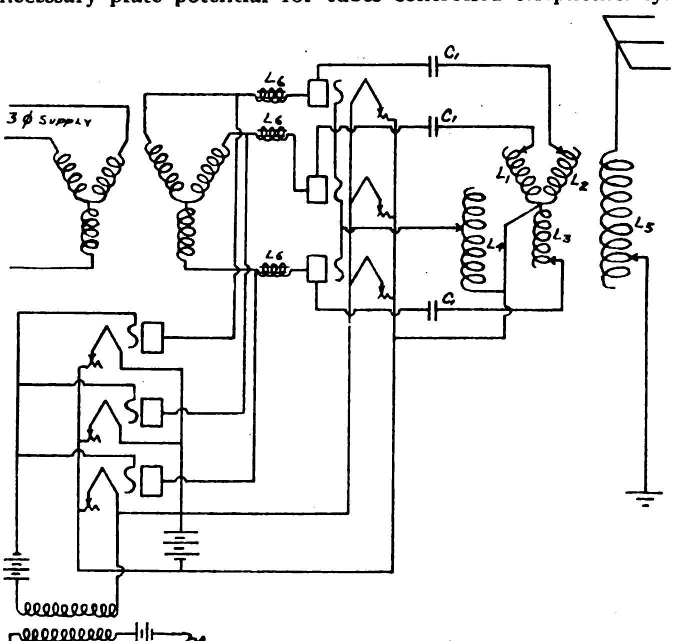


Fig. 19

Fig. 19 represents such a phone set and one which has actually demonstrated the utmost practicability. Three tubes connected as shown are used as oscillators, and Heising's system of modulation is employed to control these tubes. The inductances L_1, L_2, L_3, L_4 and L_5 are coupled together. No particular difficulty presents itself in accomplishing this, for five pancake ribbon inductances of the type used in the Navy standard field equipment were used without alteration in the original experimental set used by the author and excellent results were obtained. The capacities C_1 are all in excess of .01 micro-farad and are used to prevent the transformer secondaries from becoming short-circuited through the inductances L_1, L_2 and L_3. A radio frequency choke coil L_6 is placed in each transformer secondary lead for reasons previously explained. It will be observed that the series power feed circuit is not employed here as in Fig. 18. The overall efficiency of a circuit of this kind will compare favorably with one of equivalent output employing direct current, and in using the ordinary 3 phase 60 cycle supply, the audible ripple in the carrier wave is hardly appreciable during conversation.

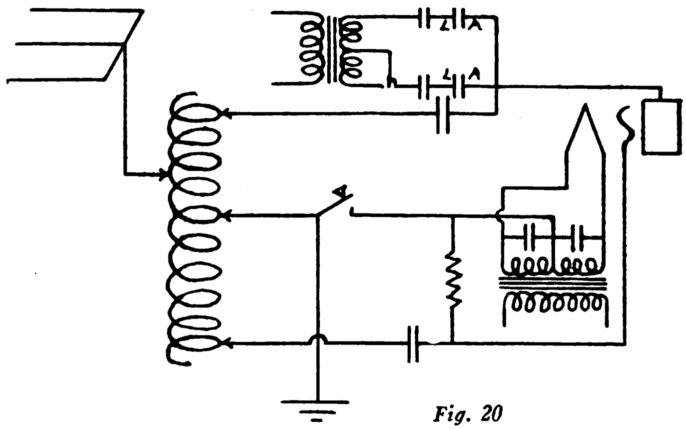


Fig. 20

The circuits that have just been considered, use unrectified alternating current on the plates of the tubes and if anything less than three phase supply is used for this purpose, difficulty will be experienced in adapting the circuit to voice modulation since a low frequency ripple will be present in the received signal. If it is desired to utilize the easily obtained high voltage single phase alternating currents for the plate supply of phone equipment, the experimenter will do well in rectifying the same in a manner suggested in Fig. 20, or by one of the various other means outlined in detail in a latter chapter. In Fig. 20 an electrolytic rectifier is used. This method, while simple, and probably the most inexpensive from the experimenter's point of view, requires more or less constant attention and is objectionable for that reason.

The Power Amplifier

Probably the most interesting improvement in vacuum tube circuits that has come out in recent years is the use of the power amplifier in radio phone circuits. Little use, however, has been made of this adjunct by the average experimenter. By way of definition to the uninitiated, the power amplifier is a device used to reproduce in greater magnitude currents having a pulsating or alternating nature. The ordinary power modulator scheme of controlling an oscillating vacuum tube circuit, (Fig. 19) is limited by the ability of the microphone through the medium of the modulation transformer to control the modulator tubes, which must, for the best results, be equal in number and power to the oscillators. This limitation results from the fact that it is very difficult to design a voice amplifier of high power that will operate without distortion.

Fig. 21 illustrates the use of the power amplifier in connection with a radio-phone set of low power represented by T. A and G are respectively the antenna and earth connections of such a set. The capacity C_1 which should be var-

Continued on page 56

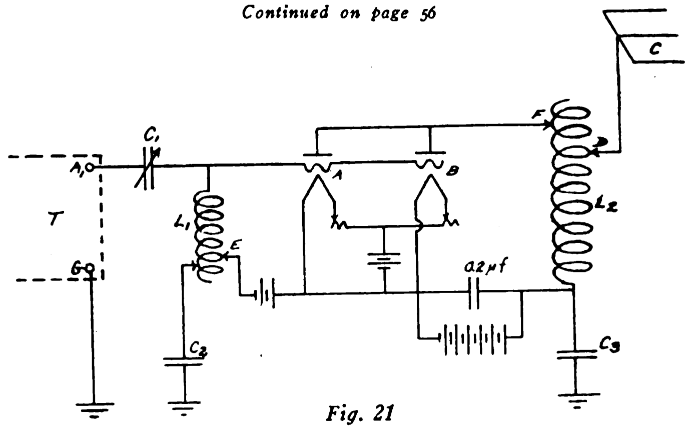


Fig. 21

Successful Experiments with Earth Antennae

A Comparison of Ground Versus Aerial Transmission and Reception

By Edward M. Sargent

SOME interesting experiments with ground antennæ performed at the refinery of the Continental Mexican Petroleum Company at Tampico, Mexico, by the writer, aided by Mr. J. T. Schilling, developed a number of new facts concerning radio reception. The site was an ideal one for radio work, the refinery being located on the south bank of the Panuco river, on the edge of a large, level stretch of filled-in land. The river water is salty at this point, and as the land level is not over two feet above the water level, an excellent ground connection was obtained by driving a 2 ft. pipe into the soil. The soil is damp 2 in. below the surface, and is soggy a foot below.

The Continental Mexican Petroleum Co. had some DeForest radiophones to be installed at different points in this vicinity, and as trouble was anticipated through interference with the local Mexican station, which was across the river and less than two miles away, the ground antenna was turned to as a possible solution of the difficulty.

The first experiments were to determine whether good transmission into the ground could be accomplished. Accordingly, a ground antenna was constructed as follows: Two 3 ft. galvanized iron pipes were driven into the ground 65 ft. apart, on a line bearing N 41 degrees E. These two pipes were connected on the surface by a No. 12 weather-proof copper wire, and a radio frequency inductance of about 40 microhenries was connected in series with the wire at a point near where it joined to one of the pipes. The coil was inductively coupled to the helix of a DeForest buzzer phone which was used as a transmitter to supply continuous wave power.

The receiving antenna was laid out in exactly the same way and was placed parallel to the transmitting antenna at a perpendicular distance of 1000 ft. from it. In place of the 40 microhenry coil, a DL-50 honeycomb and a variable condenser were connected in series with this wire. It will be noted that, contrary to the usual custom, both ends of the "antenna" were grounded in each case. The DL-50 was used as the primary in a DeForest RS-500 receiving set, and no difficulty was experienced in picking up the CW from the transmitter, using a wavelength of 400 meters and a one bulb receiver. When the far end of the receiving wire was disconnected from the ground signals became weaker. The receiving wire was then swung around 90 degrees so that it pointed N 49 degrees W and the end again grounded. Signals were stronger than with either connection when the wires were parallel. Next both wires were lengthened to 125 ft., and the ends were again grounded. A marked increase in the signal strength resulted.

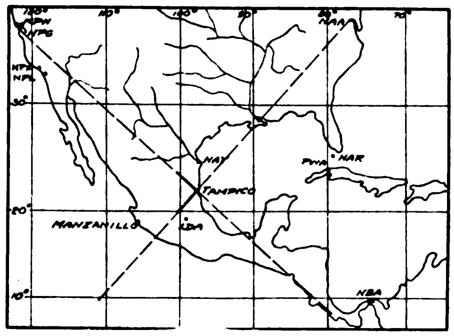


Fig. 1

The receiving wire was now 125 ft. long and bearing N 49 degrees W (pointing directly at San Francisco). When tried as a receiving antenna for radio telegraph waves, it was found that 600 meter signals from the local government station, from ships in the river, and from NAY (Pt. Isabelle, Tex.), 300 miles north of Tampico, could be received easily. NAY could not be heard unless both ends of the wire were grounded. At night, NPL's 9800 meter arc was heard, but altho the higher waves were searched very carefully, no east coast arcs could be picked up. This led to the belief that the antenna might be directional, so another of similar dimensions was laid out, along a line passing through Tampico and Washington, D. C., bearing S 41 degrees W from the receiving set. On this wire WII, WGG and WSL were picked up easily, but NPL could not be heard on a detector and was just barely audible using a one step amplifier. There was very little static on either wire. No overhead antenna had been put up at that time, so there was no chance for comparison in that respect.

On the night of April 23rd, NPG, NPX, and NPL were heard working on spark on about 2000 meters. These stations were received on the NW wire and a one step amplifier receiver. On 600 meters, NPX and KPH besides one or two boats near San Francisco could be picked up by close tuning. The Admiral Farragut and another boat off Manzanillo, Mexico, were also heard. When the far end of the receiving wire was insulated, none of these stations could be heard. On the SW wire, NAA, NAR, PWA (Havana, Cuba), and XDA (Mexico City) were all easily received.

By referring to Fig. 1, it will be noticed that the bearing of some of these stations such as PWA, NAR, NAY, XDA, and the boats off Manzanillo and Lower California varied considerably from the direction in which the wire pointed. NAY and PWA differed by nearly 45 degrees from the wire directions and could be read equally well on either. It was only when the station bearing was nearly perpendicular to the wire bearing that the signals could be entirely eliminated.

The surprising thing in all of these experiments had been the strength of the signals, and the distances from which they had been received, some of these such as KPH and NPG comparing very favorably with what could be done on an overhead antenna. Ordinarily it would seem that a wire lying along the ground and connected to ground at both ends should be nearly free from radio signals. The natural conclusion at first was that the whole system must be acting like a loop antenna with the ground forming the return side of the loop. Accordingly, a loop was constructed, the dimensions of which were equal to those of the ground wire. The loop ran parallel to the SW wire, was 125 ft. long and consisted of one turn of No. 12 weather-proof copper wire. The top wire was 3 ft. above ground and the bottom return wire one foot below the top one.

This loop was tried out against the SW ground wire, and the ground wire was found to be markedly the better. Neither NAA spark nor any of the east coast arcs could be heard on the loop, while all were easily read on the wire. This seemed to indicate that some other explanation of the action of the ground wire must be looked for.

Instead of using the ground connection under the receiving set, the two ground wires were now connected in series through the primary coil and variable condenser as in Fig. 2. Signals from NAY and XDA increased in strength noticeably, while the others were not greatly affected.

By referring again to Fig. 2, it will be readily seen that as the maximum distance between the wires (at the ends) is much less than half a wavelength, the currents induced in the two receiving wires from either NAY or XDA would be such that they would tend to neutralize each other, and the signal should be weaker using the combination than using either wire alone. Apparently then, the signals were being picked up through the ground rather than by the wires, and the best receiving direction would be determined by the direction of a line joining the two ground pipes and not by the direction in which the wires were lying on the surface. In the case just cited, a line through the two ground pipes would run almost through NAY and would be nearer in the direction of XDA than either wire used alone.

Next, a wire 125 ft. long was laid parallel to the SW ground wire and was carefully shielded over its full length by running it through a ½ in. galvanized iron pipe. The pipe was laid along the ground and connected to a good ground at the center. The end of the shielded wire was grounded. Signals on this wire, although audible, were much weaker than on the other, and NAA could not be heard at all. However, one important point had been overlooked, namely the hysteresis losses in the iron pipe, so the experiment had to be repeated.

This time a twisted pair of No. 16 rubber-covered wires, shielded by lead conduit, was used, the wires being connected in parallel. An "antenna" of the same dimensions as the other was laid out, the conduit resting on the top of the ground, which was dry. The shield was grounded at the center. On daylight signals from WGG there now was absolutely no difference between the shielded and unshielded wires. That night, however, it rained, and as soon as the top of the ground was thoroughly wet, the signals almost completely died out in the shielded wire. When the shield was lifted clear by laying boards under it, the signals returned again to their normal strength. Grounding and ungrounding the shield at the center made a slight change in tuning adjustments, but no change in signal strength. Static, what little there was, was equal on both shielded and unshielded wires. When the wire inside the shield was ungrounded at the far end and the center of the outside shield was grounded, signals disappeared entirely.

This experiment seemed to prove conclusively that the wires themselves had nothing to do with picking up the signals, but acted merely as conductors between the two ground pipes. The fact that the shield cannot be laid on wet ground while the unshielded wire can, or can even be buried, is possibly explained by the fact that in the former case the capacity between the wire and the ground is abnormally great and hence results in a considerable decrease in the effective length of the wire. This would make it compare unfavorably with the other. The shielded wire proved to have no advantages over the unshielded and was not used.

Unfortunately, the detector tube which had been used in these experiments burned out the next day. No other tube could be found that was as good, so accurate comparisons of signal strength between the first and the later experiments cannot be made. Atmospheric conditions were rapidly getting worse, long distance signals fading out, and static getting heavier with the approach of summer.

Next, both the NW and SW wires were increased in length to 250 ft. Signals from NPL, NBA, and the east coast arcs increased in strength, although not proportionally to the increase in wire length. NAA spark seemed weaker, but no conclusions can be drawn from that as he faded completely out two days later (May 14th), and was not heard again until the latter part of July.

On these 250 ft. wires, it was found impossible to tune to 600 meters with a

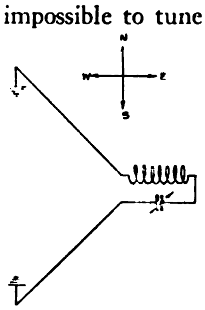


Fig. 2

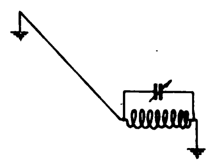


Fig. 3

primary series condenser. A "resonance click" could be found on any wave up to 475 meters, then there was a blank till 850 meters was reached, where a "resonance click" was again obtained. Above 850 meters, tuning was normal. Very few 600 meter stations could be heard, and those that could be were close by. When the primary condenser was shunted around the coil, as in Fig. 3, a "resonance click" could be found on waves between 500 and 800 meters despite the fact that the condenser was apparently short-circuited by a 5 ohm d. c. resistance (the ground resistance). This showed the presence of an abnormally high alternating current impedance in the wire at these wave lengths, and indicated that there would be a best wire length for each wavelength to be received. With a shielded wire 200 ft. long, no wavelength adjustment could be made on waves between 800 and 1300 meters. This appears to be the explanation of the fact that although on long waves there was no difference between signals on shielded and unshielded wires, on 2500 meters the unshielded wire was slightly better. The nearer the "resonance point" of the wire is to the received wavelength, the higher is the effective resistance to be overcome.

During the second and third weeks of May, the beginning of the static season, nearly all the static came in on the SW wire, the NW wire being almost clear. This showed the origin of the static to be either northeast or southwest of us, probably the latter. After May 25th, static was equally strong on both wires, but many times would be of a different character on each, so that no balancing out system could be used.

By the latter part of May, the overhead antenna was ready for use. This consisted of a grid of 4 wires, spaced 4 ft. apart, 85 ft. high, 175 ft. long, inverted "L". We now had a means of direct comparison of signals between antenna and ground wires. Signals on the overhead antenna were considerably louder than on the ground wires, but static proportionally was much heavier, and NPL and WGG could only be read with difficulty. After the middle of June, no one but XDA could be read on account of static, and the use of the antenna was discontinued. At the same time, while the static on the ground wires was troublesome at times, it never was strong enough to seriously interfere with reception from the United States arc stations and from NBA. The presence of the overhead antenna did not greatly affect the signal strength on the ground wires. When the antenna was ungrounded, the signals on the wires were slightly stronger, but this may have been due to direct induction into the receiving set, as no attempt was made to shield it.

The "daylight effect" on reception with ground wires was different from the effect on antenna reception. On short waves, signals were weaker in daytime on both, although not weakened so much on the ground wires as on the antenna. As the wavelength increased, the daylight effect was less noticeable on the ground wires and when the wavelength of 10,000 meters was reached there was a reversal, and signals were stronger at midday from NPL, NPM, NZR and NBA than they were at midnight. On higher waves this effect increased, and the United States transatlantic arcs were all stronger in daylight than at night. On the Annapolis' wave of 16900 meters this effect was so marked that at ten o'clock in the morning signals from that station could be copied on the typewriter, while at ten o'clock at night it was hard to read them. It is possible that these stations increased their power for daylight work. The writer has no information on this, but does not remember any case in which they have had an excess of power at night, so this does not seem likely.

The primary tuning of a ground antenna, grounded at both ends, is materially different from that with any other form of antenna with the possible exception of the loop. With all ordinary forms of antenna, there is a certain maximum wavelength that can be tuned to with a given inductance, when a series condenser is used. This wavelength is limited by the capacity of the antenna.

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The Click Method of Determining Resonance

By G. W. Cattell, Radio Engineer

ALTHOUGH there are several methods of determining when two circuits are in resonance, the "click" method is one of the simplest and most useful. It is particularly useful when continuous waves of small magnitude are being used. It may be considered under two heads, audible and visual.

The "audible click" method utilizes a source of continuous oscillations, such as an oscillating audion, and a pair of telephone receivers. The receivers are used to detect the resonance point and may be connected in either the plate circuit or grid leak circuit of the oscillator (See Fig. 1). Either connection will give

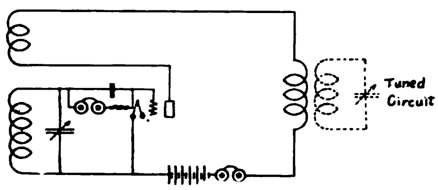

Fig. 1

practically the same sensitivity and reliability.

The circuit to be compared, hereafter referred to as the tuned circuit and shown dotted, may be inductively coupled to the plate circuit of the oscillator. The inductance or capacity of one of the circuits is varied until they are in resonance. When the resonance point is reached, or passed, a click will be heard in the telephone receivers.

Sometimes there are two points where clicks are heard. The true resonance

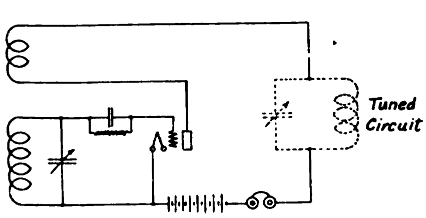

Fig. 2

point is between the two. The existence of two click points is an indication that the coupling is too tight and should be loosened.

Sometimes it is not possible to get sufficient coupling to produce a click by inductively coupling the two circuits. Such a condition may arise if the inductance is very small or the construction of the coil such that the external field is very weak. In thise case, the circuit may be connected directly in the plate circuit as shown in Fig. 2. The resonance point is indicated by a click in the receivers as described before.

The tuned circuit may also be coupled to the grid circuit as shown in Fig. 3.

Another variation is to have the detecting means in the tuned circuit as shown in Fig. 4. Under certain conditions this connection may be found very useful.

The "visual click" method is a variation of the one which has just been described. It is essentially the substitution of a sensitive direct current ammeter for the telephone receivers. (See Fig. 6.) The procedure is the same as when the

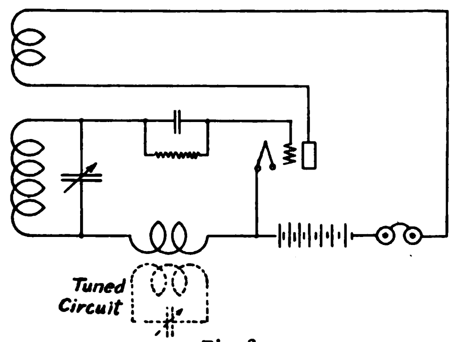

Fig. 3

receivers are used, except that the resonance point is now detected by the deflection of the meter. As resonance is approached there is a more or less sharp change in plate (or grid) current, the maximum change occurring when the two circuits are exactly in resonance.

The theory of operation of the "click" method is interesting and is given below in brief.

Inserting or coupling the tuned circuit to the oscillator is equivalent to introducing a parallel resonant circuit. As is well known, a parallel resonant circuit offers very high impedance to currents of the frequency to which it is tuned. The high impedance thus introduced tends to stop, or at least reduce the magnitude of the oscillations. If the oscillator is properly adjusted for this purpose, a change in the amplitude of the oscillations will cause a change in the magnitude of the plate and grid leak currents.

The adjustment of the oscillator has much to do with the sensitivity of the

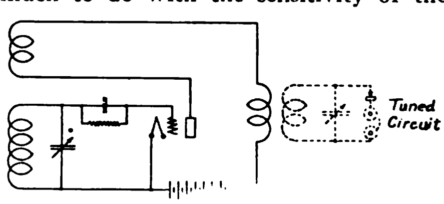

Fig. 4

circuit. By adjusting the tickler coupling, filament current, grid or bridging condenser, a critical setting may be found where the introduction of a given impedance will cause a relatively large change in the amplitude of the oscillations.

Other things being equal, the sensitivity of the method is greater if the resistance of the oscillatory circuit is kept low. Similarly, the impedance of the tuned circuit will be greater if its resistance is kept low.

If the tube is operating near the lower end of the characteristic curve, the plate current will decrease at resonance. On the other hand, if the tube is oscillating near the upper end of the characteristic, the plate current will increase at resonance. This may be seen more clearly by a study of Figs. 5a and 5b.

If the indicating meter is in the grid leak circuit, resonance is indicated by a decrease in meter deflection. This is because the grid leak current is proportional to the amplitude of the oscillations.

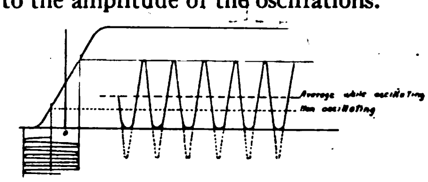

Fig. 5a

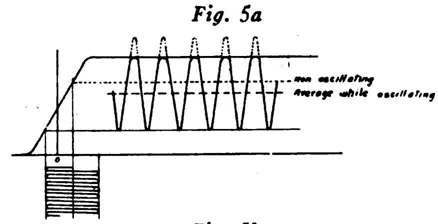

Fig. 5b

Either the visual or audible click method may be used, but the visual click method has certain advantages: (1) It is independent of the amount of noise in the room; (2) it depends upon the eye instead of the ear; and (3) in some cases the rate of change of amplitude of oscil-

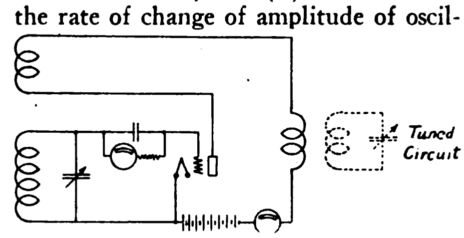

Fig. 6

lations as resonance is approached, is too slow to produce click in the receivers. (This is likely to happen when either of the circuits is high.) It is comparatively easy, however, to observe when the meter deflection is a maximum or a minimum.

The click method (audible or visual) is often used for calibration purposes or for measuring the wavelengths of a received signal.

Fig. 7 shows a scheme of connections for use in calibration work. In order to calibrate a wavemeter for example, place the wavemeter condenser at the setting desired and adjust the oscillator until resonance occurs. Then without changing the oscillator, adjust the standard

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AMATEUR RADIO LABORATORY MEASUREMENTS (Continued)

By D. B. McGOWN

We will now take our 50 turn coil, and set it up as a wavemeter. Fig. 1 shows a complete system set up for wavemeter, or condenser calibration. As we have not, as yet, arranged our instruments so we can measure wavelengths, we must first proceed to make up a condenser with a calibration curve, so as to obtain the wavelength from a few simple calculations. In Fig. 1 we have an inductance,

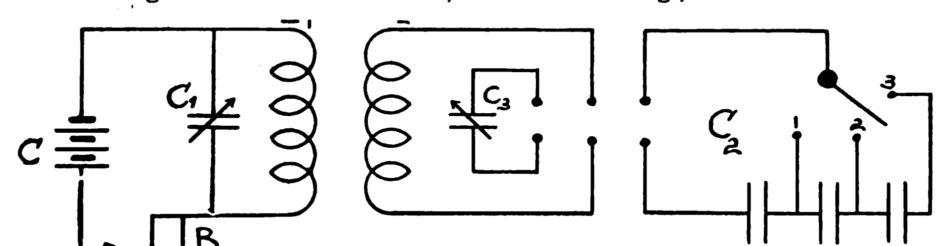


Fig. 1. System Set Up for Calibration

I_1 shunted by condenser C_1, with a buzzer and battery connected in such a way that feeble radio frequency signals are set up. L_2 is the receiving coil, and is so arranged, by means of a double pole, double throw switch, that either C_2, which is our known condenser, or C_3, which is the condenser to be calibrated, may be shunted across it. L_2 is the 50 turn coil we have just made up, or a 50 turn honeycomb, and L_1 is a similar coil.

Now to indicate the resonance point between the two circuits we use the telephones and crystal detector, which is shown connected "unilaterally." When the buzzer B is started, it will send out feeble oscillations, which, if in tune, will be audible in the telephones, due to the current induced in L_2. Now, C_1 is variable, so that with the DPDT switch thrown to the right, we may set the condenser switch, of condenser C_2, on point 1, and adjust C_1, until we get the loudest signal in the headset. Now, if the switch is thrown over onto condenser C_3, and it is adjusted to resonance, we will have found one point on the capacity scale of C_3, which is to be calibrated. This, as was stated last month, was .0003 mfd. Now, put the switch on point 2, and repeat the process. We then will have the scale value for the point of .00015 mfd, and for the third point, we will have the capacity for .0001 mfd.

This is about as low as it will be convenient to read the average condenser, and as we will in general be concerned with higher readings, we will put a "fan" blade on the switch C_2, and reconnect this portion of the circuit, as shown in Fig. 2, which will give us a method of connecting the plates in parallel.

Starting with two plates in parallel, we will get a capacity of .0006 mfd, which can be noted as before. With a higher capacity than this, it is very difficult, indeed, to measure wavelength using such small coils, as we first started with. So that the readings may not be "all over the scale" with this capacity, we must substitute large coils, say of about 250 turns capacity — again the use of honeycombs or similar type is suggested— and it will be found advisable to borrow these, if they are not available for use. With the larger coils, installed, we will proceed to measure the capacity of C_3, up, either to its limit, which, if it be an .001 condenser should not be above .009 for accurate readings, or .0018 for a .002.

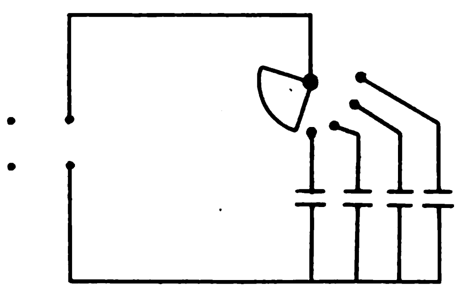


Fig. 2

Now a series of readings will be found, which will look something like the following:

Condenser scale.	Capacity in mfds.
8.0	0.0001
22.0	0.00015
40.0	0.0003
100.0	0.0006
160.0	0.0009

A curve can be plotted on ordinary cross-section paper, and the intermediate points read, so that the exact capacity on every point of the condenser scale can be read, provided it is within the limits of measurement, and the curve can even be "extended" a few degrees, with reasonable accuracy, if it is necessary to get a reading that is a short amount over the maximum, as the curve can be simply extended in such a manner as to be uniform with the general slope, and direction of the true, or original curve.

It is a good plan, while set up, to calibrate all the condensers available, as they may, and probably will come in handy at some future time, and it is always a very desirable thing to have condensers that are dependable, before starting to work. Care should be taken in selecting a condenser for calibration, to get one that is mechanically in the best of condition. One that is the least bit "wobbly" is absolutely useless, as it is impossible to get two consecutive readings that are absolutely the same. If the condenser has a poorly attached scale, or knob, it also had better not be used for any kind of calibration, or standardization work; one that has the knob, or pointer fastened with a simple set screw is very liable to give trouble, unless care is taken to never disturb the adjustment of the screw. A bent, broken, or flimsy pointer should also be avoided, whenever possible, and a good strong solidly made condenser is the only one that should be used for our standard.

We will now have no further use for the original standard condenser of glass plates, as we have transferred its capacity measurement to the variable one, and it is now in a much more easily handled form.

STATIC STATISTICS

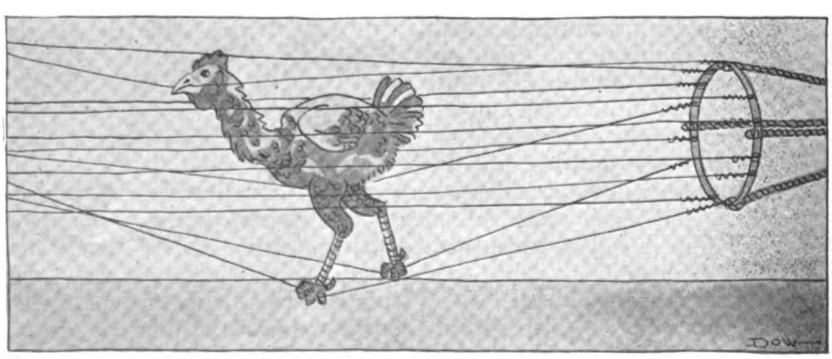
By SQUAWK McGUFF

HAM: "Understand that Mr. Mott has worked 8KW."

OLDER HAM: "Gosh, how the dickens does he get that way. I thought amateurs were limited to *one* KW. How does he get away with it? I'll bet the R. I. don't know it."

There lived a radio fanatic
Who had a crystal set in an attic.
He thought he heard POZ,
And was dancing with glee,
When another ham told him 'twas
static.

Sparks may come and sparks may go, but C. W. is continuous. H. Smith.



"Darn These Cage Aerials, Anyway!"

Modern Commercial Radio Apparatus

I. Elementary Principles of Operation

By D. B. McGown, Assistant Radio Inspector

BEFORE describing the details of the various types and kinds of radio transmitting and receiving apparatus now in use by commercial radio telegraph companies at both their marine and shore stations, it is desirable to review the underlying principles on which this operation depends. Without some basic knowledge of the "works" it is almost impossible to convey an accurate idea of what is happening in, or to, the various apparata.

Radio apparatus may be considered under the two general classes of damped wave and of undamped wave equipment. These two classes are naturally divided into as many groups as there are indi-

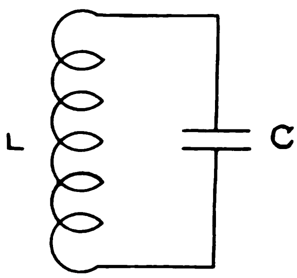


Fig. 1. Oscillatory Circuit

vidual manufacturers. But we can boil the actual theory of the apparatus down to a very few points.

All transmitters have some means of producing oscillations or radio waves. The so-called ether is necessary for the transmission of these waves. Some means must be provided for receiving or catching these same waves at a distant point. No matter what the type of apparatus, it must do these things, or we would not have a complete radio system. The waves, or trains of waves may be interrupted at certain periods, as they are in a radio telegraph transmitter, or they may simply be varied in their power, or amplitude, as is the case with a radio telephone transmitter and a few special cases of telegraph sets.

These oscillations are produced by an oscillatory circuit consisting of an inductance and a condenser connected in shunt, as shown in Fig. 1. If a charge from some external source be impressed on the condenser, C, a discharge will take place thru the inductance L. The frequency, or rapidity of this discharge, depends on the values of C and L, the resistance being neglected for simplicity's sake.

First assume that the plates of the condenser C are quite close together, and that the inductance L is made up of wire closely wound on a form. Such a circuit will be a very poor radiator of electrical oscillations.

Now suppose that we retain the inductance L, and use a condenser in the form of an antenna and ground, as shown in Fig. 2, the antenna A forming one plate of the condenser, and the ground G forming the other. If some means are used to charge the antenna, it will be found that electrical oscillations are set up in this circuit just as they were in the previous case, but with one difference. When connected to an antenna and ground of proper characteristics it will be found that energy is radiated into the space surrounding the antenna as electromagnetic waves, whose length and amplitude depend on the particular values of L and C, as well as the resistance of the circuit. These electromagnetic waves travel thru space until they reach the receiving or detecting device, and there they are caught, and their effect recorded.

The object of all radio transmitters is simply to set up oscillations in the antenna system, similar to that shown in Fig. 2, and for these oscillations to cause electromagnetic waves, which may be received at a distant station. Various means of accomplishing this are used, as will be described later.

Suppose that the antenna system exists, as shown in Fig. 2, but that instead of

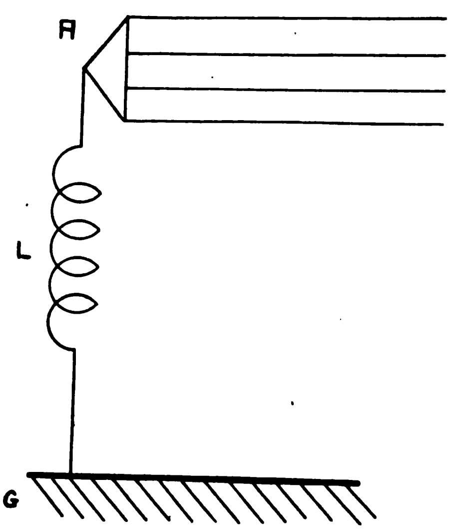


Fig. 2

the antenna's radiating energy, electromagnetic waves are impressed on it from some outside source, such as a distant transmitting station. If these impressed waves are of the same frequency as that possessed by the antenna and ground system, this system will oscillate. This oscillation, being of an electrical nature, will not be visible or intelligible to a human being, without some indicating device. There are countless devices which might be used. An ammeter might be inserted in the circuit between the inductance L and the ground G. If the antenna was oscillating strongly enough, the ammeter would move every time the antenna was charged and discharged. This would not be very sensitive, however, and usually much more delicate apparatus is used for this purpose. These devices are known as receivers, and they, like the transmitters, will be completely and thoroughly described and explained as we proceed.

Fig. 3 is obtained by adding to Fig. 2 another circuit similar to that in Fig. 1. Here we have two circuits, both cap-

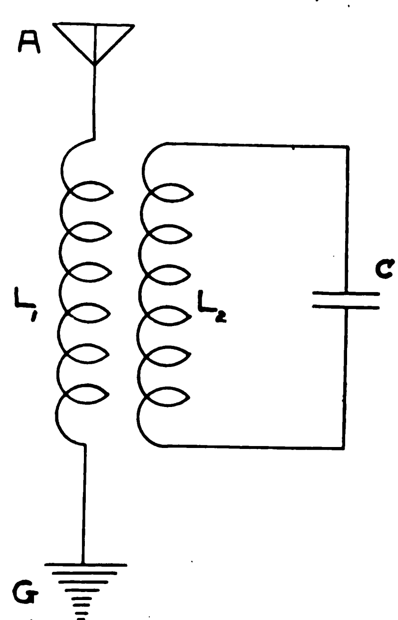


Fig. 3

able of oscillating at their own periods, or frequencies. Due to the proximity of the two inductances, L_1 and L_2 the electromagnetic lines of force which are set up around one, when a current flows thru it, induces a current in the other. If these two circuits are so adjusted that they will both have the same period of oscillation, any oscillation which takes place in one will take place in the other. Or to put it in other language, if the two coupled circuits AL_1G and L_2C are in resonance, energy will be transferred from one circuit to the other when oscillations take place. This action is made use of in all radio apparatus, either transmitting, or receiving, in ways which are modified to meet the requirements of the particular kind of action desired in the

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Hodeycobe Micraferris Brown

A Weird Tale of Wireless Rejuvenation and Escape from Cannibals

By Clyde C. Young

SOMEWHERE in the Pacific rise the peaks of Zoogoo Isle, where the cannibals ply their trade. But activities on Zoogoo were dormant. The rib-steak hunters had existed on berries and dogs for many days. It remained for the good ship Rosie to break the fast when she encountered a typhoon, slid over several coral bars and rested on the bottom some 200 yards off Zoogoo. All that was left as a reminder that the Rosie had been a ship was her cabin aft, which rose clear of the water, and a mass of tangled copper that had once been a beautiful antenna.

"Where the cannibals ply their trade."

UNGUS, chief of the Tahooties, was on hand to "welcome" those who might be fortunate enough to reach the shore line. Among the few survivors were First Wireless Operator Hodeycobe Micraferris Brown and two of his race. They were escorted to a small, dirty-looking hut. The attitude of the savages was quite unfriendly and businesslike when they ventured too near the opening in the hut.

Chief Ungus had a hobby—the search for youth. The chief had passed his sixty-fifth year, but had never given up hope that he might at some time discover the fountain of youth. He had noticed the three black boy survivors and thought that they were probably men of his own race who had made great advances in the world, or perhaps were the spirits of the dead returning. Nevertheless, he was a shrewd person, this ruler of the Zoogoos. He would hold counsel with them and if they did not come up to expectations—well, the way of the transgressor is hard.

Thus Hodeycobe found himself summoned to appear before the mighty Monarch of the Malay. Among the Zoogoos the one person who spoke English was Tatooin, a grandson of the great chief, who had at one time been rescued by a trader, after the wreck of his catamaran in a monsoon which carried him far to sea. He had worked his way to Liverpool, and consequently had picked up snatches of English. Tatooin, therefore, was brought into play as interpreter.

"The chief says to tell you," he began, addressing Hodeycobe, "that he wishes you to take forty years from his age. That if you fail to make him at least that much younger within twenty days that you are to be offered up so we may feast upon you."

"Hodeycobe's intelligence did not extend far beyond his capacity as an operator, but being a disciple of the rolling bones he was a good bluffer. Hence he resorted to politeness and tact.

"Tell de chief ah am de boy whut can pufohm dat merickle. Ah am de boy whut learned Nero that tune on de fiddle when de built de bon fire in Rome. Ah was de man whut sent the fust wyaluss message dat Columbus arrived in America. But tell his royal highness ah must get to de Rosie and salvage de ap'ratus to turn de trick."

Tatooin was not exactly sure what Hodeycobe was saying, but grasped the gist of it and was told to tell Hodeycobe to proceed without delay.

The Rosie, he found, was resting on the bottom with the wireless cabin barely clear of the water. With the help of his two companions he salvaged the complete 2-K.W. auxiliary along with the receiver and a receiver of his own. Floating near the ship, they also found two ten gallon drums of gasoline, which they towed to shore for possible use in the auxiliary.

Two wet cells in the outfit that had been on charge until the Rosie met her fate, and were well up. Hodeycobe thought they would last possibly a month if he was careful with them. He also had enough wire for an elaborate antenna system.

The location was ideal. Their prison hut was near the top of the hill overlooking the ocean to the west. Two trees were conveniently near and served as masts. He had an antenna that was some 400 feet high and 180 feet long. This gave him a fundamental wave length of perhaps 500 meters.

This was exactly what he had been hoping for. He had been thinking that if he could get on the ship's wave of 600 meters and with the old gas auxiliary in action he might attract the attention of a ship or perhaps the navy, who no doubt had ships in those waters. But this island seemed to be out of the lane of travel as he had never sighted a ship from the hilltop while at work.

CHIEF UNGUS and his retinue made a tour of inspection on the third day. Hodeycobe had the receiver working in fine style. Signals were coming in. The chief was invited to put on the phones. He could hear a wireless telephone, but of course could not understand what was being said.

The prestige of Hodeycobe was enormously enhanced. The old chief regarded him in healthy awe. The guard was somewhat relaxed, but escape was impossible unless a ship should rescue them. To take a small boat and make for the open sea was a fate almost as bad as the one they now faced.

And so, with tribal feasts, hunts, fishing excursions and so on, the days wore slowly onward. Ten more days and he would be called upon to take forty years from sixty-five. He had no earthly idea how this was to be accomplished, but in the course of the confusion he might "stall" for time.

Deciding to have Hodeycobe experi-

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The Kickback

By Volney G. Mathison, *Author of the Samuel Jones Series*

ALAN STIRINGER, sitting slouchily on the sofa in Captain Viericks' cabin, deftly flicked the ash from the tip of the cigarette he held between two long nervous fingers.

"We've got to ditch that nosy kid of a second operator," he was informing the podgy, bull-dog visaged master of the steamer *"Bellaroba,"* who sat in a leather chair opposite him. "He's got onto our secret code."

Captain Viericks' blotchy face paled a little.

"How do you know?"

"Caught him with a copy of it when I happened to walk into the wireless room on his watch this afternoon," clipped off the tall, thin-faced first operator of the *"Bellaroba."* "He had it on the desk and was decoding that last message about the cocaine shipment——"

Viericks' coarse loose mouth had taken on an ugly twist.

"You and I are the only ones on the ship with copies of that code——"

"I know—keep your shirt on, Viericks. We've been working this game together long enough to know better than to have a row about a thing like this. I lost my code-sheet from my stateroom locker a week ago. The kid found it."

The stumpy master of the *"Bellaroba"* cursed.

"Then he knows we're running dope from Vancouver down to the ring in Frisco?"

"I can't say—I've taken the message out of the file, but I don't know how much he'd translated of it when I came in."

THE two men relapsed into a glum silence.

They were a strange pair, this thin, nervous wireless operator and this sawed-off, brutish-faced commander.

Alan Stiringer was a mystery to the Pacific Coast wireless men. He never associated with any of them and apparently had nothing in common with them beyond the fact that he was an operator. It was not until after the occurrence of the grim tragedy around which this tale is woven that it was learned that Stiringer was known to the police of an eastern city as a shady character possessed of a remarkable knowledge of electrical bank-vault alarm systems and the inventor of a marvelous microphonic instrument for opening combination locks. Perhaps a few close brushes with the law and a look-in through the gray stone portals of a penitentiary had led him to take up the safer pursuit of dope-running. He presumably observed that the berth of radio operator afforded opportunities for this business, for he went to a wireless-school long enough to pass for a license. Eventually, the partnership with Viericks, a bird of his own feather.

The antecedents of Captain Viericks have never been revealed. His captaincy of the *"Bellaroba,"* however, is not hard to account for. The parsimonious owning company is notoriously partial to hard-faced, sour-souled captains who can squeeze out the extreme maximum of service from their fleet of coastwise steamers with the least possible outlay of money for upkeep and wages.

CAPTAIN VIERICKS was the first to break the silence that had settled like a chilly gloom in his cabin.

"That message had enough in it to be a dead give-away," he growled, his beady eyes glinting beneath their bushy overhanging brows. "If he got all that, he knows everything."

Stiringer took a draw on his cigarette in silent assent.

"One thing is sure—we can't move any more of the stuff till we get him off the ship."

"But how are we going to get him off? If I fire him outright, and he takes this story to the federal people, we'll be in for a hot rake-over. You know as well as I do, we've already had rubber-heels prowling around the ship looking for dope—and the company is acting queer. They smell a rat."

"Then you would——"

The two rat-like eyes beneath Viericks' low receding forehead glittered still more beadily.

"Lose him overboard."

Stiringer leisurely blew a smoke-ring.

"Tommy put the message back in the file, but not before Stiringer opened the door."

"It'd be easy to get away with—safe?"

"Absolutely."

Stiringer sat relaxed, his cigarette hanging loosely between his thin cruel lips.

"I don't think it's necessary," he said, suddenly stiffening. Perhaps he had watched a hanging behind those gray stone walls where he had once sojourned. "I've got a better idea."

"What's that—go to jail?"

Stiringer winced.

"No. But what's the matter with doctoring up a second code-key that will give a new meaning to a message that has already been put through the first code. We'll leave this second code-sheet lying around where the kid'll run onto it; and then we'll have a faked-up mes-

Continued on page 40

Ease of C. W. Transformer Design

By A. H. Babcock

A YEAR or so ago, one of my sons came to me with a transformer core he had traded-in, and asked, "How can I tell how many turns to wind on this for a 110 volt circuit?"

Here was a practical question that demanded an answer in terms a school-boy could understand and apply to every-day use. The answer was found in such simple form that he wound that core, tried it in service, and then went around the neighborhood hunting up transformers to design—for an adequate fee—which his father did not share; another example of the manner in which a business man commercializes the technical knowledge of an engineer.

But here is where the engineer gets back at him, by publishing the information, so that any radio, or about-to-be radio, experimenter can do it himself.

Usually the problem presents itself in one of two forms:

(1) I have a transformer core; how many turns and of what size shall I wind on it;

(2) How much iron must I pile up, and how many turns must I put on it?

He who looks in books for the equations used in transformer design, finds this one:

$$E = \frac{4.44\,N\,B\,A\,T}{100{,}000{,}000},$$ from which he shies, as a rule, because it looks formidable. In fact, it is simple.

E = the volts of the circuit,
N = the cycles of the circuit,
B = the number of magnetic lines per square inch of the magnetic circuit.
A = the number of square inches of the magnetic circuit.
T = the number of turns.

The proper value for B usually is the sticking point, but it has been found by long experience that for small transformers, and for ordinary grades of sheet iron, such as are now being considered, we may safely use, B=75,000 for 25 cycle transformers, and 50,000 for 50 or 60 cycle transformers.

First we rewrite our equation in this form:

$$T = \frac{E \times 100{,}000{,}000}{4.44 \times N \times B \times A},$$ and since we know N and B, we may write:

$$T = \frac{100{,}000{,}000}{4.44 \times 60 \times 50{,}000} \times \frac{E}{A},$$ from which

$$T = 7.5 \times \frac{E}{A}.$$

That is, for a transformer to be used on a 60 cycle circuit, we can get the proper number of turns for the primary coil by multiplying the house-circuit volts by 7.5 and dividing this product by the number of square inches cross-section of the magnetic circuit. "EASY!"

On a 25 cycle circuit, the 7.5 becomes 12, and on a 50 cycle circuit it becomes 9; which makes that simple expression good for any power circuit likely to be used.

One example will illustrate:

Let us assume we have a core that we wish to use on a 115 volt, 60 cycle circuit for two tubes, each of which takes 1000 volts on the plate and 15 volts on the filament, to be used in a self-rectifying circuit on both half waves. The core measures $2\frac{1}{4} \times 4\frac{1}{2}$ inches; hence $T = \frac{7.5 \times 115}{2.25 \times 4.5} = 85$ (to the nearest turn), and the volts per turn $= \frac{115}{85} = 1.353$, *which is the same for all coils.*

Now the secondary coil must have two windings in series, each to give 1000 volts, and with a middle tap. Then the secondary turns will be $\frac{2000}{1.353} = 1478$ with a tap taken out at the 739th turn.

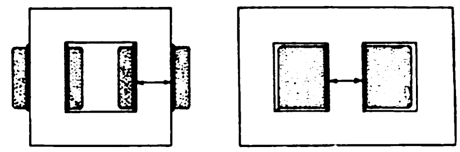
The filament coil must have two similar windings, each to give 15 volts and with a middle tap. Its turns then will be $\frac{30}{1.353} = 22$ with a tap taken out at the 11th turn.

For two 50 watt tubes, such as are assumed for this example, the primary current will be about 6 amperes. Allowing 1500 c. m. per ampere, the primary wire should be No. 10; and the filament winding may be the same size for a 6 ampere filament current when the filaments are in series. If they are connected in parallel, the wire should be No. 8 and the number of turns should be 11, with the middle tap at $5\frac{1}{2}$ turn (for ground connection). The size of wire on the plate coils may be No. 20 or No. 22.

One word of caution: Frequently in "Answers to Questions," transformer cores as small as 1 x 1 or even 1.5 x 2 inches are recommended. How thoughtless! Remember that the turns increase in the same ratio that the core area decreases; and that iron is cheaper than copper wire. Even more important is the labor of winding. For example, suppose the core of the transformer taken for the illustration above had been half as large; then the primary turns would have to be 170, and the secondary 2956. Think of the labor to put all those turns on, and possibly to take off in case of a burn-out; and then to put back again.

So, if you want to determine how much iron to pile up for a core, remember that about 1 to 1.5 volts per turn is a conservative range. For trial assume 1.25 volts per turn. Then by transforming our first equation we have,

$A = 7.5 \times \frac{E}{T}$ or, the area required is 7.5 times the volts per turn; in this case $7.5 \times 1.25 = 9.38$ sq. in.



Method of Measuring Magnetic Cross Section.

The magnetic cross section must be measured at right angles to the laminations that are enclosed by the coil; the center leg when the core is built up around the coil; and either leg where the core is built up inside the coil, i. e., between the arrows in the sketches.

D. X. WORK BY 6XAC

6XAC, the Los Altos, Calif., station of the Colin B. Kennedy Co. of San Francisco, was heard on Dec. 15 at Washington, D. C., by 3JJ, Herbert A. Wadsworth, 70 V St. N. W., and by Arthur L. Budlong, 1727 First St. N. W., in the course of a pre-arranged test with 3JJ. In both cases the reception of C. W. telegraph was on one audiotron tube. In the radiophone transmission both recipients were able to get the carrier wave and know that it was being modulated, but it was too faint to distinguish words or music. The reception on a long telegraph message was QSA, two-thirds of it being copied verbatim, but the balance spoiled by interference from 9OU and 9YB. Mr. Budlong has a four-wire cage aerial 45 ft. long and uses a single-tuned circuit with Clapp-Eastham variometer and vernier variable condenser for tuning, and a Clapp-Eastham variometer in the plate circuit for regeneration. 3JJ has practically the same equipment with a 60 ft. aerial. His reception was witnessed by J. B. Davis of 113 E St. N. W. Transmission was accomplished from 6XAC with one fifty watt tube. This test was conducted to verify previously reported reception.

Efficient Receiving Station Practice

By Chas. K. Fulghum

SYSTEM and efficiency are the two things that amateurs in general disregard. In "ye olde days" of galena and silicon a soldered connection meant something, but now if you don't get XYZ because ninety per cent of your received energy is dribbling away in an inefficient antenna system all you have to do is to "hook-up" the two stage amplifier and forget that you ever used an aerial. Such practice is the common idea of "doing good work."

The suggestions in this article are the result of observation of practice in a number of stations, both of commercial and amateur rating, as well as results obtained in the writer's own laboratory. At this station the daily concerts that are transmitted from the Fairmont Hotel, San Francisco, are received regularly. Only one bulb is used. The transmitting station is of ten watts rating and the writer's installation is five hundred miles away.

The first thing that every amateur should consider is the choice of apparatus. There are any number of good models on the market today, and at the same time it is not difficult to pick up apparatus that is decidedly inferior. The best thing that I have found is to keep from using "freak" designs and to stick to the recognized standards. If you make your own apparatus there is much that can be said as to the proper design of it. A few of the things that will tend towards efficiency in home-made apparatus are:

1. Keep all leads as short as possible.

2. Be sure that every connection is an electrical connection and not just a connection. Don't forget that solder was made to use and that you can make as poor a soldered connection as in any other way.

3. If you use regenerative tuning eliminate body capacity some way. The best way is to shield your apparatus. Long handles on controls are invariably in the way.

4. Vernirs are cheap if results count.

5. If you use audio-frequency amplification the best transformer that you can use is one that has no magnetic leakage. If you use other types place them so there will be no inter-coupling of magnetic fields.

6. Some very good work is still done with crystal detectors. They are cheap and often as convenient as vacuum tubes for short distance work.

7. Use good common sense. If you haven't any there may be "hams" in your radio club that have and people are always glad to give advice.

The next thing to consider is the care of the apparatus after you have it. As there are innumerable points that might be touched on of this character the writer will but mention those that are most disregarded.

Dirt is one thing to look out for. In most stations you don't have to look out for it, it's already there. I would advise that every amateur take a course in dusting from his mother, providing she does it right. Have handy a number of cheese-cloth dust rags, and use them. Don't use oil on cloths that you dust your apparatus with. It is almost impossible to keep from getting a thin film of oil on the switch contacts when you do and often the resulting resistance will cause a lot of trouble.

If you use a crystal detector keep the dust from it. The best are inclosed in a glass case, but covering them with a jar such as jewelers use to keep dust from watch parts is a good substitute. Try heating your crystals in a test-tube to various temperatures. If you want to clean them wash them with a potassium hydroxide solution followed by a thorough rinsing in distilled water.

Keep the contacts on your apparatus clean. Fine sandpaper is a good thing to use. Switch blades of the rotary type should wipe the contacts at an angle. Keep the contacts on the plugs of your lattice coils clean and be sure they fit snug in their sockets. Rheostats and contacts on VT's should also be cleaned with fine sandpaper.

The source of power for your receiving set should also receive your attention. Dry cells are unsatisfactory for filament heating. The expense of a few sets of dry cells for such work will soon buy a good storage battery. Also for B battery work, if you can afford them, storage batteries are the cheapest in the end. If you use storage cells be sure and see that they receive proper care.

A filament ammeter is a good investment. Don't disregard its readings, though. The life of a VT is dear to every amateur, so don't mount your tubes in a horizontal position. Also, don't run your plate voltage to the danger point.

Variometers are the best variable inductances that the amateur can use, providing you have a good variometer. One with a minimum clearance between rotor and stator and with pig-tailed connections is the best.

Observe the way that the various pieces of your set are mounted. The relation of one bit of apparatus to another often has much to do with good tuning. Capacity and inductive effects should be confined to their respective sources as much as possible.

In the operation of the receiving set try and employ a little system. Don't one day light your filaments before you close your aerial switch, and the next day close the aerial switch and adjust your receivers before you light your filaments. Owing to the variety of sets that are in use no definite information on a system of tuning can be given. A few points can be mentioned, however, that can well be observed by the reader.

When tuning in a station, don't hurry. Time flies, but often the station that you wish to get is tuned in several times before you realize it if you twirl the dials and juggle the honey-combs like you were in a speed contest. Often when you have your station you can cut down on the filament current quite a lot. Don't use amplification unless you have to. There is such a thing as sensitive ears and radio reception is a good way to acquire them.

Learn to copy on a typewriter if you can. It is a good thing if you intend to do commercial work and it is excellent training anyway. Use a machine that is as near noiseless as possible. When copying on a typewriter the use of a pair of soft rubber ear caps over the receivers is of great help in shutting out extraneous sounds.

When you are through receiving be sure and ground your aerial. Electric storms seem to be rare on the coast, but in the mountains there is danger from them. It might be mentioned here that your antenna system should be as efficient in damp weather as in dry. I mention this because I have known amateur antenna systems that were absolutely useless in wet weather.

In general it is advised that standard usages and operations are the ones to be adopted. If you get better results by an odd method of station practice, use it, but there are few such practices that will gain you anything. Distinction for the work you do as well as the way you do it is what you should aim at. DX work with a minimum of station expense is something you should work for and should you ever try commercial work you will not regret the practice. It is asked that amateurs throughout the country systemize their work for the sake of amateur radio.

REMARKABLE RECEPTION BY 6ZAC, HAWAII

Clifford J. Dow at Wailuku, Maui, Hawaii, submits a log of fourteen western stations copied by him Dec. 14-17, 1921. As he is 2100 miles from San Francisco and as this is the first time that amateur stations have been heard in Hawaii, this news will bring joy to coast workers. Especially noteworthy is the fact that these stations were read with only a loose-coupler, detector and one-stage of amplification, notwithstanding the notorious static in the Islands. Mr. Dow has an aerial 75 ft. high. His log follows:

RADIO LOG

December 14th

9:15 p.m.—7YA working 7ZT Sig "Harry."
9:16 p.m.—7YA de 7ZT "R Nr 1 R" continue wkg but arc in bad.
9:40 p.m.—7ZT de 7YA "C U Tomorrow nite. QSQ?"
9:40 p.m.—7YA de 7ZJ (Lower note than other two).
9:43 p.m.—Arc in again, but can hear 7ZJ sending msg to 7YA. Addressed to someone in "DAYTON."
9:45 p.m.—Pearl Harbor arc has strong mush wave on 350-375 meters. Forced to discontinue listening on short waves.

QRN not heavy, but bothersome. Could read all three above stations if they sent QSJ. All heard on one step of amp.

December 15th

6:45 p.m.—6XG de 6ZR "GA" (Very QSA and clear note. Comes better than KPH of any coast station.)
6:47 p.m.—6XG de 6ZR "GA".
7:00 p.m.—5IR de 5XU. (Might be 5AR or 5IF, but QRZ unreadable except when QSZ, as in calling.)
7:02 p.m.—7YA de 6ZR. Unans.
7:15 p.m.—6ZU de 6ZR. Unans.
7:17 p.m.—6AAK de 6ZR. "Fine OM sure glad to hear you on air agn. Do u hear 6XG on 370 meters? Pls drop me a line and give me the dope on this spk?"
7:22 p. m.—6AAK de 6ZR. Still working. "Wl gess tts abt all so cul. 73 de 6ZR, H. B." "Yes, am still with Meyberg, new address is 950 South Flower Street."
7:25 p.m.—7ZS de 7YA. "R QTC? QRV GA Shoot GA K!"
7:29 p.m.—6AAK de 6ZR. "QRX" (Calls 7YA, with 6AAK standing by. 7YA came right back, but evidently neither 6 stn heard him.)
7:32 p.m.—7YA de 7ZT.
7:33 p.m.—6ZX de 6ZR. 6AAK de 6ZR.
7:34 p.m.—6ZR de 7ZT. (6ZR unhears him.)
7:39 p.m.—6ZR de 7YA. (6ZR unhears him.)
7:46 p.m.—7YA wkg 6XL. Part of msg: "Boise at eleven thirty five Friday Dec. 16th will be in Spokane Saturday morning seven fifteen Dec. 17th arrive at Milwaukee station love." (Missed Sig.)
9:00 p.m.—7YL de 7YA, wkg.
9:45 p.m.—7YA working 7ZS. 7YA sigs steady all evening and fairly QSA on 1 step. With two steps will get him like living next door. Should be able copy 6ZR thru any kind of weather. QRN slightly worse than last night.

December 16th

From 6:30 p.m. to 8:30 p.m. Radio 7ZJ only station heard. Was working 7ZU during this period. At 8:16 p.m. called 7YM and told him, "You are causing interference, and are requested for the last time to BK." At 8:24 p.m. called 7ZU and said "R OK Nr 5 OK K." At 8:30 p.m. told 7ZU, "Sorry but QSS. ND. QTA. K." 7ZJ fairly QSA on one step. Unlistened after 8:30.

December 17th

QSA slightly worse than previous nights. Comes in hard splashes, quite close together.
7:35 p.m.—6ZK de 6ZR. Comes QSA as usual. Told 6ZK "GN".
9:07 p.m.—7YA and 7ZJ fairly QSA. QRN breaks 'em up pretty badly.
9:18 p.m.—7YA de 7ZJ. "All right OM QSU 73" (Finished).
9:35 p.m.—7YA de 7ZT (7ZT fairly QSA).
9:40 p.m.—7WA de 7ZU. "Didn't get ur QRA K."
9:42 p.m.—7WA de 7ZU. "Please QTA, K."
11:30 p.m.—Just completed regenerative hook-up, using Murdock coupler, one variable in series, detector and one step.
11:35 p.m.—6WZ and 7XF communicating as per record in attached letter.

December 18th

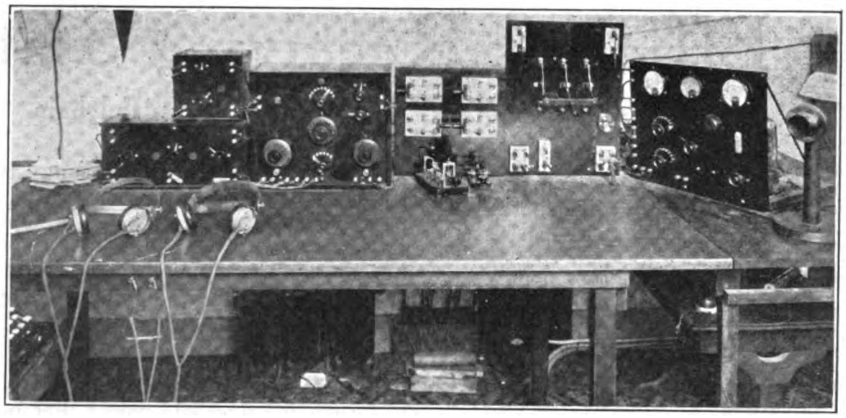
6:08 p.m.—Can hear two radio phones in. Can make out that music and speech are being transmitted, but very QRZ on voice. Compensating waves QSA. Could copy CW very easily. One fone sending "My Old Kentucky Home."
6:18 p.m.—5QJ de 5QA. 5QA very QSA and pretty to read. Using insect.
6:25 p.m.—Radio fones still concerting.
6:29 p.m.—5YQ de 9ZAF. 9ZAF about same QSA as 5QA, and easily read.
7:55 p.m.—9XM de 9ZAF. (Told 5YQ, "QRL OM, get u pretty gud, but QRL.")
8:01 p.m.—6IV de 5QA. Calling.
8:05 p.m.—6IV de 5QA. "QRM. QTA."
8:07 p.m.—6IV de 5QA. "QRM and QRZ OM. Please QSP 6AIF."
8:09 p.m.—6ZAC de LFY. (As per arrangement, Oahu Amateurs testing to Maui.) "Nr 1. Congratulations, Mr. Dow, on your receiver, and may you soon be able to transmit to us. (Sig) Yeager, LFY." "Will now QRX please listen on 200 meters for 6ASR." I listened for other stns on 200 meters, but unhear any, and at 8:36 p. m. NPM arc came in, with QRM all over scale. Many harmonics.
8:11 p.m.—6ZAC de LFY. Repeats above.
8:29 p.m.—6AIF de 5QA. "Gess we will make regular schedule. How do sigs compare with last nite? Am radiating about 4½ amps now."
8:32 p.m.—6AIF de 5QA. "Art. Spark fine here OM, and low enuff to miss QRM. QRU, tnx."
8:35 p.m.—6QA de 5QA. Gave him long call. (Arc at MPM in all time!)
9:27 p.m.—8HT de 5QA. "R QRV K."
9:31 p.m.—8HT de 5QA. "Nr 1 OK K."
9:35 p.m.—8HT de 5QA. "To Miss? 873—rest OK—K."
9:36 p.m.—"Nr 2 R Nil."
9:40 p.m.—8HT de 5QA. "Sig Mr. and Mrs ? ND on fone wake up everyone hi K."
9:42 p.m.—8HT de 5QA. "Yep. Just cudn't get rest. Maybe next one. Well, NM cul."

Stations heard pls QSL. Hearty congratulations to u all.

CLIFFORD J. DOW,
Wailuku, Maui, T. H.

NEW DX RECORD BY 6JX

6JX, G. M. Best, Piedmont, Calif., was heard by 2AVU, Ocean Side, Long Island, N. Y., at 12:30 a.m. Arlington time, Dec. 6, 1921, while calling 7OZ. Radiation at the time was 3.5 amps, on 200 meters.



9AMB

DESCRIPTION OF 9AMB

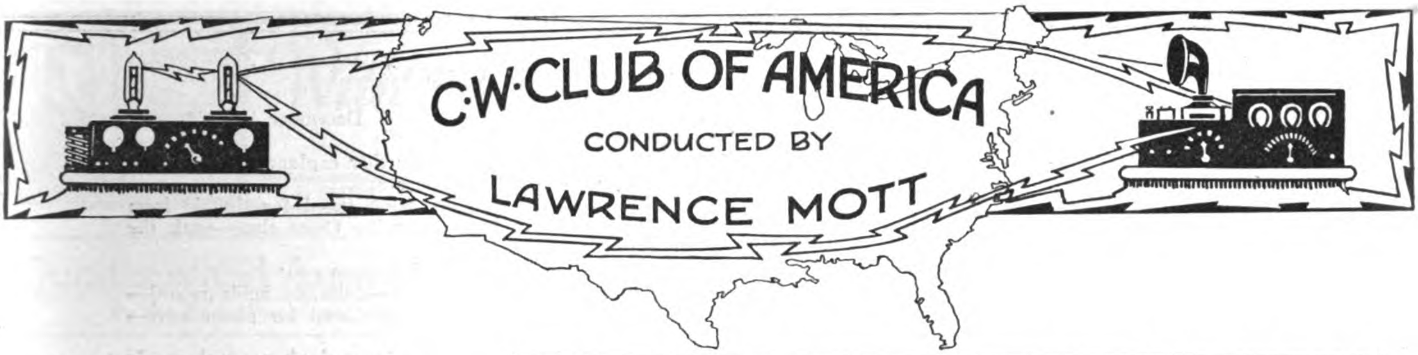
Due to his consistent work and great range, thousands of operators have heard 9AMB and will be interested in a brief account of this station, which belongs to D. L. Hathaway, 1575 Pennsylvania St., Denver, Colorado, and is operated by J. L. Hathaway. The general features are shown in the accompanying illustration.

The aerial is L type, 55 ft. long and 47 ft. high, 9 wires spaced 2 ft. apart. For some months a ground composed of buried tin, water mains and chicken wire was used. On putting up a counterpoise the radiation was the same as with the ordinary ground until Mr. Hathaway happened to find out that some inductance had to be put in the lead to the counterpoise. With the inductance in, the old radiation was nearly doubled. Later a combination of the counterpoise and the old ground was found to give slightly better results than with the counterpoise alone.

With the modified Hartley circuit he gets better results than with any other. One 50 watt tube is used. In normal use with 1200 volts and 140 milli-amperes on the plate and 9.5 volts a. c. on the filament, on a wave of about 225 meters, the radiation is 4½ thermo couple amperes. A d. c. generator is used for high voltage. For sending straight C. W. a key is placed in the grid circuit. Grid modulation by chopper or voice may be used when desired for comparatively short distances.

A variometer short wave set and 3 steps of audio frequency amplification are used for receiving. Four d. p. d. t. switches are used for changing the number of steps of amplification. Nearly all the apparatus of this station is home made.

The greatest distance worked is 2FP at Brooklyn, N. Y., with whom a number of messages have been handled. Avalon, California; Houston, Texas; Canadian 4CB, and many other distant stations have been worked. The greatest distance heard was by G. C. Farmer on a vessel 3300 miles west of San Francisco. Several reports from New York state that the C. W. has been read.



C. W. ASSOCIATION OF AMERICA

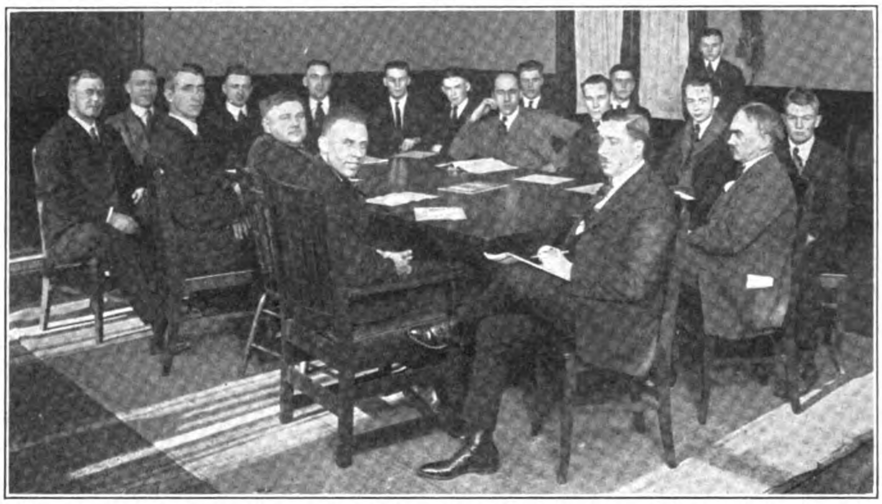
The C. W. Association of America was launched at a meeting of old-time radio men held in San Francisco on Dec. 30th as an independent organization for the encouragement of continuous wave radio development. This represents a national outgrowth of the C. W. Club of America which has been conducted by Lawrence Mott until the wide-spread interest made imperative an organization with a full corps of working officers.

At the organization meeting Lawrence Mott was elected president and founder, G. G. Griffeth, sect., H. O. de la Montanya treas., and G. M. Best, consulting engineer. Arrangements were made for nine directors to represent Pacific Coast districts. Arrangements will soon be perfected for additional directors to represent the eastern districts. San Diego will be represented by 6MZ, Mr. Gray; Los Angeles by Lex B. Benjamin; Reedley, Calif., Mr. Lindsay, 6ALE; San Francisco Bay by G. M. Best and Ralph Heintz; Douglas, Ariz., by 6ZZ, Mr. Gooding, and Salt Lake City by 6ZA, I. Carr. The Portland, Tacoma and Seattle radio clubs will be asked to name their directors.

A constitution and by-laws is being perfected by the organization committee, consisting of Lex B. Benjamin, G. M. Best, A. H. Babcock, G. G. Griffeth, H. O. de la Montanya, R. P. McKenzie and D. B. McGown.

Membership will include licensed operators having C. W. stations and others interested in the development of continuous wave radio communication. All such are invited to send in their names to Secretary G. G. Griffeth, care Pacific Tel. & Tel. Co., Sheldon Bldg., San Francisco. The initiation fee is $2.50 and dues are $4.00 per year.

The C. W. Association of America stands for a serious effort on the part of C. W. amateurs to establish regular transcontinental transmission with a minimum of relays. The association is independent and non-competitive, standing ready to co-operate with any other group organized for similar purposes.



Radio C. W. men present at Organization Meeting of The C. W. Association of America: G. M. Best, 6JX, 109 Greenbank Ave., Piedmont, Cal.; W. H. and C. E. Rich, 6IT, 1022 Boynton Ave., Glendale, Cal.; G. G. Griffeth, 6AA, 623 Sheldon Bldg., San Francisco, Cal.; D. B. McGown, 6ZE, 1247 47th Ave., San Francisco, Cal.; O. S. Garretson, 6ZAL, 118 Fairmont Ave., Eagle Rock, Cal.; L. B. Benjamin, 6XAQ, 140 So. Oxford St., Los Angeles, Cal.; Donald Skilling, 6BCI, 2960 Linden Ave., Berkeley, Cal.; H. A. Duvall, 6EN, 4965 Wadsworth St., Los Angeles, Cal.; C. G. Esler, 6EF, 784 East 46th St., Los Angeles, Cal.; Ralph Heintz, 6AUQ, 653 Miramar Ave., San Francisco, Cal.; S. J. Wood, 6HT, 512 Watson St., Monterey, Cal.; Thos. Work, Jr., 6ACR, 181 Central Ave., Pacific Grove, Cal.; Pierce Parsons, 6VM, 633 Middlefield Road, Palo Alto, Cal.; K. W. Kent, 6ATC, Los Gatos, Cal.; A. H. Babcock, 6ZAF, Southern Pacific Co., San Francisco, Cal.; H. O. De La Montanya, 6AUL, 2830 11th Ave., Oakland, Cal.; H. W. Dickow, 6SN, 251 Duboce Ave., San Francisco, Cal.; R. P. MacKenzie, 6ALU, 1016 4th Ave., Los Angeles, Cal.

ACROSS THE CONTINENT ON 20 WATTS

By LAWRENCE MOTT

TO write an article of this kind is not as simple a matter as it would appear, at the first glance—and for the reason that, by its very nature, it tends to create the belief that I am desirous of lustily blowing my own bugle! Ere I proceed, pray let me say—in all sincerity—that these words are NOT set down in a spirit of egoism! Rather am I actuated—purely and simply—by the earnest wish that all amateurs may profit by my experiences with *low-power'd* ICW transmission! This because such a set that will do the work that has been done, at my station, is well within the financial reach of practically every amateur.

I would, in these lines, convey my most appreciative thanks to countless brother operators, the nation over, who have listened for my QST each night, and who have *flooded* me with letters, postcards and telegrams, giving me detailed reports of my signals! Such co-operation and friendship as this cannot be too greatly extolled, and I take a very great deal of pleasure in thus publicly expressing my earnest thanks to them all! Lack of space—only—prohibits my listing ALL the cards that I have received, but as this article is intended to convince doubting minds as to that which CAN be done, economically, on ICW, I give only the reports of stations at approximately one thousand miles—and greater—distance from my residence at Avalon, Catalina Island, California — off the southern coast of California, 30 miles out on the Pacific Ocean.

As important to DX work as the transmitter, is the receiver! I feel that I should be doing a very grave injustice to a marvelous piece of apparatus, did I not say that the *Grebe—CR5*—has literally *earned* the highest praise that I can bestow! The 2-step amplifier, that has done equal marvels, is of special design, using special Western Electric tubes, and its hook-up I am not permitted to give. I would not, in thus praising the Grebe apparatus, declare that there are not many most excellent receivers on the market! To so do would be untruthful and ridiculous! I am merely, for science's sake, reporting that which the *Grebe has done!*

Hence I begin as brief a statement of facts as possible by introducing a letter that went from 6XAD to L. M. Clement, the Chief Engineer of The Western Electric Co., New York City, at the close of a test, the furthest-west end of which I was especially honored by having been asked to be. Copy of round-robin letter follows. The signatures thereunto appended of the gentlemen who most kindly acted as witnesses on the felicitous occasion of the first radio transmission from coast to coast of voice and music, are all well known in the field of radio engineering. I would express my gratitude to them for their invaluable assistance at the test.

"RADIO"

December 14th, '21.

MY DEAR MR. CLEMENT:

This letter is in confirmation and further explanation of a telegram that was sent to you several hours ago.

In accordance with your request, we listened for signals from your station—commencing at 8 p.m., Pacific Coast time—with the following results:

At 8:20 p.m. we copied the following from you:

". . . of Canada—Colorado Springs—Colorado holds record—would like reports from over 1,000 miles—listen for phone now—2XB."

Immediately after this we heard voice and phonograph music from you, but could not recognize voices or tunes.

During the next two hours we followed your schedule very nicely, but could not hear anything very definite on account of bad local interference from commercial spark stations.

At 9:20 p.m., however, there was a lull in the Q. R. M., and we received the following by C. W. on a loud-speaker, which was easily heard by all persons present:

"QST—2XB—testing radio telephone—this is 2XB—Western Electric Company—463 West Street—New York City—would like letters from any ship or station more than 1,000 miles from here—listen for telephone."

Following this we again heard your speech very nicely.

In receiving from you we used a Grebe CR-5 receiver, a two-step audio-frequency amplifier and Baldwin phones, or a four-step audio-frequency amplifier and Vocaloud. The receiving antenna is 150 feet long, 94 feet at the high end and 40 feet at the low, leads being brought in from the latter. The aerial consists of four wires, average 3 feet apart, spacing. The entire set is very well grounded and has an excellent counterpoise beside.

In receiving your C. W.—or carrier wave—our receiver was in an oscillating condition, which enabled us to hear you very nicely. When listening to your speech, or music, these local oscillations distorted your quality so much that your transmission was, of course, unintelligible. We listened very carefully for your speech and music with our receiver regenerating, but not oscillating—and could not hear you at all when it was in that condition.

Finally, at 10:55 p.m.—our time—we heard you calling KUXT—V—and easily copied the following:

"De 2XB—please advise by mail if hearing this transmission at more than 1,000 miles from New York—QST—KUXT de 2XB—Phone now—phone now—phone now—QST—KUXT—de 2XB—phone—K."

Immediately after this we again heard your speech as above described. We attempted to reply to you with our 100-watt set—C. W.—on 260 meters—and then on ICW—210 meters—20 watts—signing this Station's Call—6XAD—Avalon, Catalina Island, California.

We apparently did not succeed in raising you.

We are, however, entirely confident that we can work you easily from this station—in the absence of spark interference!—and will be very glad indeed if you will arrange a schedule, and advise us of it by despatch.

The undersigned were all present, and the foregoing letter is the consensus of their opinions and observations.

We all wish to congratulate you upon this epoch-making event, and we congratulate ourselves upon being the station furthest West to have heard these remarkable results of your efforts.

Cordially yours,
LAWRENCE MOTT,
Associate Editor of RADIO.

HOWARD W. LEWIS,
Transmission Engineer, P. T. & T. Co.

WM. J. MONAHAN,
E. R., U. S. N.

FRANKLIN HANSEN, Jr.,
Senior Radio Man, Pebble Beach Radio Phone Station.

FRANK G. BECK,
Radio Electrician, U. S. N.

Now then for record of stations worked and heard. Those marked with an (x) have been actually worked. Many of the others I know, to my own satisfaction, that I have exchanged signals with, but this does not constitute "work" to my mind, hence I list them as having received word *from* them—by mail, etc.—of hearing my signals.

5jd, 5za, 6wv(x), 6zz(x), 7ex, 7yj(x), 7zu(x), 7fi, 7os, 8bum(x) (Poughkeepsie, N. Y.), 8lx(x) (Pittsburgh, Pa.), 8bmx, 8kw, 8kf, 8ht (all of Buffalo, N. Y.), 8jq (Washington, Pa.), 9au, 9aqr, 9aig, 9zac, 9alg, 9dva(x), 9amb(x), 9wd(x), 9ax(x) 9zaf, 9lw(x), 9zn, 9ps, 9djz, kyw (Chicago), Canadian 5cr (Victoria, B. C.), Canadian 3lj (Agincourt, Ontario), Canadian 5bx (Vancouver), Canadian 4cb (Saskatoon). And on the night of December 22nd, I heard 2ahk (Jersey City) CQ'ing that which I am morally certain was a query for 6X—? Ere this is in print I shall have verification.

Other stations heard include 2fp, New York City; Canadian 3ji, F. H. Pounset, Toronto; A. H. Williams, 1630 Adams St., Denver, 8jl; L. N. Chatterton, Cleveland, Ohio; 9duz, Ellendale, N. D., and 9rc.

Of "6" stations I have heard, it seems to me, ALL that can "percolate" to 6XAD! I began keeping a list, but 'twould require a full page (!) of RADIO to reproduce, with my added data!

ALL of the above DX transmitting was accomplished on my 20 watt set, that was especially built for me by The Western Radio Electric Co. of Los Angeles, Calif. I mention the firm, deliberately, as it has given me the greatest possible satisfaction, in every way, and it is not justice to mention the firm whose receiver I use with so much success and omit the name of the transmitter builder! Too much may not be said for the Baldwin 'phones—that have rendered yeoman service!

I hope that the above FACTS will once-and-for-aye prove my contention, viz: that, given a good ground and antenna systems—plus counterpoise, if in any way possible—given a small transmitter, using any city's 60 cycle, a. c. current—said transmitter being built with reasonable care, on from 1.8-2.6 antenna current (being my own range, dependent on quality of city current), VAST distances may be successfully covered at LOW COST! And there never was a spark extant that can—power for power—come within 500 miles and *more!*—of these here-given results!

PRIZE AWARD TO 2FP

The $10 prize for dx reception announced by Mr. Mott in December RADIO is, after due consideration of distance and verification, awarded to 2fp, New York City.

Mr. Mott's station will be open every Tuesday, Thursday and Sunday night, from 10 till 2, for long-distance work.

With THE U-S-Radio Inspector

CONDUCTED BY MAJOR J. F. DILLON

A MONTHLY DEPARTMENT OF INFORMATION FOR OUR READERS

Questions and Answers

By the Radio Inspector

Ques. Who is the head of the Radio Service, and what is his address? L. K., San Francisco, Calif.

Answer: The commercial and amateur radio interests in the United States are controlled by the Department of Commerce, and the Secretary of Commerce, Mr. Herbert Hoover, is the real head. However, the Commissioner of Navigation, Mr. D. B. Carson. is the actual administrative and executive head. His address is "Commissioner of Navigation, Department of Commerce, Washington, D. C." The head of the Sixth District is Mr. J. F. Dillon, who has the title of "Radio Inspector." His address is 215 Custom House, San Francisco, Calif., although unless you wish to correspond with him personally, address simply "Radio Inspector." His district covers California, Nevada, Utah, Arizona, and the Hawaiian Islands.

Ques. Can the Radio Inspector's Office calibrate a decremeter for me? W. R., Utah.

Answer: No, facilities are not available for this work. Suggest that you set up a vacuum tube oscillator, with a low resistance circuit, and read the decrement, as indicated. This will suffice for the instrument decrement for work as accurate as is usually needed, and will not require any special apparatus.

Ques. I have a special amateur license. It states that 300 and 600 meters are the normal wavelengths. Does this mean that I should use these normally, instead of my 200 and 375 meters wave? K. R., Los Angeles.

Answer: No. This means that these waves are simply required to cover the law, your station being licensed as a "coastal" station. According to law, you are supposed to listen on these waves at least once every fifteen minutes, while the station is in operation, and the station shall be ready to transmit on these waves, if necessary to assist some ship in distress. The use of these waves, either, or both, is absolutely unlawful, except for these purposes.

Ques. Can the limited commercial "broadcasting stations" work with any other stations, or handle relay business with special amateurs on 375 meters? H. J., Los Angeles.

Answer: No. These stations are licensed for broadcasting exclusively and are "limited" to this service by their licenses, and they are also required to observe the 300 and 600 requirement, as described in the answer to the previous question. They may not work with special stations, except under these circumstances.

Ques. Can they use any other wavelength than 360 meters? H. J., Los Angeles.

Answer: No. According to instructions issued by the department, this is the ONLY wavelength authorized for this class of work. No stations, except those actually licensed for the purpose, may transmit music, or other broadcast matter, and this must be done on 360 meters, under a special limited commercial license. No amateurs, or others, may broadcast. The broadcasting of music on 200 meters will jeopardize the continuation of the licenses of the offender.

PROCEDURE FOR RENEWAL OF LICENSE

By D. B. McGowN, Asst. Radio Inspector.

A large number of amateur station owners, who have been issued station licenses, are finding that these licenses are about to expire. Numerous letters and requests for instruction have been received, and they show, generally, that a good deal of doubt exists as to the proper procedure and formalities necessary to make proper application for renewal.

At the time the station license expires, or before, the station owner will receive the forms from the radio inspector's office, with a request that they be filled out and returned. These forms are sent out as follows: Form 762, in triplicate, and Form 756, in duplicate. The Form 762 is the "Applicant's Description of Apparatus," and the Form 756 is the "Application for License to Radio Operator." The forms should be filled out as requested and returned to the office, together with the licenses, both station and operator, which are to expire. This is all that is necessary for renewal, unless some error is made in the data required, in which case the applicant will be notified and requested to give the necessary information. The applicant may then operate his station as before, and the licenses will be returned to him in due time. The expiring station license will simply be returned, marked "Renewed for two years from ——," and initialed by the radio inspector authorizing the renewal. New operator's licenses will be issued in all cases, and the oath of secrecy must be executed on them.

Licensees will in all cases be issued their previous call signals, and the station licenses will bear the same serial numbers. If, after three months have elapsed since the station license expired, no attempt has been made to renew the same, the call signal will be cancelled and reassigned. The operation of a station in such circumstances will be absolutely unlawful and the use of the former call letters will be considered as the transmission of false signals.

Amateurs, in general, will do well not to write impatiently a few days after they have submitted forms, asking for data as to when their license can be issued, but will wait the actual issuance of the same, which must be done in regular order.

The attention of amateurs and others is called to the unlawful tendency to use call letters at a station other than the one to which it is assigned. Call letters are assigned to a station, and not to an individual, and, unless specifically licensed as a portable station, only the call letters assigned to a specific station may be used thereat. For example, if John Bones is assigned the call 6HAM, and his station is located at 76 Blank Street, Smithville, it is decidedly unlawful for him to go over to Willy Wampus' house, at 176 Blank Street, and sign his call there, as 6HAM, whether Willy is licensed or not, it is just as illegal for him to sign 6HAM "at" 6XYZ as it is to sign the call in the first case, as it is obviously impossible for him to move his station *and its geographical location* from one point to another. The call of a station is issued for THAT STATION exclusively, and may not be used at ANY other location, without specific authority. Persons detected using their calls otherwise than at the station they are issued to, and for, should not be surprised if they are deprived of the use of the said call entirely.

The 1921 list of commercial and government radio stations of the United States, which includes special land stations, and the 1921 list of amateur radio stations of the United States are ready for distribution and may be procured also from Superintendent of Documents, Washington, D. C., at 15 cents per copy.

Applicants for radio-station licenses desiring to use their stations for broadcasting market reports and weather forecasts should submit with their application a letter from the Chief, Bureau of Markets, or the Chief of the Weather Bureau, indicating that this service is desired.

MODULATION PHENOMENA IN RADIOTELEPHONY

The apparatus now used for transmission in radiotelephony uses three-electrode electron tubes as an essential part of the equipment, with the exception of a few high-power stations which use high-frequency alternators.

In radiotelephony a wave of a radio frequency such as a million cycles per second is varied in amplitude or "modulated" at audible frequencies such as 1,000 cycles per second, in accordance with the wave form of the sound which is being transmitted. The device by which this modulating process is accomplished must respond instantaneously to the variations of the impressed sound wave, and must therefore have negligible inertia, in order that sound may be transmitted without distortion. The electron tube is a device which answers these requirements, since the electron stream will respond instantaneously to variations in the audio-frequency wave. The phenomena occurring in circuits for modulating radio-frequency currents may become very complex, and require careful study. Three principal methods of modulation in electron tube radiotelephone transmitting sets are recognized: First, by variable absorption of the output power of a generator of radio-frequency current, as by inserting a microphone in the antenna circuit; second, by varying at speech frequencies the operating grid voltage of a tube generating radio-frequency current; third, by varying at speech frequencies the input plate voltage of a tube generating radio-frequency current. The third method is often referred to as "plate modulation," and is the method used in commercial and military types of apparatus in the United States. Plate modulation is superior to the other methods in many respects.

Studies have been made at the Bureau of Standards of the phenomena of modulated radio-frequency waves, and the relative advantages of different methods of modulation and different circuits. The apparatus used in radiotelephone transmitting sets employing plate modulation has been analyzed as consisting of four units—the source of direct current, the modulator unit, the generator unit, and the radiator unit. Oscillographic studies have been made. Results of these studies are contained in a publication of the Bureau of Standards just issued, Scientific Paper No. 423, Operation of the Modulator Tube in Radiotelephone Sets, by E. S. Purington. Copies may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents. Persons desiring information regarding radiotelephony will find this paper of considerable interest.

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

J. Erskine-Murray and J. Robinson, Pat. No. 1,398,848, Nov. 29, 1921. Wireless Receiving and Transmitting Apparatus.

The patent describes a scheme for determining the bearing of a distant source of radiations at a receiving station. The distant transmitting station is so arranged that signals may be sent in succession along predetermined directions, which signals would then have a maximum or minimum effect along these directions. Each direction has its unique signal, so that by recognizing at the receiving station which of these signals is a maximum (or a minimum) the direction from which it is sent may be easily determined with an accuracy depending upon the number of angular directions used. The patent further describes means whereby bearings between the predetermined directions may be ascertained, and greater accuracy obtained. Thus the two-way switch *b* is provided in the receiving antenna circuit for connecting either coil *c* or *d* into the circuit, these coils being at right angles to each other. Coil *e* is arranged so that its coupling with *c* and *d* may be varied by rotation, and is connected to a receiving circuit. Coil *c* is placed in circuit when a maximum or minimum signal is received, and if the next signal is of almost the same intensity, this next signal may be received through coil *d*. The coil *e* is rotated until the two signals have equal intensities. The position of coil *e* may then be used for determining the bearing which is intermediate that corresponding to the two signals.

G. B. Crouse, Pat. No. 1,399,005, Dec. 6, 1921. Spark Gap.

This patent describes a highly quenched series gap, in which the spark is extinguished by a strong magnetic flux. In one form of the invention there is one vibratory contact and two stationary contacts, so that two gaps are formed in series. The vibratory contact is made of magnetic material, so as to direct the flux from the electromagnet toward the gap to extinguish the spark. This electromagnet also serves to vibrate the contact. The gap is common to the open and closed oscillatory circuit, in the usual manner. The stationary contacts are preferably mounted on a resilient plate, the position of which may be adjusted by set screws bearing against it. In this way the length of gap may be easily determined.

E. L. Chafee, Pat. No. 1,399,251, Dec. 6, 1921. Means for Changing the Intensity of Signals in Radiodynamic Receiving Systems.

A receiving system is described, in which there is the ordinary receiving apparatus, including detector tube 6 and telephone 15. In addition there is a circuit in parallel to this receiver circuit which by-passes the strong impulses, such as those due to static, etc., without materially reducing the weaker signals. This circuit includes thermionic tube 17, which may be caused to have the required resistance characteristics by properly adjusting the potential of its grid 20 with respect to the filament 19. The batteries 21 and 24 of this by-pass circuit are furthermore encased in metallic sheaths 28 and 31, so as to form therewith a condenser in parallel with condenser 5, and to prevent in a great measure the electrostatic coupling of grid 8 and the other parts of the apparatus. Such a coupling would produce capacitive effects reducing the intensity of the signals.

J. H. Hammond Jr., Pat. No. 1,399,254, Dec. 6, 1921. System of Radiodynamic Control.

This patent describes a transmission system used to control the movement of a distant object, such as a torpedo. In order to accomplish this without danger of enemy interference, the object controlled is equipped with receiving circuits responsive only when two definite wavelengths are transmitted simultaneously. Furthermore, there are several stations from which the wavelengths may be controlled, the stations being at strategic points. At one station, key 41 is provided; at the others, keys 42 and 43. Thus when key 41 is depressed, the antenna A is caused to transmit waves of say two thousand meters in length, and antenna B is caused to transmit waves of say two hundred meters in length. When key 42 is depressed, the wavelengths transmitted are two thousand meters and four hundred meters; when key 43 is depressed, the wavelengths transmitted are two thousand meters and seven hundred meters. While none of them are depressed, the antenna A transmits through a regular cycle of wavelengths, occasioned by the periodic variations of the inductance coils 11 and 20, which are included respectively in the closed and open oscillating circuit of transmitting system A. However, when any one of the keys 41, 42 or 43 is depressed, these coils are short-circuited at the same time that the antenna system B is automatically tuned to the wavelength associated with the particular key depressed. This tuning is accomplished by inserting the proper inductors 38, 39, 40, 44, 45 and 46 in the closed or open oscillating circuit. There

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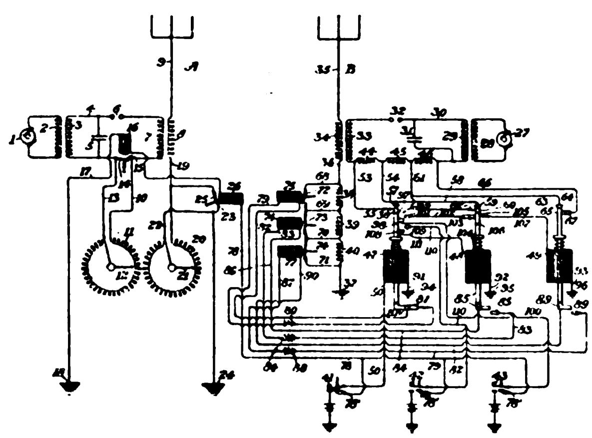

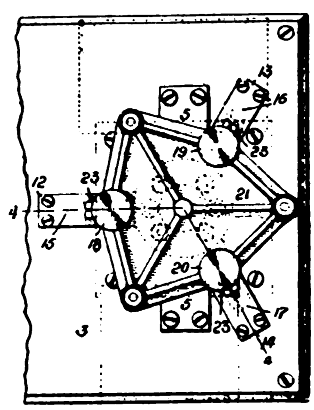

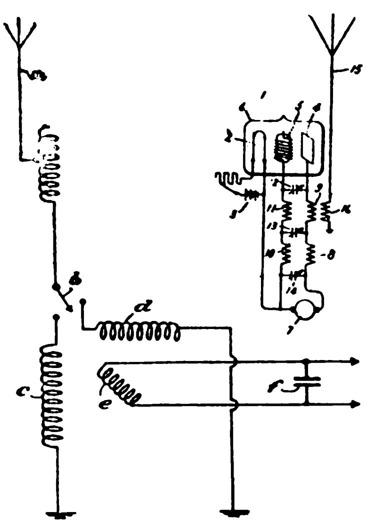

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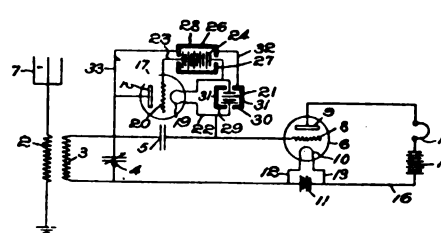

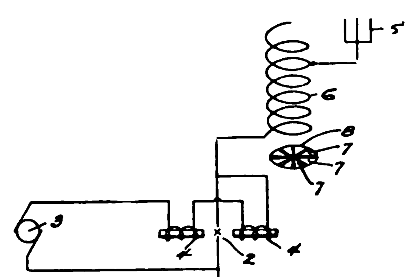

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MONTHLY BROADCAST OF RADIO NEWS

H. B. Ogle, formerly 8BT, is now 6VR at Southern California Edison Company's Kern River Station No. 1, at Edison, California. He will soon be in the air with a C. W. transmitter.

Ellery W. Stone, general manager Atlantic-Pacific Radio Supplies Company, is in receipt of definite advice from K. B. Warner, Secretary The American Radio Relay League, that twenty-six different U. S. stations were heard in England during the A. R. R. L. test conducted by Mr. Godley. Of the twenty-six stations heard twenty were C. W., the majority being from New England, but running as far west as Cleveland. Mr. Godley advises that A-P amplifiers were used exclusively for amplifying purposes in the receiving equipment used by him in England.

To pick up a telephone on a liner steaming along over 1,000 miles from the Australian coast and have a talk to somebody in Sydney is a great thing. Several passengers on the Ventura recently enjoyed the experience. It began one day when one of the passengers told another of the wonderful wireless telephone installed on the ship. The news spread, and it was not long before a lady appeared at the wireless cabin with a request to be allowed to use the wireless telephone.

"Certainly," replied the operator. "Whom do you want to ring up?"

The lady wanted to talk to Professor ——, at the Sydney University, and she gave the operator the number. "Sparks" busied himself with his instruments and the connection was made. Seizing the telephone the lady carried on an animated conversation with the "Professor" and left marveling at the progress of science. There was a general search for telephone numbers among the passengers, and soon they were ringing up talking to all parts of Australia.

Then somebody "spilled the beans." The telephone in the wireless room was connected with the navigating bridge, from which the jokers represented the shore end. Many of the travelers are kicking themselves yet.

On the evening of December 9 the amateurs of Visalia, California, met and formed the Visalia Radio Club. Mr. Errol Chrisman was elected president of the club, and much credit for the wonderful start of this club should go to him. There are 29 members in the club and prospects of many more joining in the near future. The club has secured quarters of their own and are to meet once a week for discussion and code practice.

Rotarians assembled recently in more than fifty towns, within a radius of 100 miles of Pittsburgh, to listen to the speeches of the Rotary Club International Vice-President, Ralph Cummings, and District Governor Roy Neville, who addressed Pittsburgh Rotarians in McCreery's dining room. They received the addresses by the aid of the wireless telephone, through arrangements made by the Westinghouse Electric & Manufacturing Company, to broadcast the speeches through its radio station, KDKA. In addition, many other people were able to hear the speeches of these prominent Rotarians. This was the first time in history that a meeting of this nature was received by other branches of the organization at different points, without the members attending the gathering in person.

THE SAN JOSE RADIO CLUB

The purpose of the San Jose Radio Club is to promote a spirit of fellowship among the local amateurs and to give code and theory instruction to all members desiring it. For some time a club of this sort has been needed in San Jose, and now that it has been formed the members have a determination to make it a howling success. The officers are: President, Harry Engwicht; vice-president, Jack Holmes; secretary, H. Weddell; treasurer, Irwin Coffey. The club meets every Monday evening, at the residence of Frank Quement, 51 Pleasant Street. A strictly business meeting is held once a month, all other meetings being devoted entirely to radio.

A Scrap as to Whether the Next Pacific Coast Radio Convention Be Held at Houston or Dallas.

RADIO CLUB OF LONG ISLAND

The Radio Club of Long Island has held several meetings at the offices of the Ship Owners' Radio Service, 80 Washington Street, New York City, and likes its new headquarters very much. The meetings, held every other Tuesday, have been well attended. Mr. Ferguson, the president, announces that he has arranged so that any members holding amateur licenses might take turns standing watch with the regular operator at 2CAP, the Ship Owners' Radio Service amateur station.

The members recently listened to an interesting talk on code learning by Mr. Berrell of the Ship Owners' Radio Service. He explained his method of teaching sound-reading of Morse. By his process a beginner can memorize the code in a fraction of the time usually taken. After the lecture the club was allowed to inspect a compact and efficient four-tube C. W. transmitter which was being constructed in the shop. Recently a code class was organized under the leadership of Mr. Miller, 2GA, so as to help the beginners or slow-speed fellows to get their licenses. The class meets at club headquarters every Monday and Thursday evening, at 7:30 p.m. Mr. Miller found himself unable to continue, so the class is now in charge of Mr. Edward Fenn, the treasurer.

The first business report given by radio was broadcasted from 1XE Station of the American Radio and Research Corporation, Medford Hillside, Mass., on December 19, when Roger W. Babson, leading economist and business statistician, predicted the return to prosperity in the year 1922. Mr. Babson spoke for an hour and a quarter in developing his theme, and already hundreds of replies from all over the East have been received. 1XE is broadcasting every Monday evening business reports furnished by Babson's Statistical Organization, reviewing the state of business for the past week. This service is to be incorporated in the broadcasting schedules of other stations. Once or twice a month prominent business men will speak at 1XE. The business report schedule was started early in November, when Arthur Nash, president of the Nash Manufacturing Company of Cincinnati, Ohio, spoke on the "Golden Rule in Industry," on the eve of the beginning of the disarmament conference.

LETTERS TO THE EDITOR

SIR: In the past few issues of RADIO have noted several articles concerning the "jammed" 200-meter wavelength, also suggestions for bettering this condition.

Mr. Mott's suggestion for using the "holes" between the various wavelengths in common use, is a timely one, especially from 200 to 280 meters for C. W.

The RADIO inspector's suggestion for graded licenses from 150 to 200 meters is also good.

However, I believe that if the present laws were more rigidly enforced a great deal of the trouble would be eliminated.

First, the section of the radio regulations concerning decrement is the most commonly violated. Enough emphasis is not put on this part of the law. Any amateur with a little experience knows that the decrement can be kept within 75 per cent., or less than that allowed by the government, by using a little care and "elbow grease." Most of the amateurs give little thought to this—as if it were of no importance!

Second, that section of the law which states that communication must be carried on with a minimum of power. Evidently, from listening-in, this does not apply to the amateurs. How about the suspension of the owner's station license for such an offense?

Third, the amateur license requirements should require a receiving ability of fifteen words per minute. Also a fee of about $5 should be required for a station license. Maybe this source of revenue might enable us to have a few more assistant radio inspectors.

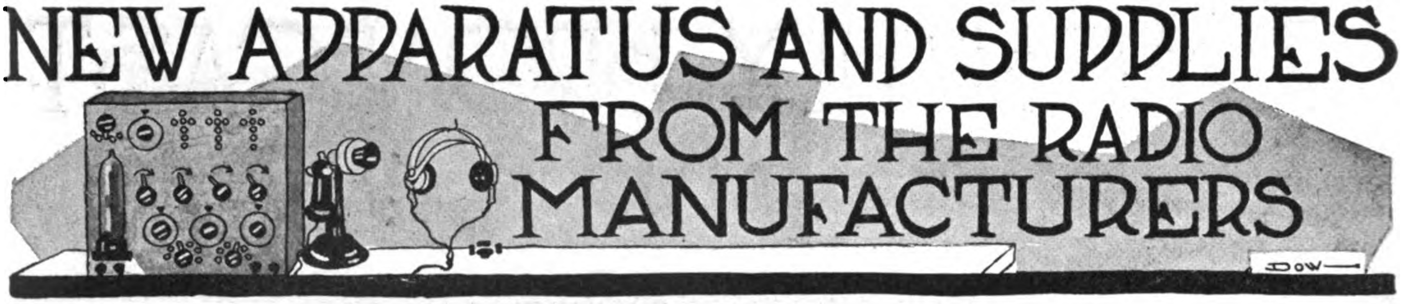
Last, there are too many radio phone concerts. It is getting to be so that you cannot tune one completely out from the other, and when it's amplified—but who can dance to two different fox-trots at the same time?

Remember, our good old game is just whatever we make it.

Sincerely yours,

H. J. McCoy.

Berkeley, Calif.

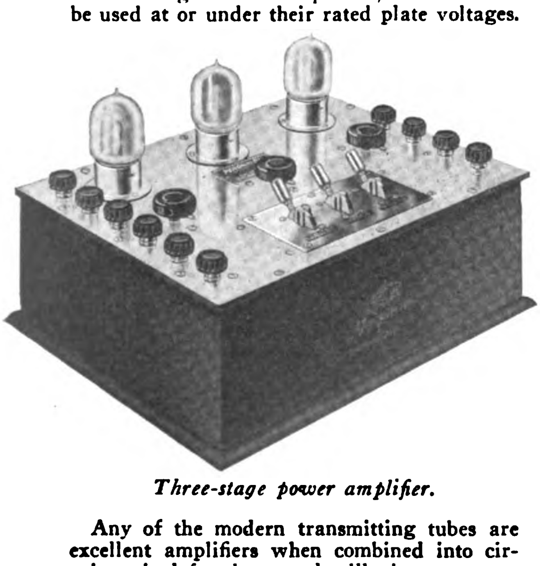


POWER AMPLIFICATION AT AUDIO FREQUENCIES

The demand for the reproduction of wireless speech and music in sufficient volume to be heard by many people at the same time, has changed the design of the audio frequency amplifier. Before the time of radio broadcasts an amplifier was of use only to make weak signals readable, with good signal strength. The present demand is that it reproduce with a minimum of distortion, and also that it deliver power enough to actuate a loud speaker with the approximate resulting strength of an ordinary phonograph.

Two-stage power amplifier.

The Magnavox Company, which has for many years been building audio frequency amplifiers, has designed for the radio fraternity a new power amplifier, built in either two or three stages. By power amplifier is meant one which will give a true power output. The new Magnavox amplifiers are designed to use any of the standard power or transmitting tubes as amplifiers, these tubes to be used at or under their rated plate voltages.



Three-stage power amplifier.

Any of the modern transmitting tubes are excellent amplifiers when combined into circuits suited for them, and will give enormous amplification when used with high voltages. In order that transmitting tubes with voltages of from 100 to 1,000 be used, it is necessary to use special amplifying transformers. These special intertube transfer coils are made by the Magnavox Company and are quite different from other types of transformers. They are open core, wound with heavy wire and highly insulated to stand large currents and high voltages. Switching from stage to stage is done with a master switch and the output does not have to be disturbed, no matter how many stages are used. This system does away with jacks and any danger arising from high voltage switching.

The design also differs from the conventional in that no input transformer is supplied. The reasons for this departure are many. It is obvious that if these power amplifiers are to be attached to receiving sets whose detector tube only uses 22½ to 45 volts, that it is not necessary for the initial transfer coil to be so elaborate as the power transformers. Then again it is necessary for the initial input coil of any amplifier to have a higher voltage ratio than the other coils. This voltage ratio also differs for different circuits. Magnavox power amplifiers are ideal to attach to a simple crystal receiver and there the input coil must be different again. Therefore, the manufacturers have given the user his choice of the initial amplifying coil or input transformer, and he should use one of the many standard makes—the type which gives him the best results on his particular set. The final output of these amplifiers will be the rated output of the tube used, both with the three-stage as well as the two-stage. The difference between the two is that the three-stage will bring up a much weaker signal to the rated output than will the two-stage.

Finally these power amplifiers were designed primarily for the distortionless amplification of music and speech in connection with the radio Magnavox. However, as these amplifiers will work successfully with any type of tube, at any voltage, they will also amplify successfully in connection with phones or with any standard type of radio receiver on the market today.

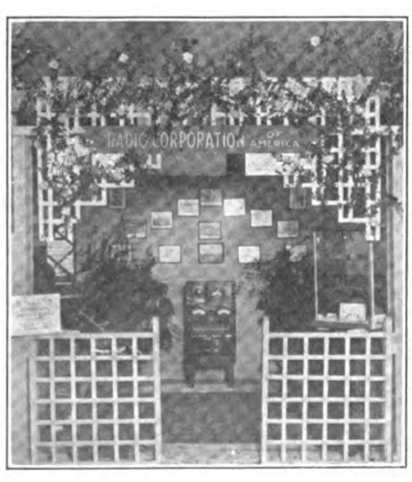


Exhibit of The Radio Corporation of America at San Francisco Radio Show.

THE HALL RADIO RELAY

By J. EDWARD JONES.

The advent of the Hall Radio Relay enables all that can now be done by land-wire to be done by radio. Automatic relaying, automatic recording, printing, sending of pictures, plans, documents and handwriting are a few of the many operations that the Hall relay adds to the accomplishments of the radio station of today.

While the true worth of the relay is more or less commercial, its introduction into the amateur field will be met with approval by those who want a permanent record, whether at four or forty words per minute.

As for printing, page 20 of the January issue of RADIO, it explains itself.

The author sent that message from a standard typewriter keyboard. The only manual labor required. I fancy I hear someone say, Printing for amateurs! Pooh, impractical!" but I say, "No, not impractical, but only just a bit ahead of the game; just the foundation of the radio structure of tomorrow."

Secrecy? Well, just try to copy a printed message with a pencil, and if you succeed the Einstein theory will be easy for you, for you will then know what he means by relativity.

The Hall apparatus, as the name implies, is a relay, *i. e.,* the weak radio impulses are made to make and break a local circuit. This small, simple piece of apparatus can be made to operate any power; for instance, weather reports have been received from one small station, and then the relay has operated a 500-k.w. set, repeating the same message simultaneously, without any human element between. Amplification! eh, what?

The relaying properties of the apparatus are somewhat curtailed at present, due to absence of remote control in amateur stations, but the specifications of a patent published in the same January issue indicates that this difficulty is surmountable. Given that, the relay will send a message around the United States with one sending—in fact, cover the entire country—the value in this respect for press, weather, etc., is incalculable. However, as things are at present, the radio impulse can be automatically relayed to a land line or local circuit. This suggests amplification, to which there is no limit.

The Hall relay is simple and foolproof. It will operate an any receiving set. Just plug in in place of, or in addition to, the regular 'phones. For its operation it requires but a weak signal—far less than the usual operator requires—and, while a child can run it, yet skillful operation will give startling results. With practice almost all Q. R. M. is eliminated, as the apparatus discriminates very closely between musical notes, either spark, or C. W., although perhaps with the latter closer regulation can be obtained. The author has frequently recorded and relayed signals completely drowned by Q. R. M. as far as the human ear was concerned.

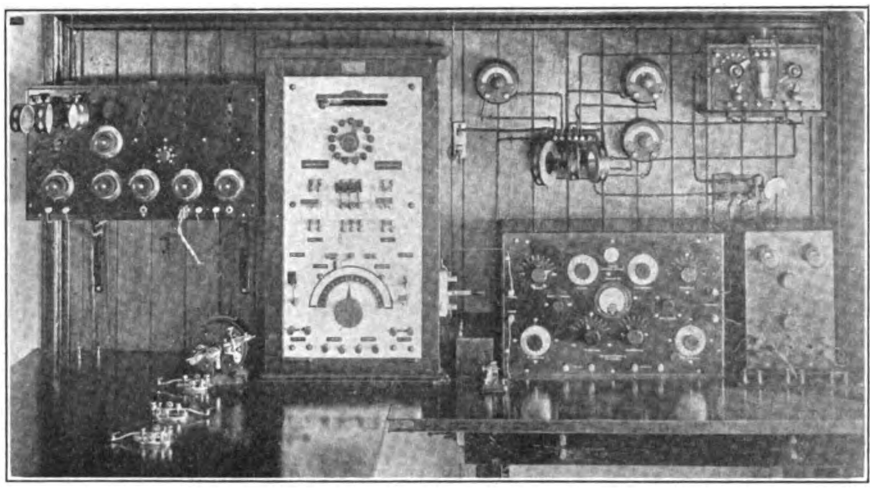
H. C. Hopkins has resigned as publicity representative of the Westinghouse Electric & Manufacturing Company at San Francisco, to devote his entire attention to the advertising agency of Dolman & Hopkins, Call Building, San Francisco.

PACIFIC RADIO SCHOOL

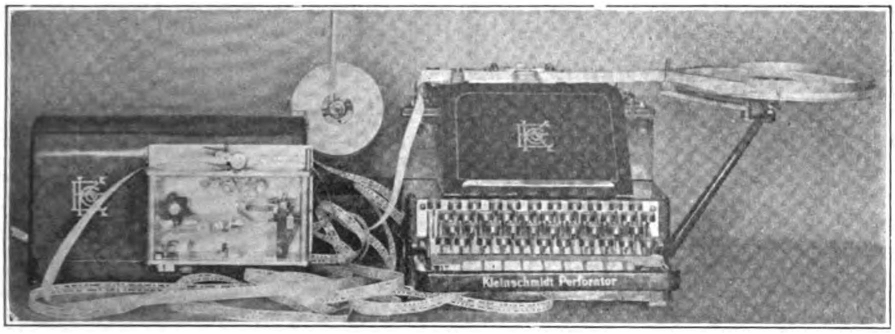
The student about to take a course in radio wants to be assured that he will secure maximum proficiency in minimum time. This assurance is given by the Pacific Radio School, an old-established institution in the Call Building, San Francisco. This claim is substantiated by personal instruction from practical operators and the opportunity to actually use the latest types of equipment.

The instructors are Mr. A. S. McKenzie, who is in charge of the school, and Mr. R. H. Pray, a former U. S. Shipping Board operator and one of the leading mid-West amateurs. Mr. McKenzie was recently presented with a handsome pair of binoculars by his students, as a token of their appreciation of the beneficial instruction received under his direction.

The transmitting equipment includes a complete 2-k.w. arc set with combined ignition key and shunt system, an Independent Company tranmitter, a Kilbourne & Clarke impulse transmitter, an old type United Wireless set, and a Clapp Eastham transmitter.



Receiving Equipment at Pacific Radio School

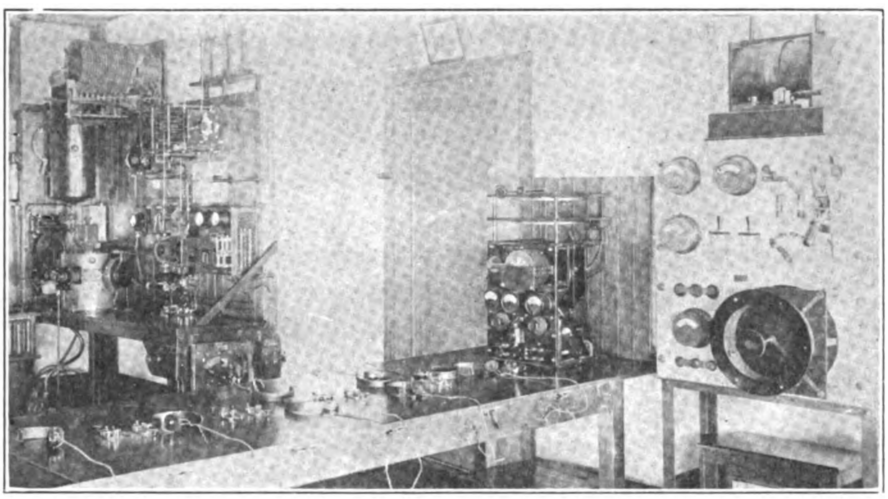


Kleinschmidt Electric Perforator

There are also five complete receiving sets, including a Kennedy Universal set and a Navy Standard Type 1420. For practice the students copy East Coast signals by means of forty phones in parallel. This school is one of the few Pacific Coast stations that heard the Clement test from New York.

This is claimed to be the only radio school in the country equipped with a Kleinschmidt electric perforator and two automatic cable transmitters. The instructors perforate a complete reel of tape every morning for the day's work. This is run at an average speed of thirty words a minute for one and a half hours. It is capable of running at any speed up to 400 words a minute. The students' receiving record is thirty-eight words.

A thorough grounding in experimental electricity is given with Swoope's "Practical Electricity" as the basis. In addition to complete apparatus for the experiments in this text, there is a Kolster decremeter, of which the students make daily use, a Tesla transformer, an audibility meter, galvanometer and other meters. The school has run at its full capacity of forty students during the past year.



Transmitting Equipment at Pacific Radio School

A NEW RADIO SHOP

The Newberry Electric Co. has installed a radio department in its fine new store in San Francisco. A complete line of equipment is carried for the amateurs' use. As the Newberry Company are also distributors for the Sonora phonograph, they have put the radio equipment into a booth where the purchaser may comfortably select what he wants, just as phonograph records are selected. This obviates the necessity of standing around a counter.

This enterprising company had an interesting exhibit at the recent Industrial Exposition. They are furnishing records to one of the local telephone broadcasting stations and are taking a leading part in the development of better service to the radio operator. C. B. Bensberg is manager of the radio department.

Radio Booth at Newberry Electric Co. Store.

BOOKS RECEIVED

RADIO QUESTIONS AND ANSWERS on Government Examination for Radio Operator's License. By Arthur R. Nilson. 86 pp., 5 x 7, published by McGraw-Hill Book Co., New York, and for sale by RADIO, San Francisco. Price $1.00.

The purpose of this book is expressed in its title. It consists of 121 questions and answers typical of those given in the examination for license, together with valuable information regarding such examinations. The text is based upon the author's experience as director of the East Side Y. M. C. A. Radio School of New York. It is assumed that the reader understands radio theory and operation, so that the book may be used for a last-minute brushing up before the examination.

NEW CATALOG

Copper Clad Steel Compcnv has issued an attractive circular of information regarding the use of "Copperweld" wire for aerials, lead-in and ground connections. Its steel core gives high strength and its copper covering gives practically the same conductivity at radio frequency as copper wire of the same diameter.

A pamphlet from the Experimenter's Information Service, 45 Pinehurst Avenue, New York City, briefly describes various designs of receiving and transmitting equipment which the amateur may build for himself by aid of complete blue prints furnished for this purpose.

The Teco Radio Company, Boston, Mass., has issued a leaflet illustrating and describing its new Vernier Rheostat, which allows very fine control of the filament current for V. T. use.

HEARD AT 7IW, EUGENE, OREGON

5fe, 5za, 6ac, (6ak), 6as, (6bm), 6bu, (6cz), 6ea, 6en, 6eo, 6ex, 6fh, 6fn, (6gf), 6go, 6he, 6hp, 6ib, 6is, 6iv, 6ka, 6ke, 6kp, (6lc), 6mh, 6mz, 6oc, 6ol, (6pj), 6pr, (6qr), 6st, 6tj, (6to). (6tu), 6uo, 6va, 6vc, 6vm, 6vk, (6vx), 6wz, 6yc, 6za, 6zk, 6zr, 6zu, 6zx, 6aan, (6aau), 6aae, (6abw), (6abx), 6acy, 6aez, (6aei), (6afn), 6agf, 6agp, 6ahq, (6aib), 6aif, 6aik, (6aio), 6aki, (6ala), 6alu, 6alp, 6amk, (6anp), 6aoc, 6aov, 6ape, 6apv, 6ask, (6atv), (6avb), (6avv), (6bbr), 6bcj, 6zal, (7ba), 7bc, 7bh, 7bj, (7bk), 7bw, 7br, (7bz), (7fi), 7hd, 7iy, 7jd, 7kb, (7ke). 7kz, 7la, 7ld, (7ly), 7mg, 7mo, 7mp, 7nl, 7nn, 7ot, (7tj), 7to, (7vz), 7wa, 7yg, (7yj), 7yl, 7ya, 7zj, (7zp), 7zs, 7zt, 7zv, (9ax), (9bd), (Can), 9gx, 9zn.

C. W. stations—4cb (Can), 6gy, 6xp, 6zn, 6aat (fone), (6ahy), 6ale, 6arc, 6avy, 6xae, 6xad (fone), 7xf (fone), 9amb, mc.

CALLS HEARD AT 2BAK, TARRYTOWN, N. Y.

C. W.—1ze, 1zf, 1afv, 1ary, 1bcg, 1bdi, 1bqt, 1bxx, (2cc phon), (2is phon), 2gr phon, 2xi phon, 2xr phon, 2xb phon, 3aw, (3bp), 3fs, (3bz). (3cw), 3fz, 3hg, 3mo, (3rf), 3zo, 3zy, 3aae, 3ahk, 3aku, (3biy), 4aw, 4by, 4co, 4el, 4kk, 4le, 4xc, 4ya, (8ba), 8bd, 8bu, 8dx, 8fb, 8fq, 8gv, (8ib), 8iv, (8jq), 8lx, 8mp, (8uk), (8vy), 8wo, 8xv, (8zd), (8zg), 8zj, 8zo, 8zp, 8zu-CW-phon, 8zv, 8zz, 8abo, 8agl, 8agz, 8ahr, 8aiu, 8akp, 8alo, 8amq, 8aqv, (8agz), 8arj, 8awf, 8awp, 8bbf, 8bed, (8bfx), 8bow, (8box), 8bpl, 9ii, (9vg), 9xi, 9xm, 9zj, 9zn, (9zv), 9zy, 9aav, (9ajá), 9ark, 9bed, 9dwj, xfl, nmw, wycb phon.

Spark—1yd, 3rw, 8dk, 8dy, 8hu, 8aja, 9kf, 9ox, 9uh, 9tl, 9aap.

E. I. R. Lounsberry, Jr., 2bb, Ossining, N. Y., is reaching out with a new 4-50 watt tube set.

R. Kessler, Nyack, N. Y., has been testing out his 2-50 watt tube set and hopes soon to be on the air.

Charles Benedict, principal of the North Tarrytown High School, intends to install a Radio Station in the new high school.

Emerson Decker, 2ua, White Plains N. Y., has installed a tube set and is a C. W. ham now as well as spark ham. More power to you, 2ua.

The Old Post Road Garage Radio Station, 2bak, is in receipt of a letter from Mr. J. F. J. Maher, chief engineer, Compani Radio Telegrafica y Telefonica Mexicano, S. A., of C. Juarez, Chihuahua, Mexico, stating that on November 12th at twelve o'clock he heard 2bak working 8ba, Detroit, Mich., and that our signals were perfectly audible and with that intensity that makes reading a pleasure.

JOS. B. SLAVIN, Operator.

CALLS HEARD BY RADIO 7VZ, ex-6AIK. ALL OVER 100 MILES.

5fe, 5za, 6ak, 6gf, 6ic, 6is, 6ot, 6pj, 6qr, 6sj, 6zb, 6zx, 6zz, 6aah, 6abw, 6aez, 6afn, 6atq, 6arc, 6ark, 6avv, 6awh, 7bh, 7bj, 7bz "cm", 7cw, 7dk, 7fi, 7fk, 7hm, 7in, 7lr, 7lu, 7ly, 7mf, 7mp, 7nl, 7nz, 7ot, 7zg, 7zo, 7zu, 9ry, 9ti, 9aeg, 9agn, 9aig, 9amk(cw), 9axv, 9ayv, 9doc.

6AWF, LOS ANGELES, CALIF.

5za, 6ak, 6ex, 6fh, 6fk, 6gf, 6gr, 6hc, 6kc, 6lu, 6oc, 6pj, 6pr, 6qk, 6qr, 6tu, 6vx, 6vz, 6wz, 6ze, 6zk, 6zu, 6zx, 6aah, 6aak, 6aau, 6aeh, 6afn, 6agf, 6aid, 6ale(icw), 6anp, 6ape, 6aph, 6arw, 6aud, 6avb, 6avv, 6xad(icw), 7mf.

STATIONS WORKED BY 7ZU, POLYTECHNIC P. O. MONT.

(5hk), (5yl), (5za), (5zu), (5zz), (6aez). (6atq), (6awh), (6ot), (6wv), (6za cw), (6zx), (7ex), (7im)?, (7ly), (7mp), (7nl), (7rn), (7ya), (7yj), (7yl), (7zg), (7zh), (7zt), (9aeg), (9aey), (9aif), (9amb cw), (9aou), (9aqe), (9ayv), (9ayw), (9doc), (9dva cw), (9fx), (9jn), (9lw), (9wu), (9xm), (9yae), (9yak), (9yal), (9zac), (9zc), (9zaf cw).

C. W. STATIONS HEARD BY 7ZU

5za, 5zz, 6xaf, 6wv, 6xac, 6xad, 6ale, 6aat, 6zn, 6za, 7ln, 7yj, 7nr, 8mga, 9amb, 9dva, 9zaf, 9nx, 9xi, 9aej, 9dtw, 9bjv, 9dtv, cz8, wjk, wv6.

STATIONS HEARD AND WORKED BY 7KS, ASTORIA, OREGON.

6fk, (6gr), 6gx, 6km, (6lu), 6mg, 6ng, 6ol, 6pg, 6qr, 6tu, 6zk, 6zx, 6aau, 6abx, 6adc, (6agf). 6aix, 6amk, 6ape, 6aph, 6atq, 6atz, 6awh, 6awi, 7bh, (7bj), 7bp, 7dw, 7fi, 7ft, 7hf, 7hm, 7jm, (7ke), (7mf), (7mp), 7nl, 7nn, 7uz, 7xa, 7ya, 7zk, 7zt, Can. 9ax, (Can. 9bd).

CALLS HEARD ABOARD S. S. "WEST HAVEN" (KJV).

5xu—2014 W. NW. of Cape Mala, Republic of Panama, Nov. 13th, 9:45 p.m., 75th meridian time. (QSA)

5xu, 6ot, 6qr, 6zm, 7ya, 7yl, 7zj (qsa)—90 miles south of Columbia River Bar.

6aef, 6ajr, 6sj, 7ba, 7ks, 7xa, 7ze, 9ax—80 miles south of Tatoosh.

6agf (6wg ? Stockton, Calif. Phone ? qsa), 6lc, 6zx, 7zj, 7zu—Off Cape Mendocino, California.

CALLS HEARD BY CHAS. F. BURDICK, RADIO 7OS, CASPER, WYO. (ONE TUBE).

Spark—5bm, 5fo, 5hk, 5if, 5ir, 5jl, 5nc, 5pu, 5qs, 5xu, 5za, 6aez, 6amb, 6awh, 6aeg, 6ef, 6ot, 6qr, 6zu, 6zx, 7fi, 7in, 7jq, 7lu, 7ly, 7mo, 7mp, 7xi, 7ya, 7zg, 7zh, 7zo, 7zs, 7zu, 9abv, 9acn, 9aeg, 9afx, 9agn, 9agr, 9aif, 9aig, 9anf, 9ang, 9ano, 9aou, 9aqe, 9atn, 9auo, 9ave, 9avs, 9awx, 9axu, 9ayu, 9dag, 9dbs, 9deh, 9dih, 9dnc, 9doc, 9dpb, 9dsd, 9dug, 9dze, 9dzi, 9ee, 9et, 9fx, 9hi, 9hm, 9ht, 9if, 9jn, 9lc, 9lf, 9lw, 9oa, 9oo, 9ps, 9ry, 9ti, 9tl, 9wu, 9xi, 9yae, 9yak, 9zn.

C. W.—Canadian 4cb, 6ale, 6wv (Denver), 6xad, 7xf, 8iq, 9aja, 9amb, 9bbf, 9bex, 9dcy, 9dzq, 9fo, 9nx, 9rv.

STATIONS OVER 300 MILES DISTANT HEARD AT 6JX AND 6XAF, PIEDMONT, CALIF.

Spark—5za, 6da, (6ea), 6en, 6er, 6fk, 6gt, 6kp, 6ky, 6lc, 6mh, 6od, 6ol, 6qr, 6uo, 6za, 6zb, 6zz, 6aak, 6acy, 6adl, 6aei, 6ahp, 6aib, 6alj, (6amn), 6aoa, 6aow, 6atf, 6avd, 6awi, 7bh, 7bj, 7bk, 7br, 7fi, (7hf), 7in, 7iw, 7jw, 7kb, 7ke, 7mf, 7nl, 7ot, 7zj, 7zp, 7zt, 7zu, 7ya, 9bd (Canadian).

C. W.—(6df), (6aoz), 6avy, 6awv, 6xad, 6xak, 6zb, 7oz, 9dva.

CALLS HEARD AT 6OM, LOS ANGELES, CALIF.

5if, 5za, 6cv, 6ex, 6gf, 6gr, 6gt, 6gx, 6hc, 6ic, 6ji, 6kc, 6km, 6lu, 6ng, 6oc, 6oh, 6pj, 6pr, 6qr, 6to, 6tu, 6tv, 6uo, 6vx, 6wo, 6wz, 6za(cw), 6zb, 6ze, 6zk, 6zu, 6zx, 6zz, 6aah, 6aak, 6aau, 6abx, 6aeh, 6aez, 6afn, 6agf, 6ahq, 6aif, 6aio, 6akl, 6ale(cw), 6amk, 6anp, 6apw, 6arw, 6atq, 6avb, 6awh, 6bca, 6bds, 6xad(cw), 7in, 7jd, 7mf, 7tj, 7ya, 7yg, 7za, 7zj, 7zt, 9amb(cw), 9dva(cw).

CALLS HEARD AT 9BD, BARRON HOTEL, VANCOUVER, B. C.

C. W.—(rb), 4cb, 9be.

"5" to numerous.

(6ah), (6as), (6ak), (6ale), (6ark), (6agf), 6aid, 6afn, 6aat, 6aua, 6agt, (6abx), (6amk), 6cp, (6ch), 6en, (6ex), (6hc), (6gr), (6jx), (6kl), 6qs, 6vk, (6vx), (6tv), (6tu), (6vm), 6hp, 6oc, 6po, (6abw), (6wz), 6ot, (6pr), (6zx), (6lu), 6xac, 6xad, (6qr), 6ze, 6fh, 7ag (7bk), (7bh), (7br), (7bj), 7bb, 7ex, 7go, 7ge, (7kb), 7mo, (7fi), 7iw, 7nw, (7nl), 7nn, 7oz, 7iy (7xf), 7jd, 7yg, (7ya), 7wa, (7vz), (7hn), (7hf), (7ks), (7tj), 7zb, (7zt), 7zj, (7zs), 7ge.

CALLS HEARD AND WORKED AT 7ED, PORTLAND, ORE.

4cb Canadian-cw, 5xu, (6ak), (6bb), (6ch), (6cp), 6cv, (6ea), (6eb), 6en-cw, (6fh), 6fn, 6gi, 6gp, (6gr), (6gx), 6hc, 6hy, (6ic), 6im, (6is), 6je-cw, 6ka, 6kc, 6km, 6lu, (6oc), 6pj, 6pr, (6qr), 6qt, 6sk, 6tu, 6vm, (6vx), (6wz-Spk & cw), 6xh-cw, 6ze, 6zn-cw, (6zu), 6zx, 6aat-cw, (6abx), 6acy, 6aei, 6afn, (6afo), (6agf), (6aid), 6ajh, (6ale-cw), 6alu, 6amx-cw, 6ang, 6ape, 6atv, 6avv, 6awh, 6awt, 6xaf-cw, 7ay, (7ba), 7bh, (7bk), 7ex-cw, (7in), (7iw), (7iy), 7jf, 7kg, (7kj), (7lu), (7mf), 7mo, 7mp, 7nj, (7nl), 7nn, 7nw, 7oz, 7po, (7tj), (7ya), (7yl), 7zp, (7zu), 9ax Canadian, (9bd Canadian), 9amb-cw, 9zac. This station also handled 107 messages, starting Oct. 15th and ending Nov. 1st.

CALLS HEARD AT 6BDQ, COALINGA, CALIF.

5za, 6an, 6al, 6au, 6aw, 6ba, 6bc, 6bd, 6bg, 6cb, 6da, 6dn, 6do, 6dr, 6du, 6ea, 6eb, 6ex, 6fn, 6fk, 6gr, 6go, 6gw, 6is, 6jd, 6jx, 6kc, 6lc, 6lw, 6lx, 6na, 6ng, 6nr, 6od, 6oa, 6ot, 6qr, 6rn, 6sk, 6uo, 6wl, 6ya, 6zb, 6ze, 6zu, 6zk, 6zr, 6zy, 6zl, 6zh, 6zz, 6zx, 6zba, 6aas, 6acy, 6abu, 6aiw, 6ajl, 6ard, 6avy, 6asp, 6ask, 6aun, 6afa, 6amk, 7nn, 7bd, 7jd, 7ya, 7yj, 7zu, 7zj calling 9fx, 8zz, 9yal, cli. Radiophones—6xg, 6xw, 6xac, 6xad, 6xae, 6xaj, wjk, 6wv Denver, Reynolds Radio Co., Denver, Colo.

CALLS HEARD AND WORKED AT 6ASJ, OAKLAND, OCT. 1st to JAN 1st.

Spark—6acy, 6ade, 6agf, 6ahp, (6aib), 6aif, 6amn, 6avb, 6awi, 6cv, 6da, 6ea, 6eb, (6ef), 6fk, 6ft, 6gf, 6gk, 6gp, 6gr, 6iv, 6ka, 6kc, 6ky, 6lu, 6mh, 6ol, 6pc, 6qr, 6sk, 6tf, 6to, 6tv, (6wd), 6wr, 6zb, 6zn, 6zr, 6zu, 6zz, 6zal, (7bb), 7bk, 7bj, 7cc, 7ej, 7ga, (7hf), 7iw, 7jd, 7jw, 7ke, (7mf), 7tj, 7ya, 7yl, 7ys, 7zj, 7zt, 7zu, 9ax, 9bd Canadian.

C. W.—5za, (6aat), (6ale), (6aoy), (aoz), 6avy, (6jd), 6xad, 7go, 7oz, 7xf, (cw and voice).

THE KICKBACK

Continued from page 25

sage sent out from shore on purpose to give him a chance to decode it. When he deciphers it through the two code-keys, as he'll have to do to make it readable, it'll get him all mixed up about that cocaine message which he had no chance to put through this new second code."

Captain Viericks' face wore an expression of sour blankness. For a moment, Stiringer sat thinking.

"We can elaborate on that idea," he exclaimed, suddenly. "When we have the bunch in Frisco send us the fake message for the kid to bite on, why not have it fixed up so that when it's deciphered with the first code it won't make clear sense, but when it's deciphered again with the second code-key, it'll appear to be from the steamship company and will read so as to give the impression that the owners are plotting to have the *'Bellaroba'* wrecked or sunk for the insurance money she is good for. We'll make the kid believe that his translation of that dope message was all a mistake —and we'll scare him off the ship at the same time."

"I don't follow you, Stiringer."

"Listen. Make it seem that these codes of ours really belong to the steamship company; and when a message is put through the first code it may happen to read as if it were something about dope-running or any other thing at random, but when decoded the second time it means something entirely different—a sort of double-code scheme. Then we'll have a phoney message shot out to us on the kid's watch, and when he gets busy and decodes it on the sly, it'll apparently be from the steamship company and will read to the effect that they are ready for us to put the old *'Bellaroba'* on the rocks —or something of that sort. If that doesn't send the kid skipping ashore, bag and baggage, then I'm no judge of these schoolboy operators."

Viericks rubbed his canine jaw.

"It's a complicated scheme," he grunted.

"Not at all," differed Stiringer. "And it'll kill two birds with one stone—it'll throw him off the dope-smuggling track and scare him off the ship, all in one shot. I'll frisk his dunnage before he gets ashore, to see that he don't pack the codes off with him for evidence against us; and if he goes and spills the story of the ship-wrecking plot, he'll get the horse-laugh, because of course the *'Bellaroba'* will keep right on plugging up and down the coast, the same as always."

"You've got cold feet—you know the other way would be quicker and easier," growled Viericks, surlily. "He wouldn't be the first one I've lost overboard."

MEANWHILE, the unwitting subject of the sinister conference in Captain Viericks' cabin was faithfully standing his watch in the wireless cabin of the *"Bellaroba."*

Tommy Dennis was a clean-cut typical American youth, who had worked his way through school and who was now trying to help support a widowed mother and a younger sister. Tommy was, as he frankly admitted, but a hopeful beginner in commercial radio, the *"Bellaroba"* being his first assignment. He had waited for an interminably long time to get a job and he was intensely anxious to keep it. He was sincerely trying to please the sneering, currish-tempered first operator of the *"Bellaroba,"* but now after six months of vain efforts to do this, he was nearly ready to believe that it was impossible.

He had been told in the beginning that it would be. The *"Bellaroba"* was known the length of the Pacific Coast, from San Diego to Seattle, as the wireless operators' misery-ship; and the dreaded assignment of experienced brass-pounders when a newly-fledged victim was not at hand. The wireless company knew all about it, and would long since have dismissed summarily the universally-detested Stiringer but for the morose master of the *"Bellaroba,"* who on one occasion had surlily informed the radio company's manager that his first operator was not to be interferred with under any circumstances.

Not long after coming aboard the ship, Tommy, in an excess of curiosity, had inquired of Alan Stiringer as to the source and contents of the mysterious code-messages that were being constantly sent and received on the *"Bellaroba."* Tommy's curiosity was rudely rebuffed, however, by a snarly command to mind his own business. Naturally, the young operator's suppressed interest in the strange messages secretly increased enormously; and when one day he chanced to find lying on the floor in the operator's sleeping-cabin a loosely-folded sheet on which was a typewritten code-key, he had been unable to resist the desire to keep it to see if it would work on the coded telegrams.

But the very first time that Tommy got out the code-sheet to apply it to one of the mysterious messages, which he had just received from N-P-E, Alan Stiringer unexpectedly came walking down the deck toward the wireless cabin. In a cold fright, Tommy hastily put the message back in the file and stowed the code-sheet in his pocket—but not before Stiringer opened the door and saw enough to comprehend what was going on. The next time Tommy came on watch, the message had disappeared from the file, thus he never had an opportunity to decode so much as one word of the telegram that was causing Stiringer and Captain Viericks such great concern.

Uncivil as had been Stiringer's treatment of his second operator before this incident, he assumed a still more harshly acrid demeanor toward him now. As the *"Bellaroba"* approached Vancouver, Captain Viericks filed an arrival message while Tommy chanced to be on watch. Ten minutes later, Stiringer came in and found the message lying on the desk, waiting to be sent.

"What's the matter?" he snapped. "Why haven't you sent that?"

"V-A-B is receiving a message from a ship off-shore," hurriedly explained Tommy. "I don't want to break in till he stops——"

"Never mind who he's working—call him—bust him up!"

"It's against the regulations—and it's a mean thing to do——"

"Get out of that chair, you whining little fool!" snarled Stiringer. Throwing himself down into the seat, he snatched at the key and crashed into V-A-B with full power, until the long-suffering Point Grey operator stopped everything to clear and get rid of him.

All during the return trip down the coast to Los Angeles, Tommy fancied that he could feel something ominous impending aboard the *"Bellaroba."* Nothing unusual happened, however, until the steamer sailed from San Pedro for San Francisco and north. Tommy relieved Stiringer as usual at midnight; and as the first operator left the cabin, a paper fluttered out of his coat-pocket. Picking it up, Tommy stepped out on deck and called after Stiringer, but the first operator had already gone below.

Knowing that a scathing reprimand awaited him should he leave the wireless-house unnecessarily while on watch, Tommy went back inside and put on the phones. Alan Stiringer often neglected his watch by the hour, but Tommy was not so privileged.

Glancing at the paper that Stiringer had dropped, Tommy saw with surprise that it was another secret-code device. On the corner was the inscription, "Use after decoding with first key."

As Tommy sat puzzling over this, he heard K-P-H calling him. He gave an answering call, and the San Francisco station sent him one of the coded messages which came so frequently. Calling a quartermaster, Tommy sent the telegram to the captain's cabin. In a few minutes the man returned, bringing an answering message, also in code.

Tommy sent it off to K-P-H and then settled down on the long monotonous watch to six o'clock. Sitting in the silent wireless cabin tuning the signals of an occasional off-shore ship working to land through the clear, quiet hours of the early morning, Tommy's attention reverted persistently to the strange messages he had just received and sent. Who were these recondite telegrams from, and what sort of information could they contain that they had to be sent so mysteriously?

Why MAGNAVOX Equipment Is Necessary In YOUR Set

THERE is no substitute for the RADIO MAGNAVOX. It is standard equipment, tested and approved by the radio fraternity, and no set now is complete without one. It supplies the means by which music, news, speeches, conversations, signals, etc., received by radio can be reproduced so loud and clear, and true to the original that any number of people may hear them and enjoy them simultaneously, depending on the amount of amplification.

Because the strength of sound depends on the amount of current in the movable coil, and the strength of the magnetic field, the effectiveness and volume of the MAGNAVOX can be greatly increased by hooking up with one of the new MAGNAVOX two or three stage POWER amplifiers. This assures the MAGNAVOX receiving the greatest possible power input because these amplifiers are designed to use transmitting tubes and high plate voltages. They are also designed especially for the amplification of music and speech, eliminating danger of distortion.

YOU WILL eventually have this equipment. Why postpone such enjoyment? MAGNAVOX equipment is simple and free from complex adjustments. Any one can hook it up and operate it without trouble. Nothing can take its place. See your dealer today and obtain maximum efficiency and results from your set.

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The hours dragged slowly by. The last Orient-bound tanker operator had cleared and gone to sleep, and the six-hundred meter tune brought in nothing but an occasional faint splatter of static. Tommy's thoughts ran steadily on the two secret messages he had handled and he asked himself with increasing insistence what harm could arise were he to try to decode them with the code-keys that had fallen into his hands. Perhaps it wasn't exactly right; the contents of the messages were none of his affair. But Tommy argued with himself that no one need know anything about it; whatever he learned he could keep to himself just as well as he respected the secrecy of the ordinary run of messages handled aboard the *"Bellaroba."*

Tommy's curiosity eventually bested his conscience; and taking the shorter telegram from the file, he attempted to decode it with the first code-sheet. The result was a jumble of words and half-sentences as meaningless as the original. For a while Tommy was perplexed, but he soon grasped the purpose of the second code-key that Stiringer had dropped and with it he decoded the message a second time.

The result was amazing. In a few minutes the skilfully-coded telegram had become plain English:

"Bellaroba scheduled undergo annual inspection next trip. Your defective port boiler will be condemned by inspectors therefore must carry out plans this trip or we are out fifty thousand."

Though there was no signature, the text showed Tommy that it must be from the steamship company. But now he knew scarcely any more than he did before. What was the meaning of that "carry out plans this trip?"

Tommy transferred his attention to the replying message. As he decoded it, his eyes opened wide and his face grew pale.

"Weather too clear last few trips. Must have stormy weather to keep insurance company from charging intentional sinking, but will put ship on Fox Rocks this trip. Strong inshore currents there well-known, will make job safe if pulled at night."

Tommy sat frozen to his chair. So this was the plan that was to be carried out. The steamship company was plotting to wreck the *"Bellaroba"* for the insurance money! It would never have occurred to Tommy to doubt the evidence of those two decoded messages. People burnt houses and wrecked automobiles to collect the insurance—so why not sink a ship?

WHEN the *"Bellaroba"* berthed at her pier in San Francisco for her usual four-hour stop, Tommy went down the gangway, his valise in his hand. If the *"Bellaroba"* was going to be sent to the bottom, he was not going with her.

Tommy was no coward; he had his mother and sister to think of. For their sake, if for no other reason, he could not afford to risk his life in an old steamer that a scoundrelly corporation was planning to wreck. Tommy felt certain that while undoubtedly the unscrupulous captain and the sneering first operator would take precautions to insure their own safety, at least a part of the ship's complement would meet their death.

It was a worried and miserable Tommy that rode uptown on a clanging Kearny Street car on his way to the wireless company's office. Now that he had quit the *"Bellaroba,"* when would he get another ship—if ever. He had waited months for that first assignment, and here he was facing the cheerless prospect of another long wait on the beach. He knew that the static-room was jammed every day with an army of ship-less operators, many of them old-timers, and now he would undoubtedly find himself at the very bottom of that frightfully-long waiting-list. At the door of the office, Tommy hesitated, torn by his doubts and fears. What should he do? Drifting back down to the street, he walked slowly up to the nearest square and sat down on a bench to think it over a while longer.

Hours flew and still he sat with his grip between his feet, undetermined. Before he went off the ship Tommy had put the two code-keys and copies of the sinister messages he had decoded in his valise; and now as he sat in the square trying to decide what he should do, it gradually became clearer and clearer to him that the only right thing to do was to take all that incriminating evidence down to the custom-house and give it to the steamship inspectors. The steamship company might laugh him to scorn; but at least he would thwart their conscienceless plot to wreck the *"Bellaroba"* and cause the death of many innocent people. Perhaps the steamship people would use their influence to keep him from ever getting another ship—well, let them. His conscience would be clear.

But when Tommy opened his valise to take out the code-sheets and the messages, he could not find them. He had put them right on top, and now they were gone. Somebody had taken them from his grip before he left the ship.

Tommy began to realize that he was the victim of a cruel hoax. Who but Alan Stiringer would have done this? With deliberate malice he had schemed it all, and Tommy could see why. The first operator wanted to frighten him off the ship. So that was the secret of the whole miserable business, was it! Well, plotting Mr. Stiringer would have to hatch up a better scheme than that. Burning with indignation, Tommy snatched up his grip and boarded a street-car bound for the water-front. Twenty minutes later he was at the steamer's pier—but he was too late. The *"Bellaroba"* had sailed.

Forlorn and filled with many forebodings, Tommy haltingly entered the wireless company's office, just at closing time. Everybody had already gone, except worried-looking Manager Edbrooke, who was busy on the telephone. The moment he caught sight of Tommy, he replaced the receiver on the hook with a relieved expression and turned to the young operator.

"What are you doing here—hasn't the *'Bellaroba'* sailed?"

"Yes—I—I missed her!" And then trembling, Tommy began to pour forth his explanation. In a moment, however, Edbrooke with a short gesture checked his torrent of words.

"Never mind—we know Stiringer. You did pretty well to stick it out with him six months—no operator ever stayed six weeks with him before. I suppose the *'Bellaroba'* went to sea with only one operator, but we weren't notified, so it's the captain's and Stiringer's funeral, not ours. Do you want another job—right away?"

"Another job!" gasped Tommy, hardly believing his ears.

"A call came in five minutes ago for an operator to take out the *'Falcon'*, sailing from pier twenty-one in half an hour. She's a fine little steam-yacht—a one man job. You're not in line for anything like her, but the only old man I can get on the phone right now lives way over in Berkeley and it'll take him over an hour to get down town. Make a bee-line to pier twenty-one and get aboard. The job's yours."

ABOARD the *"Bellaroba"* lunging northward around Point Reyes in a rainy southwesterly gale, another conversation was taking place in Captain Viericks' cabin.

"Well, it worked," exulted Stiringer, bracing his chair with his long, thin legs to keep it from sliding with him as the ship rolled and pitched sharply. "The meddling monkey packed his clothes and skipped."

"Yes—and we're at sea with only one operator," Viericks reminded him, sourly. "There's a heavy fine for taking a passenger ship to sea without two wireless operators."

"Don't worry about that—it's easily fixed," Stiringer assured him. "Put in the ship's log that we found a licensed radio operator among the passengers and signed him on for the run north to save having to turn the ship back. I'll fake the wireless log to show a continuous watch; and when we get to Seattle, I'll go and hunt up another operator."

The swift little steam-yacht *"Falcon,"* also bound for Seattle, steamed out through the Golden Gate hardly an hour behind the *"Bellaroba"* and plunged likewise into the winter's storm that was

blowing outside. All the way up the coast the trim vessel swept before the shrieking gale, which steadily increased in fury and pushed up a mountainous westerly sea, criscrossed by a sharp, jouncing chop that boarded the yacht occasionally with jarring deluges and sent white gushers of sea-water flying the length of the ship.

The second day out, the wind suddenly abated a little and switched around to the westward, bringing a dank, blanketing fog which came swirling over the water in eddying, wind-torn wisps, turning the day into a damp murky twilight through which the towering greasy swell looked like dead gray walls looming and disappearing, monotonously. The gloomy, fog-streaked daylight at length gave way to darkness, and through the night the *"Falcon"* bounced restlessly in the trough of the turbulent sea.

At two o'clock in the morning Tommy was called out by the worried captain.

"We think we glimpsed some steamer's range-lights through the fog just now, way inshore—better send out a call and if there really is a ship in there, tell him he's running into danger. We've been taking soundings since midnight and just picked ourselves up heading dead on Blanco. There's a strong current setting in here, tonight."

THE steamer *"Bellaroba,"* lunging on over the crests of the seas through the drizzly fog had, according to her dead-reckoning, made Cape Blanco, that treacherous Hatteras of the Pacific; and shortly before two o'clock the officer on watch hauled her in on the more northerly course to Cape Flattery. Her deck-lights turned out now, the big steamer swept on through the night, a great black spectre in the chill wet mist.

A light burned in the radio cabin, but the phones were hanging on the tuner. It was the time when the second operator should be standing his watch, but thanks to Captain Viericks and Alan Stiringer, there was no second operator there; no one to hear the repeated calls from the *"Falcon"* that impinged futilely on the *"Bellaroba's"* antenna; no one to copy those few words of warning flashing over the fog-shrouded seas which would have reversed the steamer's engines and checked her in her swift course to destruction.

Suddenly there was a thudding of fear-winged footsteps flying along the deck; and hoarse shouts arose from the bridge of the ill-fated *"Bellaroba."* Above the awful booming of breaking rollers dead ahead, the wild clang of the engine-telegraph came up from the depths of the ship, a sharp, metallic alarm of imminent catastrophe. Ten seconds afterward, there began a jarring, thundering crash, followed by a terrific rending of metal, as if some mighty hand were tearing out the ship's vitals. The lights went out; the throbbing of the engines ceased; then above the deafening reports of splitting steam-pipes there arose a shuddering rumble like the roar of a thousand onrushing express-trains, and a hurtling deluge of sea-water swept over the *"Bellaroba,"* smashing life-boats to splinters, uprooting ventilators, shattering cabins, and sending foaming white tongues into the innermost parts of the ship. Steel stays shot skyward, spurting fire from their torn ends, the two masts went down, and the doomed vessel rolled over in her death throes.

Three hours later the dull light of a gloomy dawn found lying among the Fox Rocks of Cape Blanco a capsized, broken shell, over which the seas rolled in grayish, foam-flecked masses.

THE END

COMMERCIAL RADIO APPARATUS

Continued from page 23

apparatus, as whether a set is to be used for sending or receiving.

As an example, a spark gap may be placed in series with the condenser C and the inductance L_2, in Fig. 3. With some means of charging the condenser to a potential high enough to overcome the resistance of the spark gap, the condenser will discharge, and create oscillations in the antenna circuit. The usual means of charging this condenser is an induction coil, or high potential transformer, with which the reader is doubtless familiar. It is possible, however, that a vacuum tube, or other source of energy be used to charge the condenser, altho we are not ready at this time to go into details as to how this can be accomplished.

The same apparatus may again be used for receiving. If we use the apparatus shown in Fig. 3, but attach a device of some kind to the circuit L_2C, we can observe an indication every time the circuit is set into oscillation. It can only be set into oscillation by the antenna's picking up passing currents from the space surrounding the antenna, which currents should be of the same frequency as the natural vibrating frequency of the antenna and ground system, AL_1G.

A device used to indicate the presence of electrical oscillations is called a detector, and countless numbers of them exist, but all of them are only means for changing the oscillations, or making their presence known to an observer. Very few detectors are sensitive enough to indicate feeble oscillations, but those few are so wonderfully and extremely sensitive that they convert almost inconceivably small amounts of energy into signals.

It will be found that all radio apparatus operates on the principles outlined above.

The next installment will explain in detail the navy standard transmitter.

CLICK METHOD

Continued from page 21

wavemeter until it too is in resonance with the oscillator. The wavelength corresponding to the condenser setting may

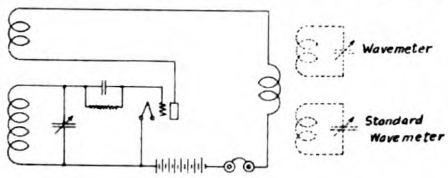


Fig. 7

now be read directly from the standard wavemeter. Any number of points may be similarly taken and the results plotted if so desired.

Fig. 8 shows how the click method may be used to measure the wavelength of a received signal. Adjust the oscillating audion (or heterodyne) to zero beat

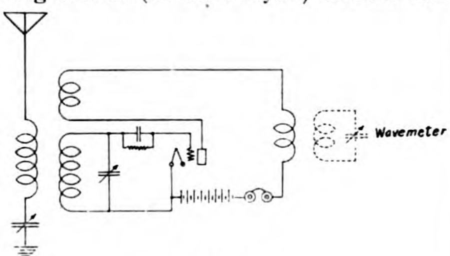


Fig. 8

note. Couple the oscillator circuit to a wavemeter and adjust the latter until resonance is obtained. The wavelength of the incoming signal is that now indicated by the wavemeter.

The click method may be used in many other ways and those mentioned here are but indicative of its usefulness.

Question: How may an amateur test his transmitter before applying for a license?

Answer: With a dummy antenna, or special permission to test may be granted by a radio inspector, before the license is granted. This will NOT allow any transmission of messages, however, as this cannot be done until the licenses are actually issued, and signed by the inspector issuing them.

Question: Are signals sent on a test buzzer conductively coupled to a receiving set employing a vacuum tube in an oscillating or regenerative condition, considered as coming from a transmitting station, and should a station communicating by the above method be licensed?

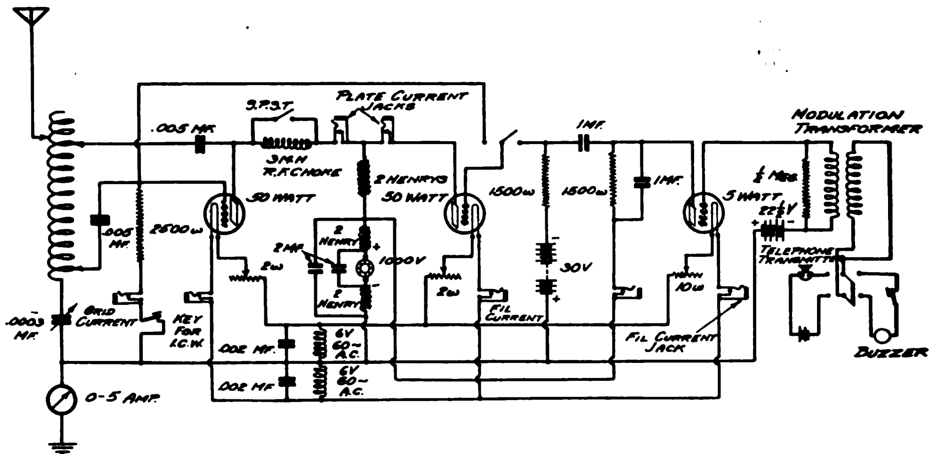
Answer: Yes, such stations must be licensed, as they are actually radiating and transmitting signals. Even tho such stations are licensed, care should be taken not to transmit on any wave length, except those specified in the license, as a receiver is capable of very rapid and easy adjustment to various wave lengths.

Queries and Replies on C. W. Practice

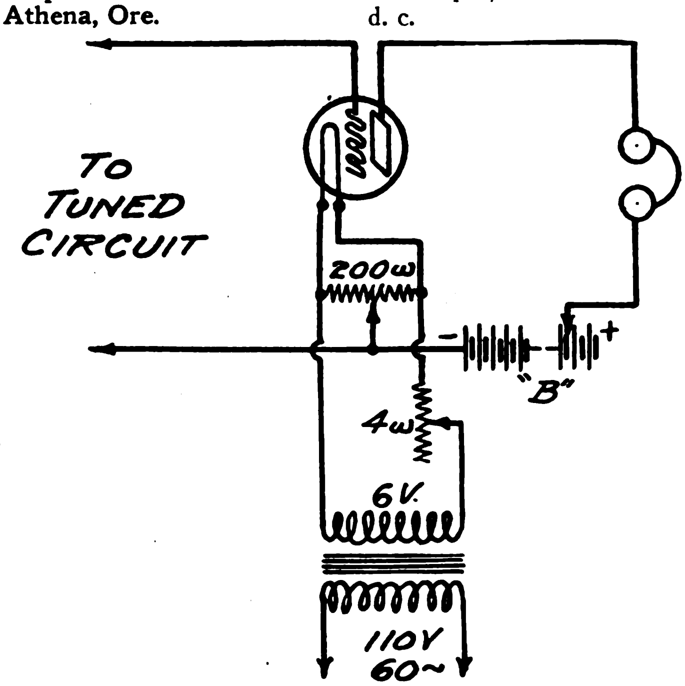
By Gerald M. Best

Question: Please publish the wiring diagram of a 50-watt phone and C. W. transmitter using two 50-watt tubes, 1500-volt motor generator and other necessary apparatus.—G. E. W., Billings, Mont.

Answer: A single coil circuit for the transmitter you desire is shown below.



Question: Could the potentiometer which is mounted on the Remler detector panel be used to balance out the a. c. hum, when lighting the detector filament from a 110 to 6-volt step-down transformer?—C. M. E., Athena, Ore.



Answer: No, as this potentiometer is tapped at certain fixed points, and you probably could not locate its exact center. A slide wire resistance of about 200 ohms will give the best results, as shown herewith.

Question: Why will a 50-watt tube not pass more than 60 milli-amperes of plate current without the plate becoming red, when the same tube will pass 125 mills continuously on d. c., both a. c. and d. c. voltages being 1250?—H. L. G., Douglas, Ariz.

Answer: If you are using 1250 a. c., you will have a peak voltage of 1.4 times 1250, or about 1750 volts, which will overload your tube, thereby producing overheated plates. Your tube will no doubt have a longer life if you do not operate it at a voltage greater than its rated input, which I assume is 1000 volts d. c.

Question: How can I eliminate a growling and humming noise from my two-stage amplifier?—S. M. F.

Answer: You did not state whether it was a. c. induction from nearby lighting circuits or local troubles in your amplifier. Try grounding the negative of your "B" battery, and the cores of your amplifying transformers. If this does not help matters, you will probably have to shield the inside of your cabinet with thin copper sheeting, being careful to ground the shield thoroughly.

Question: Using a Gurney Duplex Set, what would be the best aerial 40 feet high to receive the 360-meter music? My supports are 135 feet apart.—A. C.

Answer: A single wire 40 feet high and 135 feet long would be ample for 360 meters. If the cost of wire is no object, two wires 135 feet long would not raise the fundamental wavelength greatly and might improve reception.

Question: I have a type UL 1008 Oscillation Transformer for my C. W. set. This transformer has only four places to connect to and I have five connections, aerial, ground, filament, grid and plate. How may these connections be made—P. B., Quincy, Calif.

Answer: C. W. and I. C. W. circuits shown in the Radio Corporation catalog all show the antenna and grid connections brought to a common terminal, thereby permitting the three remaining terminals to be connected to the filament, plate and ground.

A RADIO FABLE

By Earl Ennis

Once there was a Prohibition Sleuth who hadn't made an Arrest for a long Time. And his Boss called him in and gave Him the merry Raspberry, telling him that a Bird in the Hand was better than a Drink in the Dark and to get busy or there would be a Vacancy behind his Badge.

So the Sleuth went out with his dark Lantern and his Sniffing apparatus. And he gum-shoed around. And after awhile he saw a Light in a Woodshed. So he crawled on his Stomach over a Dog-House, and through a Pig Sty, and under a Sewer Pipe and peeked through a Crack. There were Two young Men in the Shed and they were very intent on their work.

The Sleuth polished up his Badge with his Sleeve and listened carefully. When he had heard a lot of Words, he opened the Door and informed the Youths that he represented Uncle Sam, the well known Owner of America.

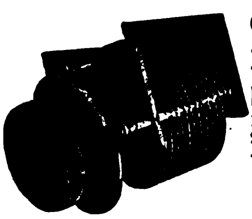
"I heard what you said," he announced. "You can't heterodyne Annapolis in this country. It's against the Volstead act."

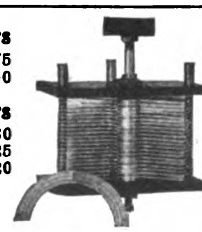
"But . . ." said the Youths.

"Shut up," said the Sleuth. "I know my Business. Give me that bottle while I complete my case."

So the Youths handed him a bottle and he took a drink of pure Sulphuric Acid and fell dead over the Rectifier.

Moral—Study radio and save Insurance!





EARTH ANTENNÆ

Continued from page 20

In the ground antenna, such as described here, there is not this limiting capacity, and the wavelength may be indefinitely increased by increasing the capacity of the series condenser. This is a marked advantage in favor of the ground antenna. It is a well known fact that in tuning with a series condenser in an antenna circuit, maximum signals are invariably received when the highest possible value of condenser is used. This is due to the fact that with a high condenser value, a small inductance can be used and consequently the resistance of the circuit is kept low. (Note. It must be remembered that this reasoning applies only to the primary circuit, where the important thing is to have a maximum current flow. In the secondary, where a high voltage is required, as to operate a vacuum tube, the opposite condition holds, and low condenser and high inductance are always best.)

In some of the tests at Tampico, a DL-25 coil was used as a primary to receive Annapolis, together with a series condenser of about ½ microfarad capacity. Signals with this arrangement were louder than when a DL-1000 primary was used. The use of a DL-25, however, represented an extreme case, and it was found that better signals could be received with a DL-150 primary on account of the higher degree of coupling obtainable. The necessary amount of coupling and the available size of variable condenser are the only things that limit the size of the primary coil. At Tampico a variable condenser of .006 microfarads maximum capacity was used and a DL-250 primary coil was large enough to cover all waves up to 10,000 meters.

For press reception, a ground wire 500 ft. long, bearing NW was used. On this, signals from NBA, NPL, and NPG (8600 meters) could be copied on the typewriter in daytime or night using a 2 step amplifier. Press was copied daily despite the fact that many times, during one of the press schedules, a thunder storm would be going on directly overhead. It seemed to make little difference whether the wire was on top of dry ground or under 3 or 4 inches of water after a heavy rain. The signals were always the same strength, and there was no day to day variation.

As regards the action of the ground antenna, there is a possible explanation in the fact that every radio transmitting station sends current into the ground, and that this current is sent through the ground in all directions radially from the point where the leadin enters moist earth. Theoretically, this current will travel an infinite distance around the conducting surface of the earth, its amplitude gradually diminishing and approaching zero as the distance from the starting point becomes greater. A ground antenna placed in the path of this current and pointing at the transmitting station would act as a shunt around part of the earth and would receive a current depending upon the relative resistance of the earth and the wire. The longer the wire, the greater the current should be, provided the wire resistance did not increase so much as to nullify the effect of the added voltage drop due to the increased length. If the wire were placed parallel to the approaching wave front, no current should be picked up. This was found to be the case.

Regarding the "daylight effect," the writer has no explanation to offer, and can merely say that the effect described herein was also noticed by Mr. Schilling on many occasions, particularly on signals from Annapolis. It would be interesting to hear in the columns of this magazine from other experimenters who have investigated along these lines, and if possible get the results of their observations.

VOICES OF THE NIGHT

By EARL ENNIS.

From the far magnetic spaces where the Northern lights flare forth;
From the warmer Southern oceans far below;
From the distant Eastern reaches, where the oldest races live,
And the Oriental traders come and go;
Through the night come faint-flung whispers, in a score of different tones—
In a language with a queer and rhythmic flow—
And we smile in odd contentment as the conversations flit.
There all a bunch of voices that we know.

Oh, it's chatter, chatter, chatter,
From a thousand copper strands,
Through the fogs and mists and storm-winds
Of a dozen different lands;
From a tanker off to leeward,
From a freighter out of sight—
It's an endless, ceaseless babble
By the voices of the night.

When old Behring Sea is frothy and the ice floes madly swirl,
And a vessel plunges northward through the dark,
There's a mighty heap o' comfort in that gabble off in space,
When you come across a friendly little spark;
When you hear far Sitka's whistle, and old Estevan's hee-haw,
And the peanut-whistle accent of an arc,
And some compass station operator wags a friendly jaw—
And you slip a ball score over for a lark.

Oh, it's chatter, chatter, chatter,
From a thousand copper strands,
Through the fogs, and mists, and storm winds
Of a dozen different lands;
There are many occupations
On this footstool here below,
But they haven't got the pal-ship
Of the friendly radio.

THE C. W. MANUAL

Continued from page 18

iable and the inductance L_1 represent a dummy antenna circuit for the radio-phone T. C_2 is a capacity sufficiently large as not to affect the period of oscillation of the circuit $C_1L_1C_2$ plus the internal circuit of T. This capacity together with that of C_8 are placed in the circuit to prevent a shortcircuiting of the source of high potential to the power amplifier and T. The potential variations across the inductance L_1 are impressed upon the grids of the amplifier tubes, which, with proper circuit adjustments, reproduce the output of T in greater magnitude depending upon the size of the tubes A and B. The adjustment of L_1, while quite critical, is not difficult to make.

The proper procedure for adjusting such a circuit as shown in Fig. 21 is as follows: Adjust the circuit C L_2 C_3 to the wavelength desired by moving the variable contact D along the inductance. Then adjust the capacity C_1 until the antenna current is a maximum and at the same time alter the

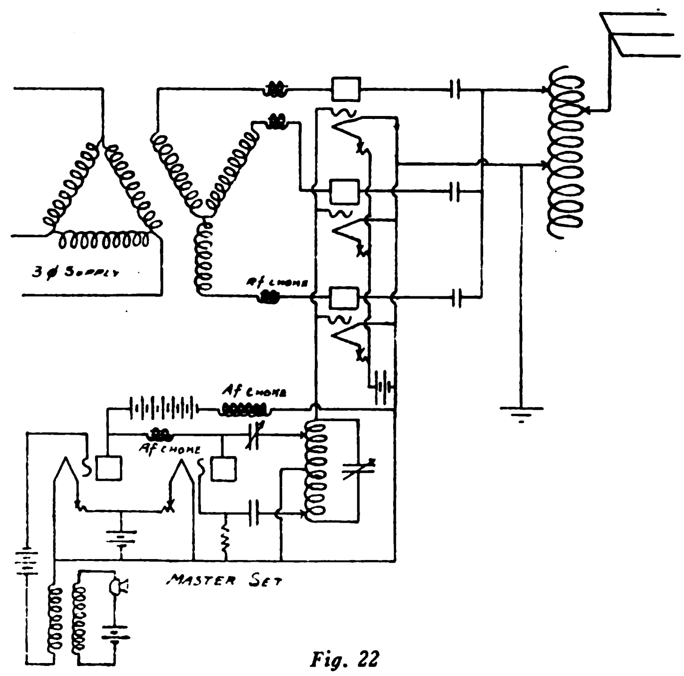


Fig. 22

position of the tap E to obtain the best value of grid potential. Last, shift the plate tap, F, until a second maximum antenna current is obtained. Using a simple arrangement of this kind employing a Western Electric Company 5 watt phone set at T and two 5 watt tubes in the power amplifier, a laboratorian at Mare Island, California, succeeded in communicating by voice with an amateur in Portland, Oregon, a distance of approximately six hundred miles. In a similar manner much larger tubes at A and B could be controlled by T, giving a greater range of communication. The details of a 10 watt power amplifier such as the one described above will be forthcoming in a later chapter.

Fig. 22 shows a 5 watt voice amplifier controlling a 5 watt oscillator which in turn controls the entire output of a 750 watt power amplifier supplied by three phase alternating current at 4,400 volts. The efficiency of such an arrangement is very great when compared to that of the power modulator system of control and very little voice distortion is obtained.

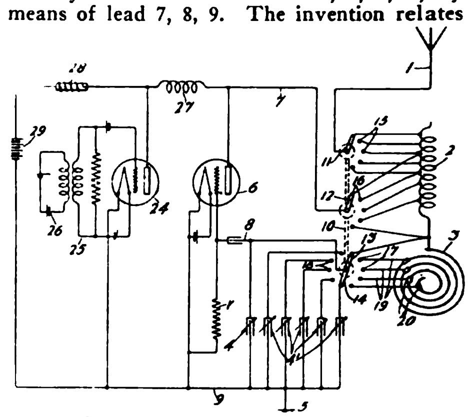
PATENTS

Continued from page 32

is also an interlocking scheme between the three keys 41, 42 and 43 whereby while 41 is transmitting, the other two are prevented from so doing, and while 42 is transmitting, 43 is prevented from so doing.

L. M. Clement, Pat. No. 1,395,390, Nov. 1, 1921. Oscillation Generating System.

An oscillation generating tube 6 is coupled directly to an antenna circuit 1, 2, 3, 5, by means of lead 7, 8, 9. The invention relates



to an efficient and simple means for changing the wavelength transmitted. For this purpose, a common shaft 10 carries all the contact arms 11, 12, 13 and 14, which coact with taps to vary respectively the number of turns of coil 2 in the antenna circuit, the number of turns of coil 2 in the plate circuit of tube 6, the number of turns in coil 3 in the antenna circuit, and the capacity between the grid and filament of the tube 6. By properly choosing the points where the taps connect, it is possible by a single movement of shaft 10 to change from one wavelength to another.

J. H. Payne, Jr., Pat. No. 1,400,235, Dec. 13, 1921, method of and means for producing alternating currents.

An oscillating tube is described, in which electrostatic coupling 12, 13 and 14 are provided between the grid and plate circuits. By tuning the circuit 8, 13, 10, 14, including two of these couplings and two inductors in the grid and plate circuit, to a frequency materially less than the oscillations set up in the tube by coupling the grid and wing circuits, it is possible to radiate groups of waves of the high frequency, the group frequency being determined by that of the circuit 8, 13, 10, 14.

H. F. Elliott, Pat. No. 1,399,945, Dec. 13, 1921, radiotelegraphy.

A transmission system is described in which signaling is effected by simultaneously closing and opening a number of circuits 7 inductively coupled to the antenna loading coil 6. These circuits 7 overlap each other to the proper extent so as to eliminate any mutual induction between themselves. The closing and opening of these circuits is effected by electromagnetic switches operated from a common source.

H. J. Round, Pat. No. 1,395,987, Nov. 1, 1921. Wireless Signaling Apparatus.

This patent describes a scheme for keeping the wavelength of the aerial constantly equal to that of an oscillating circuit which supplies the aerial with radio energy. This is accomplished by the use of a circuit C coupled both to the aerial circuit A and the oscillating circuit B. Two windings D are provided, at right angles to each other and in circuits C and A. The member E is a secondary of an induction motor and so arranged that if the wavelength of circuit A is equal to that of C, then there is no torque exerted upon member E. If there is a difference, E rotates and operates a variometer F which is in series in the aerial circuit A, so as to bring the wavelengths into equality.

SUNSET RADIO CLUB

At the last regular meeting the following officers were elected for the ensuing year: President, A. A. Hudgins, 6IZ; Vice-Pres., Edward Kinney, 6ACK; Secy., G. MacMullen, 6AL. Traffic Committee—Chairman, A. A. Kramer, 6EV; John F. Gray, 6MZ and A. A. Hudgins, 6IZ. Program Committee—Chairman, W. W. Dann; Lawrence Mott, Edward Kinney. The Program Committee is to arrange for a scientific paper for each regular meeting throughout the year. For the first meeting in January a paper on High Versus Low Antenna by 6ZB is announced.

6TW, Eugene R. Merritt, having returned from duty with the shipping board has assumed the head of the Radio Department at the Southern Electrical Co. and is busy visiting the various stations throughout his territory in an effort to be of assistance wherever possible.

6BAZ, Mrs. Mary Houston, has entirely remodeled her transmitter and is now using a ½ Thor putting 4 amps into an 80 ft. antenna. The club wishes some of the DX chaps would QSL our Y. L. operator.

6ADA, having completely rebuilt the station at a new location, is now reaching out in his old style.

6MZ recently suffered an attack of acute high voltage and is re-insulating prior to recontinuing with the Sink 1 KW Jefferson.

6AJH has returned home from the hospital but will be bedridden for a while. His station has been remodeled principally through the kindness of Dudley Chambers, 6AHF, and 6AJH will probably be on the air before this is printed. The club hopes that Lester will be given plenty of chance to operate without QRM whenever he is able to touch the key.

A new station is being erected in Coronado by George Remington, using ½ Thordarson, Surdam enclosed gap, and say, you fellows in the sand lots, take notice—*a sea water ground!*

6MZ reports satisfactory progress for DX messages handled in his section. Those stations particularly active being 6FK, AEH, 6ZB, 6KC, 6AKL.

6FK holds the local record for long distance receiving and is also going some on his spark set. Only lack of time prevents him from handling the major portion of the A. R. R. L. traffic.

6EV is never heard from any more. He is our star operator, an old stock exchange Morse man. Those trying to do DX work wish he would come in and personally act as traffic officer every night until our conduct is perfect.

A new C. W. station will shortly be installed by W. W. Dann at 1258 Cypress Ave. No license number has been received to date. 50 watt tubes will be used.

6AHF has built an entirely new plant with a 90 ft. mast and expects to QRM New York shortly.

The village of Bolinas, Calif., according to "*World-Wide Wireless,*" published by the Radio Corporation, has the most wonderful damped wave phone known to the radio art. Most of us have been under the impression that it was necessary to have undamped waves for the operation of telephones; nevertheless, the writer can make an affidavit that the telephone connecting the village of Bolinas and the village of Willow Camp literally operates on the damped wave principle. The two villages are connected by a farmer's line, strung on poles across the shallow bay. When the tide is in and the wind blowing from the southwest, the waves from the waters of the Pacific periodically wash over the telephone wires, and as a result the voices are intermittently cut off. If that isn't damped wave telephony, what is?

JIMMY'S WIRELESS

(As told to the poet)

I've got a wireless set at home.
I saved to beat the band,
And thought that when I had it all
It surely would be grand.

But, dern it! All the family
Just butt in all the time,
Though when I saved to buy the things,
They never helped a dime.

There's Bud; he wants the baseball score.
I find him every noon
Just using up my batteries—
I'll need some new ones soon.

And Sis brings all her friends around
To hear the music play.
When I come home from school I find
Them monkeying every day.

And, after supper Dad comes 'round
And says: "How goes it, Jim?
Here's Jones and Smith to hear some tunes."
And 'course that, too, means him.

They hang onto my head-sets then
The whole two hours long—
The only chance I get to hear
Is when something goes wrong.

And Mamma seems to think I'm mean
Because, of afternoons,
I can't go with her to the church
And have it play some tunes.

I guess she thinks it's somethin' like
A phonograph, by Heck!
But 'cause I don't produce the goods
She jumps right on my neck.

I'll tell the world it's pretty tough
To work and get a set
I never have a chance to use—
I've scarcely heard it yet.

—A. H. HUTCHINSON.

STATIONS HEARD AND WORKED BY 6ACM, 1700 SONOMA AVE., BERKELEY, CALIF.

Spark—6ak, 6bm, 6da, 6dp, 6ea, 6eb, (6ef), 6en, 6er, 6fd, 6fh, 6fk, (6gf), (6gp), (6gr), 6gt, 6gx, (6is), (6iv), (6ka), 6kc, 6ki, 6km, 6kp, 6ks, 6kv, (6ky), (6lc), (6mh), 6od, 6oh, 6ol, 6om, (6qr), 6tf, 6to, 6tv, 6uo, 6vv, 6vz, 6wh, 6aab, 6aak, 6aas, 6aau, 6abm, 6abp, 6abw, (6abx), 6acy, 6acz, 6adg, 6adl, 6aeh, 6aei, 6afn, 6afy, 6afz, (6agf), 6agm, 6agp, 6aha, (6ahp), (6ahu), 6ahv, 6aib, 6aif, (6aio), 6ajh, 6akl, 6akw, 6all, 6alp, 6alu, 6amn, 6anp, 6arw, 6auh, 6avb, (6avd), 6avv, 6avy, 6bak, 6baz, 6bez, 6zb, 6zu, 6zx, 6zz, 6zal, 7ah, 7bb, (7bh), 7bj, (7bk), 7br, 7bs, 7fi, (7hf), 7in, (7jw), 7kb, 7ke, 7kh, 7kq, (7mf), 7mu, 7nl, 7nw, 7ot, 7oz, 7tj, 7ya, (7zj), 7zk, 7zn, 7zt, 7zu, 9ax, 9cp, 9ed, Can. 9bd.

C. W.—6dp, 6pr, 6abg, 6abx, 6ajh, 6ale, 6alu, (6aoy), 6aoz, 6xab, 6xad. 7xf (cw and music).

Daylight—6bm, (6gr), 6is, 6ka, 6kc, 6ki, 6km, 6mh, 6pr, 6abx (cw and spk), 6acy, 6afy, 6agf, 6aif, 6avb, 7ah, (7bh), 7bk, (7mf).

CALLS HEARD AT 6AIF, BAKERSFIELD, CALIF.

Spark—5vq, (5za), 5zj, (6aah), 6aau, (6abw), (6abx), 6ac, (6acr), 6acy, 6ada, 6aeh, 6aei, (6aez), 6afn, 6afy, (6agf), (6ah), (6ahp), (6ahv), 6ahy, (6aib), 6ail, (6aio), 6ajr, 6ak, 6akl, 6akt, 6ala, 6all, (6alp), 6alu, 6amk, (6amn), (6ang), 6ani, 6aoa, (6aoe), 6ape, 6ark, 6arw, (6as), 6atq, 6atv, 6au, 6aud, (6avb), (6avv), 6awh, 6bak, 6baz, 6bcj, 6bfe, 6bfx, 6bgl, 6bw, 6cv, 6cz, 6da, 6dm, (6ea), 6eb, (6en), (6ex), (6fh), (6fk), 6gf, 6gp, 6gr, 6gt, 6gx, (6hc), (6ib), 6ik, 6is, 6jc, 6ka, (6kc), 6kp, 6ks, 6ky, 6lc, 6lu, 6mf, 6mo, (6mh), 6ng, (6oc), (6od), 6oh, 6ot, 6pc, 6pj, (6pr), 6pt, (6qr), 6sc, 6sj, 6st, (6tf), (6to), 6tu, 6tv, 6uo, 6vk, (6vx), (6wh), 6wo, 6wz, 6yn, 6zal, (ex 6ka), 6zam, 6zb, 6ze, 6zu, (6zx), (6zz), (7ba), 7bh, 7bj, 7bk, 7cw, 7fi, 7ft, (7hf), 7ij, 7in, 7iw, (7jd), 7kb, 7ke, 7ly, (7mf), 7mp, 7mu, (7ot), 7tj, 7ya, 7yg, 7zb, 7zo, 7zp, 7zt, 7zu, 9wu, 9yal, Canadian 9ax, Canadian 9bd.

C. W.—(5za) (cw and fone), 6aat, (6abx), (6ale), 6arc-(icw), 6asj, 6asx-(icw), (6aul), 6avy, 6awt, 6awv, 6dr-(icw), 6jd, 6jq, 6jx, 6km, 6oo, 6wv-(cw and fone), 6wz, (6xad), 6za, 6zad, (6zn), 7xf-(cw and icw), (9amb), 9bex, 9dtm, 9dva, 9nx, 9xm, wl2, cl8, ag1-(fone), and "mc" (Chihuahua, Mexico).

HODEYCOBE MICRAFERRIS BROWN

Continued from page 54

ment on his grandmother, who was in the neighborhood of some 125 years, Chief Ungus and his suite called upon Hodeycobe one afternoon.

"Chief says make grandmother young," grunted the interpreter.

"Tell chief ah am busy today and come later."

"Chief say no. Chief say plenty time now get ready. You do now."

The wrinkled old mother of a decidedly plural progeny stepped forward. She was adorned with wrinkles an inch deep. She was all that age implied—gray, stoop-shouldered, toothless, weightless and nearly clothesless. The skin clung to her bones and her flesh was fast disappearing.

Hodeycobe realized that putting "pep" into this poor unfortunate would be comparatively as easy as shaking hands with Friday through an introduction of Robinson Crewsoe. The moment had arrived whereby he was through. His two partners looked on in profound silence. They, too, felt the end was near.

Hodeycobe's brain, however, was not entirely dumb and he got busy therein. He had the woman step close to the apparatus. They started the old gas engine and the generator wheezed a tiny spark at the touch of the key. After much ceremony he had the woman hold a wire in each hand. One was a ground and the other the power lead.

"Now, lady, stand right quiet like because dis am whut yo' call a major operation. Dis am de wonderful invention of all times. Yo am gwine be young again and do de jazz like de spring chicken."

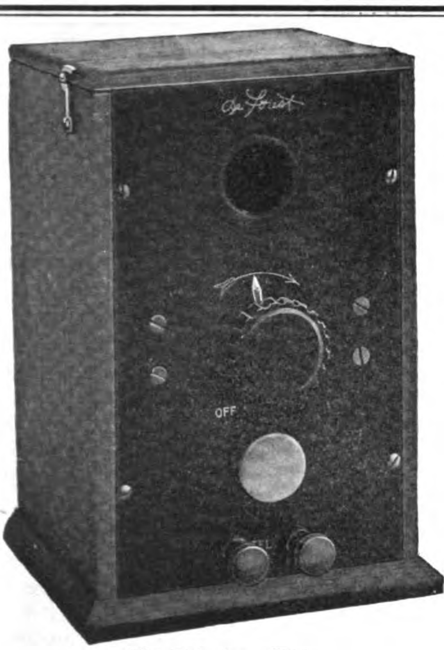
The interpreter was translating the words to the chief, who seemed greatly interested. Outwardly Hodeycobe was calm, but inwardly directly the opposite.

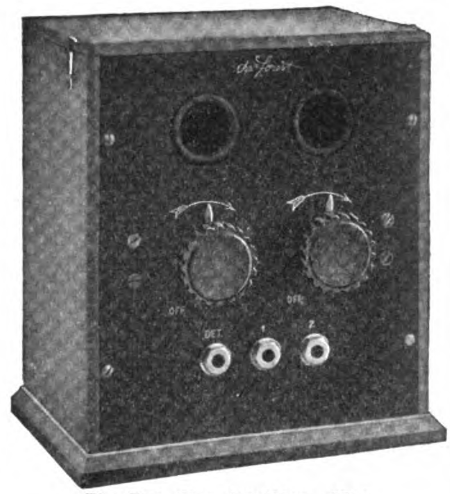
The current was then shot into the lead she held. Her eyes rolled to the clouds and her mouth came shut so abruptly that her tongue did not have the proper opportunity to escape. It was a cruel trick, but Hodeycobe was in a cruel position. She dropped to the floor, the old generator surprising Hodeycobe as much as anyone. Heavens, what a kick!

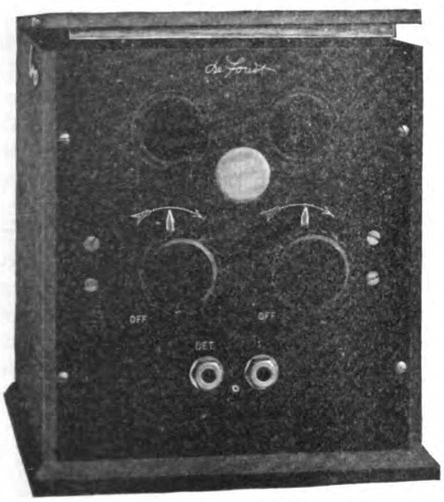
"My friends," began Hodeycobe, standing over the form of the electrified female, "she am now in de sleep of youth. If yo' all will kindly migrate from heah and leave us alone ah will be greatly appreciative. Come again tonight."

The chief went out, followed by the party, an implicit believer in the achievements of the great Hodeycobe. They chanted a war song of thanksgiving.

Hodeycobe picked the lady up and laid her behind a screen. He was about to bind and gag her when he thought he noticed an expression on her face that did not bespeak life. He quickly felt of







her pulse. There was none. She had passed away.

"Well now dat entangles me still moah. Now dey can try me for fust degree murdah. Goshamighty why and which. Wheah shall I do and what shall I go," he chattered inadvertently. She was certainly dead. Not even a flicker of the eyelid.

Under cover of darkness he carried her to a nearby thicket and covered the body with ferns. Carefully he concealed all visible signs and walked slowly back to his hut. He felt sorry for the poor old woman, but she certainly had lived to a point where it was now nothing but suffering. He lay down on the mat which served as a bed and fell into a troubled slumber.

TO the south and east of Zoogoo, some twenty miles distant, is the Isle of Honyok. Here reigns Chief Gugluck, a forceful character. The one thing that was foremost in the life of Gugluck was his daughter, Princetta.

This young lady had heard of Hodeycobe's achievements on Zoogoo from a spy of her own tribe. The menfolks of Honyok had no attraction for her and long since she had given up the idea of matrimony within that group. It must be a great man from a distant country. The spy's narrative of this young man, a captive on Zoogoo, seemed to fit her ideal to perfection.

Early that night she stole quietly through the sleeping village and pushing her catamaran into the water, pointed its nose for a distant speck—Zoogoo Isle. This was certainly brave on her part, as the Gugluck Malays were deadly enemies of the Zoogoo tribe. But Princetta was a daring young beauty and cared not for danger. She had no plans except that when she did get on the island that she would immediately find her man. She had not a doubt but what he would accept her. Never had there been a thing in the world that she wanted but what she did not get.

She arrived early in the morning. Landing beneath a huge palm tree she carefully concealed her canoe and made her way stealthily through the long grass. She soon located the hut of Hodeycobe by the antenna on the trees. Everything was as the spy had said. She made her way to the rear of the hut and crawled under without so much as the crack of a twig. Lying on a mat was Hodeycobe in his troubled slumber. As she was about to awaken him she heard footsteps approaching and slid behind a screen.

It was the committee to see the result of the age experiment.

When the party entered the room their keen eyes darted hither and thither. One of their number awoke Hodeycobe. They had brought with them Hodeycobe's two friends who had been as-

signed to a separate hut. The thing had been planned so that if the experiment failed the three would be together for the final jamberee. No chance for escape.

Knowing full well it was foolhardy to stall further he decided to bluff, and turning toward the back of the hut said:

"Ole lady, if yo' evah done sumthin' foah a fren', do it now. Spirit of de spirits now is yo' time to save a life. Dat life is mine. Come forward to de rescue."

Now the daughter of Chief Gugluck was in a peculiar circumstance. There was nothing for her to do but to come out, and she did.

Hodeycobe staggered.

His two friends suddenly became weak in the knees.

The committee fell upon their knees at the feet of Hodeycobe—scientist par excellence.

Hodeycobe collected himself together in surprisingly double quick time. He arose to the emergency in beautiful style. This was probably the American in him. He did not have the slightest idea how this transposition came about. Anyway, that was the least of his troubles now. He must seize the opportunity.

"Brethren, befoah yo' all stands not a miracle, but a fact in flesh an' bone. Men, yo' is sons of the South Seas. Yo' brains and brawn speak fo' yo' 'telligence."

Here he laid his hand tenderly on the shoulder of Princetta, who winced under the touch of her noble ideal. She was proud of him. He stood so high, so noble, and commanded the attention of his hearers. She was indeed happy. She could not understand what it was all about, but nevertheless it mattered not.

"Heah's de ansuh to yo' great chief. Take dis young lady to him and say foah me that 'heah am yo' grandmothuh transfohmed to sweet sixteen.' It's the old lady whut now ain't.".

Princetta now found herself carried to the old chief. This worthy gentleman was nonplussed. He gazed at the girl, trying vainly for a resemblance to his grandmother. He was also thinking of the wonderful achievement of this venerable unknown. He actually displayed outward signs of extreme delectation which was certainly unusual. To bring a smile to the countenance of Chief Ungus was a feat long desired by all. He was absolutely and profoundly satisfied.

BILLY EASTON and Carbolic Acid Johnson, since the apparent accomplishment of their companion, were given more freedom. They wandered hither and thither in the village, but always under close surveillance. They had often vainly tried to get in touch with the young Beauty Princetta. But one day they spied her on the hillside gathering flowers. They noticed too that she cast longing glances toward Hodeycobe's abode, but she dare not go there, as she had been foiled in the attempt several times. It would never do to let her fall in love with a foreigner.

Now two old heads like Billy and Carbolic were not to believe that this young thing had been older than she now stood. Carbolic took it upon himself to get a little information. An idea had already framed itself in his mind.

"You come see great man?" he asked.

Ah! Her eyes brightened. She straightened and drew a deep breath. Carbolic had hit the nail on the head.

"Why?" she asked in English.

Carbolic was so enthused for the moment that he was almost caught off his guard and would have spoken in a louder tone had not his friend stepped in and cautioned him to be very quiet lest they be heard.

"Good," whispered Carbolic. "Can you catchum a boat foah us tonight? If yo' can get us a boat ah will take you to de great man Hodeycobe."

"Hodeycobe," she said softly, and repeated it over and over again.

"Yes, Hodeycobe, de great man who yo' all like so well." This was another chance and it went home well. Carbolic could see it all now.

Without a word she turned and led them down the hillside and into the dense foliage that surrounded the clearings. Hidden under the spreading branches of a tree was her catamaran.

"What foah yo' ask about that boat?" inquired Billy.

"Just follow yo' daddy, kiddo, and trust to luck. I'se got a plan and if I can get back and carry it out befoah dat old chief eat-em-alive takes a notion he wants to be young again, then I'se win, and we go scot free, boy, scot free. We will go theah in the night and we'se gonna kidnap a baby."

"Baby?"

"Zacly, and we'se gonna bring him heah."

DESTROYER No. 1076 was on foreign duty. She had no special assignment, but was moving along under quarter steam more for the purpose of making a breeze to cool the sweating brows of the crew.

In her wireless room sat First Operator Quigley. Quigley had been hearing the most spooklike signals for two nights. They were getting on his mind so much that he dreamed of them. After one more night of the same experiences, Quigley could stand it no longer. He made a bee-line for the commander's room. Knocking on the door he was told in a pleasant voice to "come in."

Commander Jimmy Goldfield was a young fellow, good looking, energetic, and otherwise. If he could smell adven-

HEARD AT 6ALL, PASADENA, CALIF. DEC. 21 TO JAN. 4.

5ad(cw), 5if, 5mj, 5of, 5za(spk-cw), 6ak, 6dd, 6dp, 6ex, 6fh, 6gf, 6gr, 6gx, 6ic, 6je(cw), 6kc, 6kn, 6nq, 6pr, 6qr, 6sj, 6tf, 6to, 6tu, 6tv, 6uo, 6vm(cw), 6vx, 6za, 6zb(cw), 6zu, 6zx, 6zz, 6aah, 6aak, 6aau, 6aax, 6abw, 6ada, 6aeh, 6afn, 6agf, 6agx, 6aif, 6aio, 6akl, 6alw, 6anf, 6anp, 6atq, 6auc, 6awh, 6baq, 6baz, 7bh, 7mf, 7tj, 7zm, 9xm(cw), 9wd(cw), 9amb(cw), 9ayu(cw), 9dtm(cw), 9dva(cw), 9xaq(spk-cw), 9xaq.

HEARD AT 6AWT FROM NOV. 28 TO JAN 5

5za-cw (vy qsa 8 ft. fm cans.), 5zx, 6ea, 6eb, 6gf, 6gp, 6gr, 6gt, 6gx, 6ka-spk-cw, 6kl, 6kp, (6ky-spk-cw), 6mh, 6od, 6oh, 6qr, 6zu, 6zx, 6zz, 6abg, (6abx-spk-cw), 6adl, (6ale-cw), 6alu, (6ahp), (6aib), 6aif, 6aio, 6amk, (6xad-cw), 6zal, 7aw, 7ba, 7bb, 7bh, 7bk, 7br, 7cw, 7fi, 7gb, 7ge, 7gj, (7hf), 7in, 7iw, 7jd, 7jf, 7jw, 7kj, 7ly, 7mf, 7mp, 7nl, (7nn), 7tj, 7xf-cw voice, buzzer, 7ya, 7yg, 7yl, 7zj, 7zt, 7zu, 7zx, 9ax Canadian, 9bd Canadian, 9??-400 cycle spk on around 4:45 a.m. Dec. 11, 9dva-cw very qsa 2 ft. fm cans., qra ? pse, cl8-cw.

HEARD AND WORKED BY 6ABW AT ROSEVILLE, CALIF.

4id, 4cb, 5ib, 5za, (6as), (6avd), (6aib), (6aif), (6aau), 6aeh, (6aio), 6agf, 6agp, (6ahp), (6ajw), (6akl), (6amn), (6acy), (6adl), 6amk, 6aoz, (6bm), (6baj), (6bet), 6baz, 6cu, (6dd), 6ea, 6ex, 6eb, 6en, 6fk, (6iv), 6is, 6jy, (6kc), (6lc), (6mh), 6ot, 6pr, 6qr, (6tu), (6to), 6tv, 6vx, 6wv, 6xad, 6xac, 6zr, 6zam, 6zn, (7br), (7bh), (7bj), (7bk), (7fi), (7gj), (7hf), 7iy, 7im, (7kb), (7lo), (7mf), (7mu), (7jw), (7nn), 7ot, 7mo, 7pm, (7rn), (7tj), (7my), 7wa, (7xf) cw phone and music, (7zj), 7zu, 7zv, 7zg, 8agl, 8zg, 8cl, 8uj, 8zn, 9ax, 9bd, 9aja, 9air, 9ayu, 9bbf, 9dva, 9dtm, 9yal, 9blo, 9xaq, 9if. Messages handled in last two weeks, 65.

CALLS HEARD AND WORKED BY 7ZT, PORTLAND, ORE.

(Canadian 5ak), (Canadian 5bi), (Canadian 5fe), (6as), (6cv), 6dd, (6dp), 6ea, 6en, (6ex), (6fh), (6gr), 6gt, (6gx), 6gy, (6hc), 6hp, 6id, 6is, (6ka), 6kp, (6ky), 6lc, (6mh), 6oh, 6ot, (6pr), (6qr), 6qs, 6to, 6tu, (6uo), (6vx), (6wz), 6zm, 6zr, (6zx), (6abw), 6abx, (6acr), (6acz), 6afn, 6afy, (6agf), (6ahp), (6aib), 6aju, 6alp, 6amk, (6ang), (6ark), 6avv, (6bbr), (6bca), (6zal), (6zam), (7ba), 7bf, (7bh), (7bk), 7bz, 7cd, (7fi), (7ge), (7hf), 7iw, 7iy, 7jf, (7ke), (7kj), (7km), 7ly, (7mf), 7mo, (7mp), 7mu, 7nj, (7nl), (7nn), 7np, (7tj), 7vg, 7vo, (7vz), 7wa, 7wm, (7ya), 7yj, (7yl), 7ys, (7zh), 7zm, (7zp), (7zu), 7aal, (Canadian 9ax), (Canadian 9bd).

C. W.—(Canadian 4cb), 6jd, 6jq, (6ka), (6vm), 6aif, (6ale), 6xad, 6zad, (7go), (7rn), ture his nose led him there. After listening to Quigley's short description of the disturbing signals he thought for a few moments.

"Quigley," he said, "can you trace the sounds?"

"I think so, sir. I have rigged up a temporary rangefinder and have determined the general direction."

"What is it?"

"South by east, sir."

"Good. I'll turn the ship over to you. Give orders up the speaking tube to the pilot and he will follow you. There's nothing like getting to the bottom of this, and we haven't anything else to do."

"SAY, for the love of Mike, keep that spalpeen quiet," warned Billy to Carbolic Acid, who had a pop-eyed papoose in tow as they stole along toward Hodeycobe's hut. They had been to the neighboring isle and had kidnapped a kid.

They went along quietly until they reached Hodeycobe's hut. There were voices inside. Peeking through they discovered the owners of these voices. One was Chief Ungus. He had come to be made young. They were just in time. The natives were gesturing with Hodeycobe, who was sweating profusely and sparring for time. The chief would not listen to argument and through his interpreter made it known that he wished this parley closed abruptly and action to begin. Hodeycobe was to make him at least forty years younger. If he wished to take off more than forty years that was optional.

Hodeycobe appeared so nervous that he could scarcely stand. He bade the worthy monarch be seated. This gentleman leaned with his head against the back of the hut.

Carbolic Acid, the man that got his name for his ability to drink home made stimulant, raised a heavy club he had found on the beach. It descended against the spot whence the shadow of the chief's head was protruding. Wham! The chief dropped without even so much as a grunt. The mighty stroke was well aimed.

This performance was not noticed by his body guard, who were so engrossed in examining the queer machinery and the thud of the blow was drowned out by the chug-chug of the wheezing gas engine which Hodeycobe had started for the chief's benefit.

Hodeycobe turned to look at the chief, perhaps having some word for him, and to his amazement beheld the pride of the Zoogoos flat on his muscular back.

About the same time an idea popped into his head. Why not serve the chief as he did the old lady? He quickly turned to the body guard and told them that they must now leave, as the chief was in the "sleep of youth as was the old lady." Without a word they filed out.

By this time their respect for Hodeycobe knew no bounds.

Hardly had the last man of the guard made his exit before his two companions jumped into the hut. They secured ropes and worked like mad to bind the chief securely. He was gagged safely, hurried down a path to the beach, and placed in a cave whose entrance was covered so that prying eyes may not see. Cannibals' eyes are infernally sharp, they had learned.

Rushing back to the hut, Carbolic unwrapped the baby from the blankets and took him inside. Hodeycobe then saw the idea for the first time. He was overcome. Tears streamed down his face. He hugged his companions feverishly.

The child, awakened by the commotion, set up a wolf howling chorus compared to which the ordinary wailings of a hungry civilized baby were as a blissful silence. This aroused the entire village, and with cannibal curiosity, they rushed toward Hodeycobe's hut. A fighting mass of humanity struggled to gain entrance that they may see the latest in reducing age.

Their chief had been transformed. There was no doubt of it. Had they not left him there, and now sitting on the very same chair was a strange infant. The seven picked men, body guard of the monarch, picked up the child and bore him to the tribal meeting grounds beneath the shining stars.

The ceremonies were on.

EARLY the next morning, while the feasting was still in progress, destroyer No. 1076 nosed her way in between the coral bars toward Zoogoo. When a mile off shore the crew was very much surprised to see three men rush to the water's edge, plunge in, and make for the ship with a wickedly speedy stroke. They soon covered the distance.

The natives were too overjoyed to pay attention to their escape.

Captain Goldfield stood on the bridge and watched the proceedings through a glass. They had traced the strange sounds to this rendezvous.

Far back on the island Commander Goldfield caught sight of a solitary figure running like the wind and waving a war club. On the face of the figure was a terrible expression. His whole countenance reminded one strangely of first degree murder.

It was King Ungus.

But that which surprised him most was the form of a girl, rushing to the water's edge. She dove into the surf and made for the destroyer. It was Princetta—erstwhile grandmother apparent—rushing to her lover—Hodeycobe Micraferris Brown.

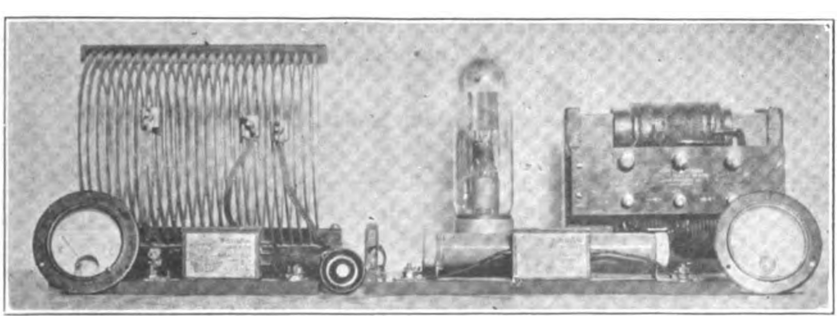
THE END

DESCRIPTION OF C. W. TRANSMISSION SET AT 6AWT

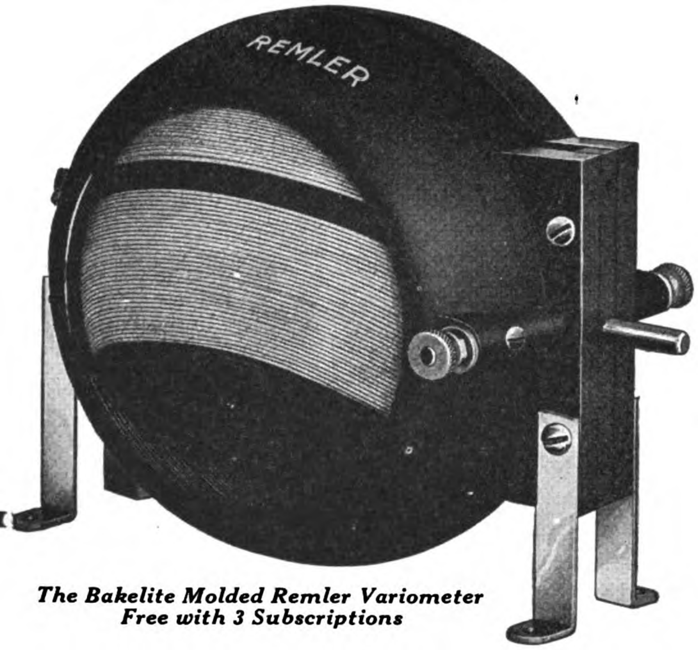
For transmitting one 50 watt Radiotron power tube is used with 750 or 1300 volts, 60 cycle, a. c. on the plate. The filament is run on a. c. through an Acme 150 watt filament transformer. Radiation varies from 2 amps on 750 volts plate to 3.1 amps on 1300 volts. At present, due to transformer trouble, the set is run on 750 volts. Radio Corporation apparatus is mostly used. The transmitting aerial is a 4 wire L type, 30 ft. long with a 60 ft. leadin. The aerial is on 16 ft., 10 ft. and 6 ft. spreaders. At the free end it is 60 ft. high. Water pipe system is used for a ground.

The receiving equipment consists of a Grebe CR 8 receiver with a home-made 2 step, using R. C. U. V. 712 transformers. Ordinarily, the first step is used for receiving. A single wire aerial 100 ft. long and 70 ft. high is used.

Until recently a 20 watt C. W. set was used for transmission. With 500 volts d. c. on the plates, the radiation was 1.5 amps. Plate current was furnished by an Esco 125 watt, 500 volts motor generator. For voice, 2 tubes were used as oscillators and 2 as modulator. On voice, radiation was 1 amp. For buzzer and C. W., the four were used as oscillators. C. W. from this set was reported as being received at a distance of 900 miles. Same distance has been easily covered on new C. W. set.



C. W. Transmitting Set at 6AWT



The Bakelite Molded Remler Variometer
Free with 3 Subscriptions

Save The Most Offer Ever the History

Think This Over:

You want the best that money can buy when it comes to purchasing radio apparatus, in order to get maximum results. You also want to read the best publication in print when it comes to radio literature. But these cost money, and here is a plan for getting both at the cost of one.

You should read every word of this advertisement carefully in order to realize its importance—its plan for saving you many dollars in your radio purchases and the remarkable assistance it renders you in getting what you want—at half the regular price.

You can have one of the following premiums FREE for securing three subscriptions to RADIO: Remler Type 500 Bakelite Molded Variometer; Remler Type 504 Bakelite Molded Variocoupler; Remler Honeycomb Coil Mounting; Pen Brand 43-plate Variable Condenser; Pen Brand 23-plate Variable Condenser.

And all of the above instruments are the very latest in radio perfection. The Remler products are well known and need no introduction. The Pen Brand Variable Condenser is the last word in construction, permanence and beauty. You will be proud to have these instruments in your station.

Subscribe for One Year and Get These

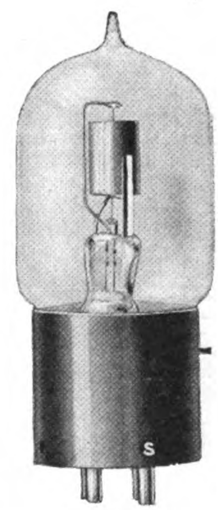
Perhaps it will be difficult—or impossible—for you to secure three subscriptions to RADIO. You may want to subscribe in your own behalf for one year, and we are going to give you choice of one of the following premiums with your own subscription:

Remler 3-inch Bakelite Dial and Knob; Remler Polished Bakelite V.T. Socket; Remler Filament Rheostat; Pen Brand Grid Condenser; Remler QSA Coil, up to 100 turns; Latest License Quiz Book; Remler Variable Grid Leak; Remler Switch, Knob and Blade.

Some of these premiums retail at $1.50. Imagine the saving! You get as much as $3.50 worth of radio usefulness for $2.00. Isn't this worth while?

SEND $2.00 FOR YOUR SUBSCRIPTION AND 12c FOR MAILING THE PREMIUM

The Latest Pen Brand VERNIER VARIABLE CONDENSER
FREE WITH TWO SUBSCRIPTIONS
Ideal for C. W. Tuning. Mailing Charges, 15c.



TUBES

Send us three one-year subscriptions to RADIO and you can have one of the following tubes as a premium:

A.P. Electron Relay Detector Tube.
A.P. V.T. Amplifier Oscillator Tube.
Cunningham C-300 Detector Tube.
Cunningham C-301 Amplifier Tube.

POSITIVE

1—We positively guarantee all premiums to be exactly as represented.

2—Premiums are genuine in every respect, standard and tested.

3—All premiums are NEW. No second-hand or rejected apparatus of any kind.

4—Premiums are shipped to you directly from the manufacturers in San Francisco.

5—Each instrument is thoroughly tested before leaving the plant.

WITH SUCH A SWEEPING GUAR-

NOGO EMITS SOME SHARP BATTLE-WHOOPS

(Translated from the Walsirwinese by David P. Gibbons.)

To Editor RADIO (which sheds free spark-light on Pacific at very nominal cost-price).

DEAREST SIR:—

A fews days past ago my Cousin Scratchi returned himself here from sea trip to borderland of hot tamale Mexican country, which are now nearly altogether at peace, account of jazzing of business by bootleg magnets and race-trakkers.

"How are all the little things?" I slang him, after the customer salute.

"You try and see," respond Cousin Scratchi with rye smile, making sleight fishout from stern pocket, "dispenser who sell me this say it has been proved most highly."

"No more proof needed," I refuse thankfully in Volsteady tone of voice, "I appreciate to know what you learned, if any such, about wireless situations while ocean voyaging."

"Oh! quite much indeed," snagger Scratchi; "I have listened tightly to the commercial amateurs on two hundred and thereabove, and the amateur commercials with nervous key-fingers, and also I too discovered out a small few of honorable operators who give thoughtful care to gentlemen at other end."

"But do not all coasty stations of glorious navy behave in suchlike manner?" I rogate.

"I should kiss a submarine!" yip Scratchi with pantagey crackle, "hardly ever so if not at all. Commercial and navy business never mingle up with delicious result and should be separated strongly apart like Sinn Feiners and tan-black Limeys. Also I sniggest that Hon. Harding express free pardon to all now serving term at those station and furnish up newlycomers with correspondence diploma in wireless etiquette or so."

"Where can such most rare teaching be hunted out?" I deploy.

"Teaching of it not rare," Scratchi vibrate sharply, "but practice are. With diaframs to eat operator can obtain many cost-free lessons when KPH are extracting from the ether messages, positions, services and whichnot in stady streams."

"Are he the only one who so do?" I rasp ruffly.

"Oh! indeed no," oscillate Scratchi with disarmament expression, "but he protrudes out like bandaged-up thumb-finger."

"And our fellow-banzais from away-far ancestor land, do they not observe the strictly rules?" I peruse hopefully.

"Truly so," Scratchi make comeback, "since Nippon from here are quite longish distance all marus keep nose brightly polished when approaching prohibition limits. Their deporture on side of

Continued on page 76

Pacific which they own excludedly, however, are horse of different hue."

"Who own ocean hence southly?" I require.

"Harvard and Yale own each one-half," snip Scratchi, "KPH own the other two-third and KFS have strong option on half per cent of what are left."

"How then," I pose with Einstein quirk, "do other stations enter in?"

"Feebly, whenever," buzzes Scratchi, "exceptly during time-sparks and press-hours."

"Then they make press-catching more highly difficult then before?" I moan.

"Some presses might be," rap Scratchi, "but NPG'S spark-press not whatever, because cannot. Operator who do so have devised up very private spacing system which he tick forth with one eye on key-hand and other opticle on clock-hand. Result are very ruinous."

"Who grab up such stutter?" I tap in.

"Only ships which can also purchase hometown daily papers," Scratchi transforms me, "like Admiral Liners, which are painted nice greenish color for easy reference."

"Ships of much courtesy these," I interrog with know-something air.

"Oh! indeed yes," rotates he, "and supplied up with most careful-driving skippers,—never guilty of such cheap rudeness as to pass anything while voyaging, unless mightbe a lumbering schooner which are loggerhead with seedy millers and must not arrive before very overdue."

"Do they not also contain operators of high calibrations?" I make connection.

"Who can tell so?" insert my cousin. "Quite smallish portion of the twelve daily watch-hours are now devote to radio-working, since operator are also expense-biller, freight-chigger and combined purse-clerk under new American style wage-plant."

"Did you receive in any telephone voice-speech while passing from hither to yon and back again?" I resist.

"At all times," Scratchi condenses, "I hear the sweetish voice of Miss Avalon with very central modulations, and enjoy much rich conversations of movie vampers, both he and she. I also joyly raise up Mr. Fairmount speaking, gentleman of graceful impersonality, who donate humerus vocal puff-up to himself and store people while interrupted with classy musical bands and jonmacormix."

"Do you wish to make another such trip-around?" I demand.

"Very soonly," flash Cousin Scratchi, "Hon. dispenser gentleman have biggish shipment coming along and I desire to enjoy fresh supply."

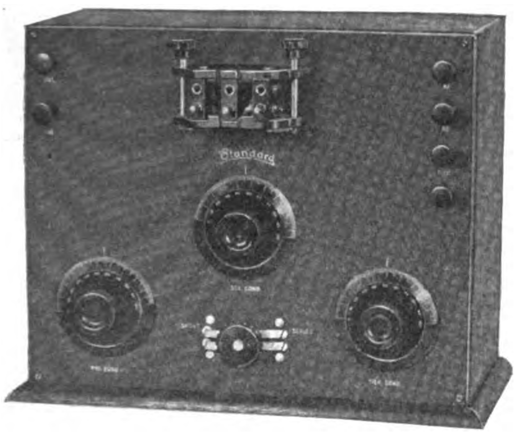
I thank him fluidly and expand to him going-away greets and goodluck wishings.

Same to you, dear Mr. Editor, from

Yours very statically,

HILOLI NOGO.

ASSEMBLED-BUT NOT WIRED



Multiple Wave Tuner—Here you obtain in a single instrument the equipment to receive all classes of signals on all known wave-lengths,—150 to 25,000 meters. It responds to both damped and undamped waves, and is equally efficient for both wireless telephone and telegraph. Minimum number of controls provide extreme simplicity of operation, yet the design renders the tuning especially sensitive and selective. Equipped with DeForest triple-coil mounting and Chelsea condensers. Enclosed in handsome oak cabinet.

Price, completely assembled, F.O.B. New York, $45.00

Set of 18 DL Coils, to receive all the most used wave-lengths, **$40.00.**

Complete set of parts, ready for assembly, **$39.65.**

With the addition of a Crystal Detector, the "Standard" Audion tube control for **$12.50,** or the Detector and two-step described below, you have a complete receiving station, lacking nothing in range or efficiency.

WIRE YOUR OWN—SAVE MONEY

"Standard" radio instruments—*assembled, but not wired*—solve your problem of getting commercial grade apparatus at prices but little more than the cost of the parts. Here, briefly, is the "Standard" plan:

There are two distinct parts in building complete radio instruments: the actual panel drilling, mounting, etc., which is essentially machine work; and the wiring, which is hand work.

The Standard Assembling Company buys the parts at wholesale prices, and does all the assembling work with the proper machine equipment. This, of course, requires a well-equipped machine shop, not available to the average amateur, and produces a quality of work you could not possibly duplicate.

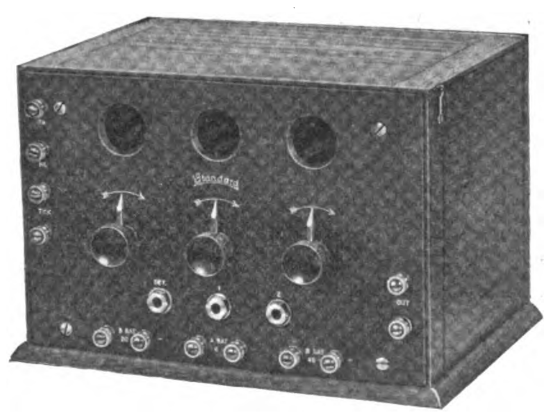
But the wiring is hand work, and *you* can do it as well as it can be done at the factory. And because it *is* hand work, it is the most expensive part of the assembly. So right here is where you save the biggest part of the expense. Besides, you probably have your own ideas about wiring.

By buying "Standard" instruments you get the appearance and results of high-grade, correctly assembled apparatus, and at the same time you save all the expensive wiring costs. Only in this way can you secure the combination of machine work where it is necessary, and a price that is only slightly more than a miscellaneous group of parts would cost you. The two instruments shown on this page are excellent examples of the "Standard" plan. Where else could you ever hope to get such handsome, efficient instruments for the prices quoted?

Either of these instruments will be shipped to any part of the United States on receipt of one-third the purchase price. Examine it carefully. Then if you are fully satisfied that it is the best radio purchase you ever made, remit the balance. Otherwise, simply return the instrument and we will refund your money, less carrying charges. Could we make any fairer offer? Then

Take this Opportunity to try the "Standard" Plan at Our Risk.

Detector and Two-Step Amplifier—Your choice of two types, Commercial or Amateur. The commercial type is assembled from the most costly, efficient units available. Radio Corporation UV-712 transformers and General Radio tube receptacles typify the quality thruout. The Amateur type is an exact duplicate, except that transformers and sockets of high efficiency, but lower cost, are used.



Prices, F.O.B. New York:

Commercial type, unwired	$55.00
Amateur type, unwired	47.00

Here is clear saving of $10.00 in either case, thru the "Standard" Plan.

Also offered, fully wired, ready-to-operate, at

Commercial type, wired	$65.00
Amateur type, wired	57.00

Complete set of parts, ready for assembly:

Commercial type	$42.00
Amateur type	35.00

Send 2c stamp for literature describing the complete line of Standard instruments.

STANDARD ASSEMBLING COMPANY

19 Bridge Street, Dept. A, New York

Duplicate the Set *Heard Across the Atlantic*

Amateur history was made on December 9, when 1-BCG in Greenwich, Conn., was heard in Ardrossan, Scotland—a distance of over 3500 miles.

This amazing feat was performed with four Radiotrons UV-204—one used as a master oscillator, the other three as amplifiers.

There was nothing special about 1-BCG's equipment. His circuit was similar to those described and illustrated in the RCA Catalogue for CW transmission.

You can duplicate the equipment used at 1-BCG for experimental communications at a comparatively small expense.

Look over the RCA Catalogue and Instruction Book. Select the set most suitable for your needs, and then order the required parts from your nearest dealer.

100 Watt Radio Telephone Transmitter

Microphone and Stand	$15.00
Jack ($1), Plug ($2), Cord ($1.50)	4.50
Oscillation Transformer UL-1008	11.00
Magnetic Modulator UT-1367	17.00
Antenna Ammeter UM-533	6.25
Sending Key UQ-809	3.00
Transmitter Grid Leak UP-1718	$ 1.65
Transmitter Condensers UC-1015.	5.40
Transmitter Condensers (2) UC-1014	4.00
Filter Reactor UP-1627	15.75
Radio Frequency Choke	2.00
Radiotron Power Tubes UV-203 (2)	60.00
Kenotron Rectifier Tubes UV-217(2)	$53.00
Filter Condensers (5) UC-1635	10.00
Power Transformer UP-1016	38.50
Incidentals	12.95
Approximate total	$260.00

For complete circuit and details of necessary apparatus to make up this radio telephone set see Fig. 1, page 11, RCA Catalogue, which can be secured from your nearest dealer or by sending 25 cents direct to

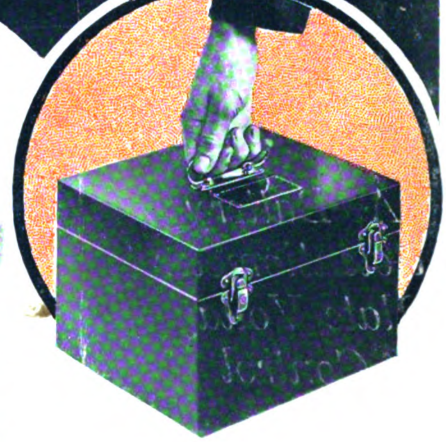
SALES DIVISION, *Suite* 1804

Radio Corporation of America

WORLD WIDE WIRELESS

233 Broadway, New York City

de Forest *Everyman*
Radiophone Receiver



The de Forest "Everyman" is the ideal receiving set for homes and for amateur stations for receiving radio music and radio news and for hearing ship and broadcasting stations. Neat, compact, portable, and easily adjusted. To pick up high-power stations simply add inexpensive duolateral coils. "Everyman" set, cased in a handsome walnut finished cabinet with carrying handle, includes enclosed crystal detector, highly selected tuner, telephone set, and duolateral coil plug. The few necessary instructions for operating mounted inside the cover of each set—see photograph above. Price, f.o.b. San Francisco, **$26.50.** Ask your dealer for this set by name—the **de Forest "Everyman" Radiophone Receiver.** If he does not have it, write us direct.

The prices on many de Forest parts have recently been substantially reduced. The popular de Forest reversible filament Rheostat, F-500, has been reduced to $1.20, the de Forest moulded tube receptable, R-500, cut to $1.10. Other new prices are as follows:

LC-100 Triple coil mounting, Reduced to	$6.40
LC-101 Triple coil mounting with base, Reduced to	10.07
LC-200 Coil plug, Reduced to	.53
LC-400 Triple coil mounting unassembled, Reduced to	3.72
TPR-600 New type coil plug, Reduced to	.64
Conescu 3" White dial and knob, Reduced to	.80
Conescu 4" White dial and knob, Reduced to	$ .79
S-100 Series parallel switch with 8 switch points, Reduced to	1.07
S-600 B Battery switch	1.00
G-100 Variable grid leak	.64
3-4 Vario coupler, increased to	5.83
D-101 Crystal detector, increased to	2.91
R-400 Inverted tube socket, increased to	2.75

If your dealer cannot supply you with de Forest standard equipment and de Forest accessories, write us direct. We distribute, sell and install complete radio equipment for any location or purpose. Our accessory line includes such standard equipment as Magnavox loud-speaking and amplifying apparatus, Westinghouse charging outfits, NAA Galena supplies, etc. We have machinery and special facilities for giving complete expert service both to dealers and to retail purchasers. Write us.

ATLANTIC-PACIFIC RADIO SUPPLIES CO., INC.
638 Mission Street, San Francisco, California
Eastern Office, 5 Kirk Place, Newark, New Jersey
HENRY M. SHAW, PRESIDENT

For the best book on Radio ask your dealer for "Elements of Radiotelegraphy" by Lieut. Ellery W. Stone, U. S. N. Price $2.50

Radio Dealers

The Atlantic-Pacific Radio Supplies Co., Inc., are **sole Western distributors** for the de Forest "Everyman" Radiophone Receiver and for the entire de Forest line of complete radio equipment. **National distributors** for The Moorhead Laboratories, Inc., manufacturers of A-P vacuum tubes, and also **sole Western distributors** for the following companies and supplies:

Shaw Insulator Co., Moulded Insulation; **Diamond State Fibre Co.**, Condensite-Celoron; **Redmanol Chemical Products Co.**, Insulating Paints and Varnishes; **Pacent Electric Co.**, Radio Essentials; **C. Brandes, Inc.**, Radio Head Receivers.

No radio stock is complete without these standard lines. We selected these as being the best, the most saleable and the most desirable from all standpoints, among the many brands of radio supplies and materials in the nation at large. We weighed the comparative merits of each line carefully before making a selection, being careful to pick only those which are standard and proved by experience. Write us for wholesale prices and full particulars. Do it now to insure prompt delivery.

RADIO

Established 1917 as Pacific Radio News

Volume IV *for* MARCH, 1922 *Number* 3

CONTENTS *for* MARCH, 1922

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Forecast of Contributions for April Issue

Hugh R. Sprado, whose article on interference elimination in this issue should be of benefit to many of our readers, will contribute two articles in April RADIO, one on "The Intermediate Circuit," and another on "Eliminating the Grid Battery."

Geo. F. Patrick of New Orleans has some good ideas for the amateur in an article on "Construction of a Wave Meter for Tuning C. W. Transmitters."

"Experiences of a Radio Engineer in China" will be the subject of an interesting article by Chas. R. Grubbs, who has recently returned to America from China, where he made a number of radio installations.

A helpful series of radio letters to salesmen by H. A. Eveleth, who is in charge of radio sales for the Electric Appliance Co. at San Francisco, will be revamped for publication as simple talks for the non-technical man, starting with the March issue.

The fiction feature will be an exciting tale of the adventures of a radio engineer in Alaska by Volney G. Mathison, well known author of the Samuel Jones Series.

The next installment of "The C. W. Manual," by J. B. Dow, will deal with "The Design and Construction of a 10-Watt C. W. Transmitter, I. C. W. Transmitter and Phone Set Using Direct Current."

"How to Design an Antenna for C. W. Transmission" will be treated in detail by Gerald M. Best, whose answers to questions on C. W. practice are proving valuable to many of our readers.

"Confucius has said:
"The accomplishment of great things consists In doing small things Well"
Perfection of detail — makes the Grebe Receiver What it is—

The Grebe CR-5 Receiver

Licensed under
Armstrong U. S. Patent
No. 1,113,149

GREBE RADIO

Doctor Mu.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus to Dealers, Schools, Colleges, Radio Clubs and Experimenters All Over the World!

"PITTSCO" SERVICE DISTRIBUTES "RADIO CORPORATION'S" PRODUCTS ALL OVER THE WORLD! TRY US AND SEE!

"PITTSCO" NOW HAS TWO STORES! BOTH CARRY "RADIO CORPORATION'S" COMPLETE LINE. ORDER TODAY!

AMPLIFIERS

No. DA Westinghouse, Detector and two stage in mahogany cabinet.....$68.00
No. RORK Grebe, two stage with automatic filament control jacks....... 55.00
No. RORD Grebe, Det. and two stage with automatic fil. control jacks... 75.00
No. 2684 Amrad, Det. and two stage in mahogany cabinet. Splendid value.. 47.50

AMPLIFYING TRANSFORMERS

No. UV-712 Radio Corporation....... 7.00
No. QO Clapp-Eastham, semi-mounted. 4.00
No. QO Clapp-Eastham, fully mounted 5.00
No. 50 Chelsea, new type........... 4.50

ANTENNA WIRE

"Pittsco" No. 14 Hard drawn copper (80 ft. per lb.), per lb............ .40
500 ft. special value at............ 2.25
"Pittsco" 7 strand No. 22 tinned copper, per ft...................... .01
500 ft. 4.25
1000 ft. Special value at.......... 7.50
"Pittsco" 7 strand No. 20 phosphor bronze, per ft.................. .02
500 ft. special value at............ 7.50

"B" BATTERIES

No. 7623 Standard 22.5 Volts, small.. 1.50
No. 7625 Standard 22.5 Volts, large.. 2.65
No. 7600 Standard 22.5 Volts, variable 16½ to 22½ Volts.............. 3.00
No. 7650 Standard 22.5 Volts, large, variable, 15 variations 3.50
No. 763 Eveready 22.5 volts small.... 2.25
No. 766 Eveready 22.5 volts large, 16½ to 22½ volts.............. 3.00
No. 627 Ace, 45 volts, variable....... 3.50

COILS (Duo-lateral)

DL-25	$1.40	DL-300	1.75
DL-35	1.40	DL-400	1.80
DL-50	1.50	DL-500	2.00
DL-75	1.50	DL-600	2.15
DL-100	1.55	DL-750	2.35
DL-150	1.60	DL-1000	2.60
DL-200	1.65	DL-1250	3.00
DL-250	1.70	DL-1500	3.50

COIL MOUNTINGS

No. LC-100 DeForest 3 coil mounting with gears, reduced price.......... 6.00
No. LC-101 DeForest 3 coil mounting with gears and wooden base....... 9.50
No. 400 Remler 3 coil mounting with base and extension handles........ 6.50

CONDENSERS (For CW work)

No. UC-1014 Radio Corp. .002 MF. 3000 volts 2.00
No. UC-1015 Radio Corp. .0003, .0004, .0005 MFD. 7500 volts........... 5.40
No. UC-1803 Radio Corp. .000025 MF. 10000 volts 5.00
No. UC-1806 Radio Corp. .002 MF. 6000 volts 7.00

CONDENSERS (Grid and plate types)

No. UC-570 Radio Corp. .0025 MF... $2.00
No. UC-569 Radio Corp. .001 MF.... 1.50
No. UC-568 Radio Corp. .0005 MF... 1.35
No. UC-567 Radio Corp. .00025 MF.. 1.20
No. UX-543 Radio Corp. Condenser meg. .... .50

CONDENSERS (Filter type)

No. UC-1631 Radio Corp. .5 MF 750 volts 1.35
No. UC-1632 Radio Corp. 1 MF 750 volts 1.85
No. UC-1634 Radio Corp. .5 MF 1750 volts 1.50
No. UC-1635 Radio Corp. 1 MF 1750 volts 2.00

C. W. INDUCTANCES

No. UL-1008 Radio Corporation..... 11.00
No. P-1 Acme 8.00

C. W. POWER TRANSFORMERS

No. UP-1638 Radio Corp. 325 watts.. 25.00
No. UP-1016 Radio Corp. 750 watts.. 38.50
Acme 200 Watt 350-550 Volts Mtd.. 20.00
Acme 200 Watt 350-550 Volts unmtd. 16.00

FILTER REACTORS

No. UP-1626 160 Milliamperes...... 11.50
No. UP-1627 300 Milliamperes...... 15.75

GRID LEAKS (Radio Corporation)

No. UP-1719 For 5 Watt Tubes...... 1.10
No. UP-1718 For 50 Watt Tubes..... 1.65
No. UP-5:6 ½, 1, 1.5, 2 or 3 megohms ea. complete with mounting....... 1.25
Grid leaks only, each............. .75

HOT WIRE METERS

No. P-1 Roller-Smith 0-2.5 Amperes, flush mtg. Special value at....... 4.75
No. UM-530 Radio Corp. 0-2.5 Amps.. 6.00
No. UM-533 Radio Corp. 0-5 Amps.... 6.25

JACKS (Radio type)

No. 61 Pacent open jack............ .70
No. 62 Pacent closed jack.......... .85
No. 63 Pacent 2 circuit............ 1.00
No. 65 Pacent three spring Automatic filament control type 1.20
No. 66 Pacent five spring A. F. C..... 1.50

LOUD SPEAKERS

No. R-3 Radio Magnavox, new type horn, very latest model........... 45.00
No. P-1 Vocaloud, station type....... 30.00
No. 400-W Federal Pleiophone....... 14.00

RECEIVING SETS (Crystal)

"Aeriola Jr.," Westinghouse, complete with Brandes "Superior" phones.. 25.00
"Radiola" DeForest, complete with Brandes "Superior" phones...... 25.00
Radio Service Type S-8 without phones, splendid value 7.50

MAGNETIC MODULATORS

No. UT-1634 ½ to 1½ Amperes..... $9.50
No. UT-1357 1½ to 3½ Amperes.... 12.50
No. UT-1637 3½ to 5 Amperes..... 17.00

RECTIFYING DEVICES

No. UV-216 Radio Corp. "Kenotron" 20 Watt type for UV-202 tubes..... 7.50
No. UV-217 Radio Corp. "Kenotron" 150 Watt type for UV-203 tubes.... 26.50
No. P-1 DeForest 20 Watt Rectifying tube for use with 5 watt tubes..... 7.00

RECTIFYING DEVICES (for "A" Batteries)

No. P-1 Tungar, 5 ampere type, complete with bulb.................. 28.00
No. P-2 Tungar, 2 ampere type with Bulb 18.00
No. P-3 FF Battery Booster, 5 amp. type 15.00

REGENERATIVE RECEIVERS

No. CR-3 Grebe "Relay-Special" 175-680 meters 65.00
No. CR-5 Grebe 175-3000 meters, "Super-special" complete set...... 80.00
No. CR-8 Grebe 175-1000 meters, complete set, latest "Relay-Special"... 80.00
No. CR-9 Grebe 175-3000 meters, complete set with det. and 2 stage amplifier self contained, "A Masterpiece" 130.00
No. RA Westinghouse, 180-700 meters, very selective, mahogany cabinet... 68.00
No. RC Westinghouse, RA receiver and DA Det. Amplifier combined in one cabinet, a splendid unit, compact...130.00

TELEPHONES

No. 56 Murdock 2000 ohm double..... 5.00
No. 56 Murdock 3000 ohm double..... 6.00
No. CW-834 Western Electric 2200 ohms 15.00
Brandes, "Superior" with new headband 8.00
Brandes "Trans-Atlantics" with new headband 12.00
Brandes "Navy Type" with new headband 14.00
Baldwins Type C 12.00
Baldwins Type E 13.00
Baldwins Type F 14.00
Baldwins Type C unit only 6.00
Federal A. and N. Type 2200 ohms... 8.00
Federal A. and N. Type 3200 ohms... 10.50

VACUUM TUBES

No. UV-200 Radiotron detector...... 5.00
No. UV-201 Radiotron amplifier...... 6.50
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The Standard Plan allows the experimenter to incorporate his own ideas in completely assembled, machine made radio instruments.

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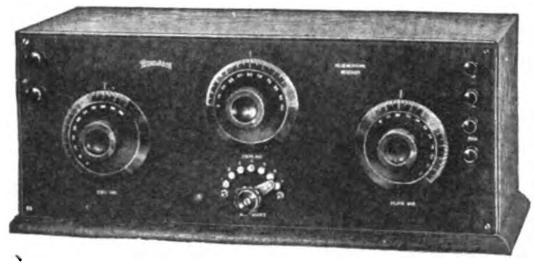

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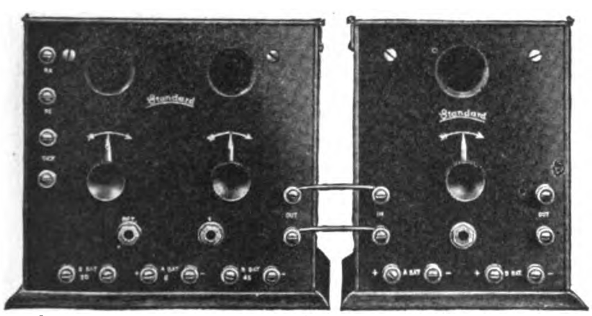

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The complete outfit, model 105, consists of a "MARVEL" highly efficient crystal receiver, mounted in a handsomely finished mission oak cabinet, 150 feet of solid copper wire for antenna, 25 feet of insulated wire, 5 porcelain insulators, a 1000 ohm telephone with leather covered headband and a telephone cord, antenna switch, ground clamp, extra "MARVEL" Radio crystal, code chart, abbreviation chart, and complete simple instructions for installation and operation. Nothing else needed **$15.00**

Model 110, same as above, but with a 2000 ohm double headset **$18.00**

The Marvel De Luxe with fine tuning attachment in handsome carrying case complete with double headset, Antenna equipment, etc.—no additional parts to buy **$25.00**
As simple to operate as a phonograph.

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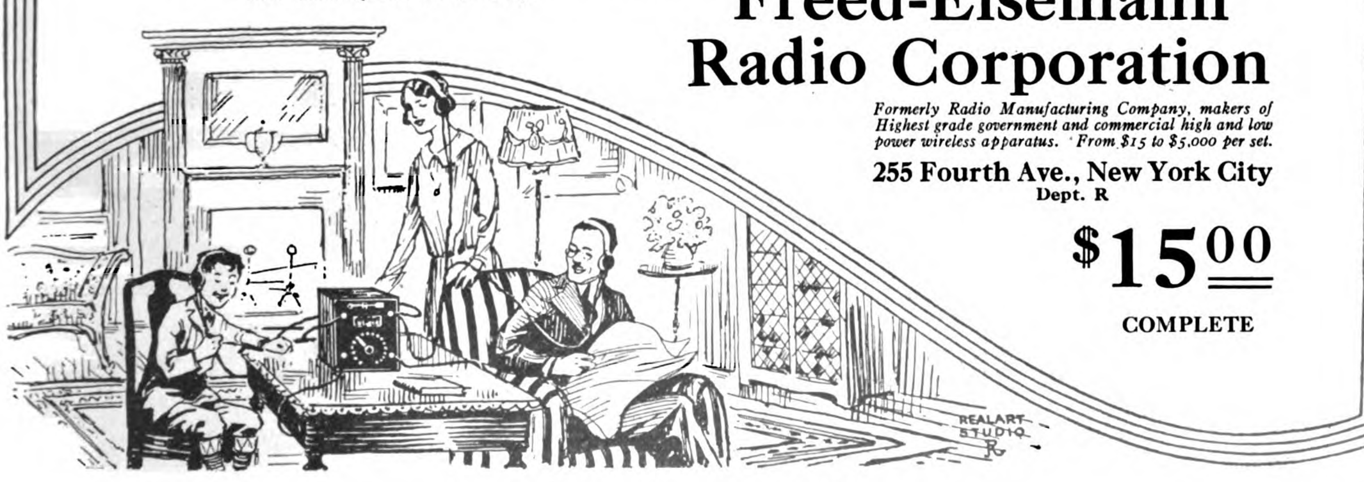


March, 1922 **RADIO** Vol. 4 No. 3

Radiotorial Comment

THE founders of our government in their wisdom provided for the encouragement of inventive genius by granting full protection to the inventor through letters patent. Much good has resulted from such protection, but some times by limiting the use of articles of general public utility, some harm has been caused. So the suggestion seems pertinent that the patent laws be modified so as to allow any responsible person to secure a license from the owners of a patent, in order that it be applied to the greatest public good. Thus can everyone, including the owner of the patent, gain the largest benefit from an invention.

TODAY'S applications of radio are based upon the patient, and oft unrewarded, work of scientists. Without the pioneer efforts of men who labor for the pure love of research, without hope of compensation other than the joy of discovery, radio would still be a mere scientific toy. Not the least of these agencies, so helpful to the advancement of radio, has been the U. S. Bureau of Standards. Looking backward for 20 years, what a great gap there would be in current knowledge of radio if it were not for the contributions of Austin, Kolster, Grover, Curtiss, Dellinger, Whittemore, Hull, Miller, and other devoted workers in this branch of government service. Such work as theirs should be encouraged, not alone by the heartfelt tribute of those who have benefited thereby, but also by substantial congressional appropriations for carrying forward these accomplishments. Every reader of RADIO can do his part to bring this about by urging his congressman to get behind such an appropriation.

TO many of our readers, the most interesting department is that devoted to Calls Heard. To realize that one's signals are reaching out gives a thrill and a satisfaction that is exceeded only by hearing some hitherto unheard distant signal. So an effort is being made to have this department really mean something. Hereafter the lists of Calls Heard will include stations 250 miles or more distant from the receiver. For it is little distinction to reach or receive shorter distances, but to be listed as a real DX worker is worth striving for. Our readers all over the country are invited to contribute regularly to this department.

WE are impelled—just at this time—to ask the great, and potentially useful, body of citizen radio to read and ponder on selfishness, jealousy and lust for power by a few. Having done so we would ask that those who have the *good* of citizen radio at heart—remember them. This, as in several ways it has indubitably been brought to our attention that *all three* are seriously at work in our ranks, and the time to crush these fatal weaknesses is—NOW!

We have but to look across the waters of the Atlantic ocean to poignantly realize the meaning of the term "chaos," it its fullest sense!

Selfishness, jealousy, and lust for power by a few brought about the Great War, and they are the direct causation of the present turmoil-worse-confounded that maintains in Europe!

Let us be frank with one another—for the good of the cause!

Citizen radio must *not* be a stamping ground for petty politics, wire pullings, and so forth! Cheap clap-trap and melodrama—all—on the part of a certain few who have attempted—and still are attempting—to arrogate unto themselves the right (?) of a dictatorship, a species of Kaiser'ism, in matters that concern only the *private rights* of each amateur radio operator—as an American citizen, of good standing.

There must NOT be any Association, Club, or Organization of *any* kind that in the least threatens the personal liberties of each individual in the field of amateur radio—nor must there be *any* body of men that say to the others: "Do thus-and-so!" "Prevent such-and-such!" "You MUST do this!" "You must NOT do that!"

All such attempts at the coercion of citizen radio is the cheapest sort of balderdash, and it would be laughable, were it not for the fact that there are many amateurs who—because of their residences being in the more remote districts—do not realize the dangerous tomfoolery that is going on, and that tends inevitably to disrupt, rather than to coordinate, amateur radio effort.

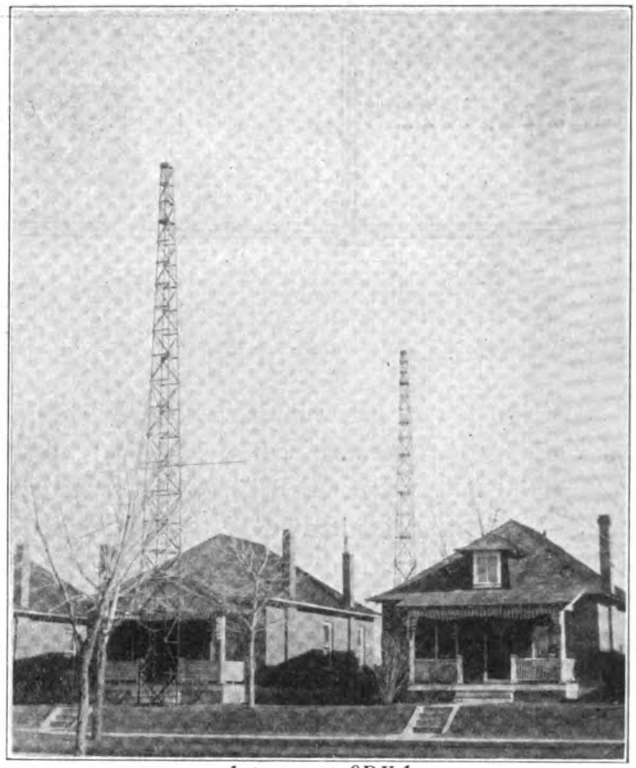
To citizen radio we have this to say: As licensed operators you have shown energy, individuality, resourcefulness and self-reliance! Study very carefully the proposals, orders, and what-not, of *any* group of men, giving due consideration to the *motives* behind the arguments that have been shoved at you, willy-nilly! BEWARE of the least attempt to usurp your rights as individuals! BEWARE of the element of Personal Domination! On that reef, families—and entire Nations—have been wrecked!

9DVA—1000 MILE RADIUS WITH 10 WATTS

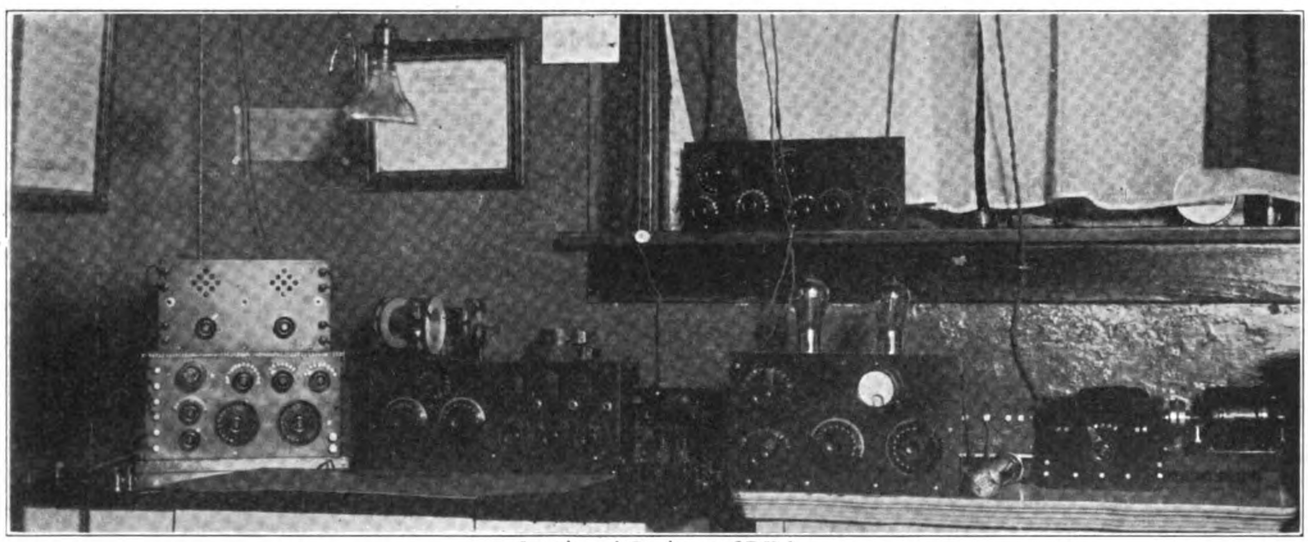
The effectiveness of continuous wave transmission with small power is well illustrated by 9DVA at Denver, Colorado, which has been heard by amateurs on both the Atlantic and Pacific Coasts. Mr. Wilson, the owner, has erected two steel towers at his home, 2316 East 12th Ave., Denver, Colorado. He employs a five-wire aerial, 50 ft. long and 50 ft. high.

Two 5-watt tubes are used for transmission, using a modified Hartley circuit. A normal radiation of 1.8 amperes is obtained when using 7½ volts on the filaments, and 350 volts on the plate with 90 milliamperes plate current. Plate current is supplied from a 350 volt d.c. Esco motor generator set controlled by the rheostat shown to the left of the generator. The complete transmitting equipment is shown on the small table at the right in the picture. The aerial switch appears between the transmitter and the long wave receiver on the table at the left. A useful feature is the Clapp-Eastham filament heating transformer to the right of the transmitter, thus doing away with any rheostats on the transmitter.

Three sets are used for receiving. The small set on the window-sill is a regenerative receiver for tuning spark signals. The long-wave set with honey-comb coils has a detector and two steps of amplification. The short wave set with the two-step audio-frequency amplifier in separate cabinet above is used solely for tuning continuous waves.



Antenna at 9DVA



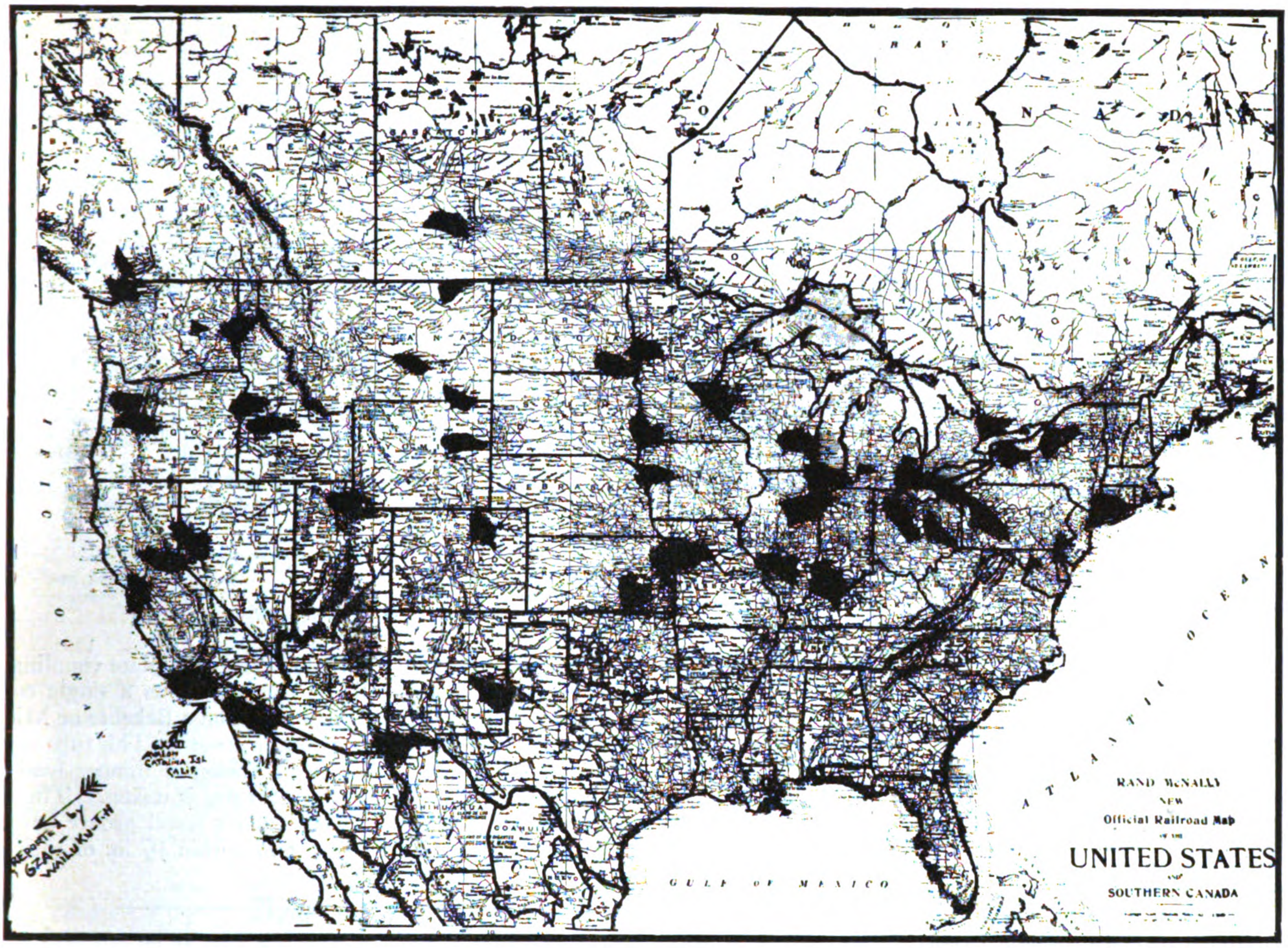
Interior of Station at 9DVA

RADIO 7YJ

Radio 7YJ is the spark station installed by the physics department of the Oregon Agricultural College at Corvallis, Ore., in charge of Jacob Jordan. As it is frequently reported in distant lists of calls heard, a brief description will be of interest to many operators. The department plans to have a 100 watt C. W. and phone transmitter on the air before the close of 1922.

Continued on page 21

Radio 7YJ, Oregon Agricultural College



A Novel Method of Showing Stations Reached

By Lawrence Mott

ALWAYS with the idea uppermost in my mind—of trying to prove to the great amateur fraternity that low-powered C. W. or I. C. W. will easily and effectively cover most astonishing distances—I bethought me to have a map of the United States, that hangs in my operating room, photographed for a reproduction in these pages. Each flag denotes a station that I have either actually worked, or from whom I have, in my files, written proof that the operator has heard 6XAD. Lest there be some readers who did not see a description of my smallest of three transmitters in January RADIO, I say that this smaller transmitter used but four five-watt tubes for the making of the rather satisfactory records, as shown by the map.

Such work as I have done has not been with an intricate apparata, at all! Any amateur can possess such a transmitter as my smaller one, for no vast outlay. Of course, the ground, counterpoise and aerial systems have much to do with these records, and I am furthermore convinced that my location, on Catalina Island, out in the Pacific ocean, has also materially been of benefit, as I hear East coast stations every night that I am at my instruments!

I give, for interest's sake, the call letters, geographical location of the stations worked by me—marking these with an (x). The others have *conclusively reported hearing my signals.*

(N.B.—90 per cent of the stations are C. W. or I. C. W.)

2FP—Brooklyn, N. Y.
3JI—(Can)Toronto, Canada.
3JJ—Washington, D. C.
3ALN—Washington, D. C.
3BHW—Philadelphia, Pa.
8ZAC—Barnesville, Ohio.
8ZG—Salem, Ohio.
9RC—Chicago, Ill.
9ZN—Chicago, Ill.(x).
9AJA—Chicago, Ill.(x).
3FS—Philadelphia(x).
3HJ—Haverford, Pa.
3AHR—Philadelphia, Pa.
5HK—Oklahoma City, Okla.
5ZA—Roswell, N. M.(x).
6ZAC—Hawaii.
6ZZ—Douglas, Arizona(x).
6AJR—Reno, Nevada.
6AWT—San Francisco(x).
7FI—Pullman, Washington.
7OS—Casper, Wyoming.
7ZU—Polytechnic, Montana(x).
7RN—Cashmere, Washington.
7FI—Pullman, Washington.
7YJ—Corvallis, Oregon(x).
8JL—Cleveland, Ohio(x).
8LX—Crafton, Pa.(x).
8EW—Crafton, Pa.
8JQ—Washington, Pa.
8BUM—Syracuse, N. Y.(x).
8BRL—Crafton, Pa.
8BDG—Cleveland, Ohio.
8AXI—Syracuse, N. Y.
8BMX—Buffalo, N. Y.
8KW—Buffalo, N. Y.
8KF—Buffalo, N. Y.
KYW—Chicago, Ill. (The Westinghouse Station.)
9DTM—Denver, Colo.(x).
9DVA—Denver, Colo.(x).
9AMB—Denver, Colo.(x).
9BJI—Denver, Colo.
9AYU—Denver, Colo.
9AQR—Kansas City, Mo.(x).
9AOG—Lawrence, Kansas.
9LW—Wahpeton, North Dakota.
9BAD—Ellendale, North Dakota.
9AIG—Sioux Falls, South Dakota.
9BEX—Denver, Colo.
9ZAF—Denver, Colo.(x).
9JQ—St. Louis, Mo.
9FM—Kansas, City, Mo.
9ALG—Wichita, Kansas(x).
9NX—Wichita, Kansas(x).
(Can)**9BD**—Vancouver, B. C.
9DUZ—Ellendale, North Dakota.
9XM—Madison, Wisconsin.
9RPS—Wichita, Kansas.
9BEX—Denver, Colo.
9ASP—Kansas City, Mo.
9AU—Chicago, Ill.
9WD—Chicago, Ill.

I think that I have not overlooked any good friend who has either worked me or reported me, but I have some 500 postal cards, letters and telegrams; the matter of sorting them is not simple! A great many other calls have been worked by me, I know to my personal satisfaction, but as I have no written proof, I do not set them down. This for the reason that there be some who might challenge so formidable a list of DX work—on but 4 five-watt tubes, I. C. W., and I fain would have my proof by me!

Herewith a very small list of the hundreds of stations that I hear—the more distant ones *only:*

Continued on page 61

The C. W. Manual

Third Installment

By J. B. Dow, Ensign U. S. N.

EXPERIMENTAL PHONE CIRCUITS

The scope of the present chapter will be limited to the development of two simple radio-phone circuits with which the experimenter may study the principles of operation involved and, in general, the factors which govern the operation of oscillating vacuum tube circuits for transmitting purposes.

The Design and Construction of an Inexpensive One-eighth Watt Experimental Phone Set

In the development of the subject matter above, certain factors which are to govern the design, will be stated briefly as follows:

1. The apparatus must operate from a source of direct current having an e.m.f. not exceeding 110 volts.
2. In order that the apparatus may be constructed at a minimum of expense, one tube only will be used, and by virtue of the limiting e.m.f. for plate supply, the circuit must be designed to use the ordinary receiving tube as an oscillation generator.
3. The band of frequencies at which the circuit must operate will be restricted to those corresponding to wavelengths between 200 and 350 meters.
4. In order that flexibility, so necessary for experimental work, may be had, the design will be further limited to that of a laboratory *lash-up*. This will enable the author as well as the experimenter to confine his efforts to the circuit itself, and to the construction of the component parts, rather than to an array of mechanical details.
5. It is assumed that the apparatus herein considered will be used with an antenna having a capacity of 0.0004 to 0.0008 micro-farad.

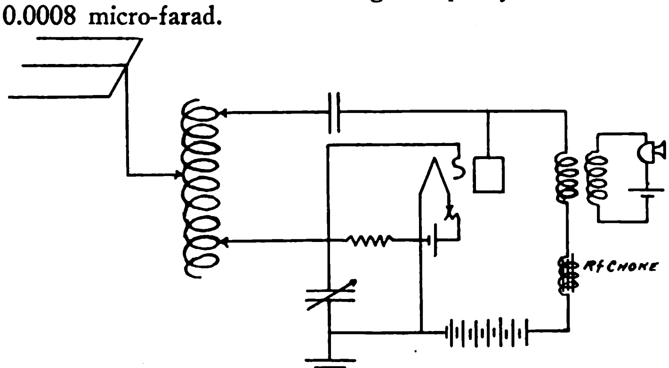


Fig. 14. Modulation Control by Transformer Secondary in Power Circuit

Two circuits are available for this purpose. See Fig. 14 and Fig. 23. The difference lies in the location of the modulation transformer in the circuit.

Let us consider first, the matter of high voltage supply to the plate. A voltage of 110 has been selected because it is a commercial value and in case it is not obtainable as such, it may be quite easily obtained from an arrangement of batteries. If its source is a generator, it may be necessary to smooth out the ripples by means of a filter circuit, though this will rarely be necessary. If noises are present in the received signals, a suitable filter circuit may be made for such a low power circuit as this, by constructing two coils each of 5000 turns of No. 36 D. C. C. magnet wire on a laminated soft iron core, having a 5/8 in. by 5/8 in. section and a length of 8 in., insulating each layer with thin white paper.

These coils should be inserted in series with each leg of the supply circuit and cross-connected by two paper dielectric telephone condensers having a capacity of 2 micro-farads each, as shown in Fig. 24.

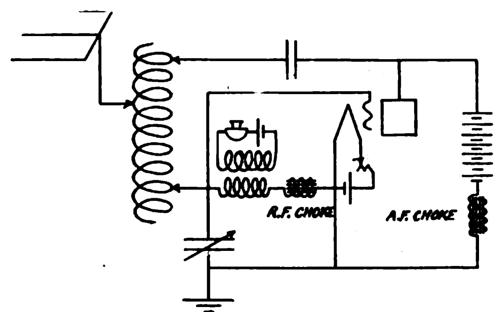


Fig. 23

The antenna inductance as well as the plate coupling coil and grid input coil will be constructed as a single coil of 40 turns of No. 14 bare copper wire on a Bakelite or Micarta tube 5 in. in diameter and 6 in. in length. This tube should, preferably, have a 1/8 in. wall, though a thinner wall may be used with equal success if care is taken. The tube should be mounted in a lathe, and a spiral groove having a pitch of 1/8 in. should be cut to within ½ in. of each end.

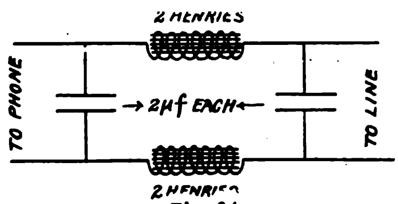


Fig. 24

This will net a 5 in. winding space into which it will be possible to wind the required 40 turns. Every other turn should be tapped as shown in Fig. 25, care being taken in soldering the taps, which may be made of strips of light shim brass, in order to prevent either solder or flux from short circuiting the turns. The taps should be soldered in place as the respective turns of wire are placed on the tube, and if care is exercised in this particular, no trouble from the sources mentioned should result.

As shown in Fig. 25, the radio-frequency choke coil consists of a 250 turn honey-comb.

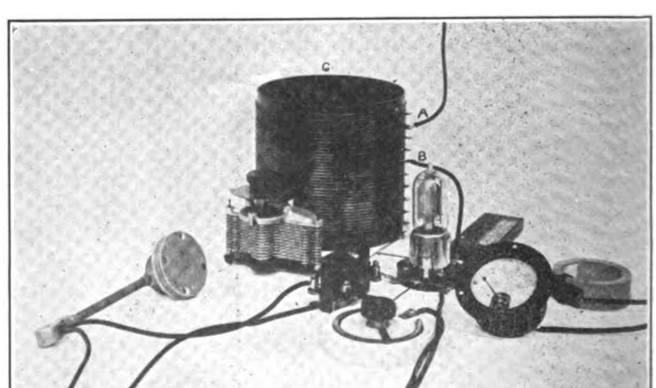


Fig. 25. View of 1/8 Watt Phone Circuit. This circuit utilizes a single receiving tube as an oscillator and can be operated entirely from five blocks of 22 volt B batteries in series for the plate supply and a 6 volt storage battery for heating the filament.

The condenser inserted in the circuit between the coupling tap and the plate of Fig. 14 is an ordinary paper dielectric telephone condenser having a capacity of ½ micro-farad. In a low voltage circuit like the one under consideration, a smaller capacity is not recommended.

The variable condenser of Fig. 25, is of the type commonly used with receiving equipment and should have a capacity of approximately 0.001 micro-farad.

The milliammeter with a scale reading to 30 milliamperes, the vacuum tube and its receptacle, and the filament rheostat are standard equipment needing no detailed description.

Fig. 26 gives the details of the modulation transformer.

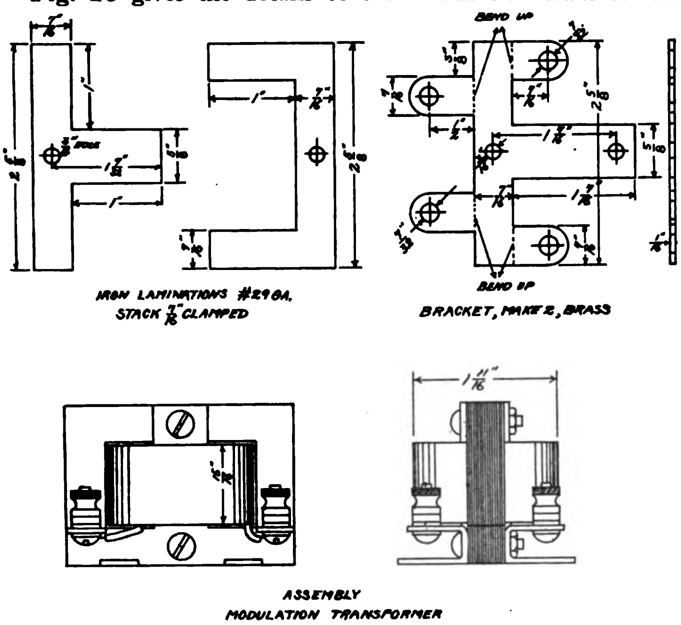


Fig. 26. Assembly of Modulation Transformer

Coil data: Primary, 150 turns of No. 28 enamel insulated wire in three layers. This should be wound upon a 15/16" mandrel and over 8 wraps of 5 mil fish paper. Secondary, 4000 turns No. 40 enamel insulated wire in 28 layers of 140 turns per layer. Layers should be insulated from each other with thin paper, and primary, from secondary, with three wraps of 5 mil fish paper. Whole coil should be impregnated in paraffin after winding. This will result in a coil 1 11/16 in. in diameter and 15/16 in. wide which will fit the core detailed in Fig. 26 above.

It will be observed by referring to Fig. 14 that a grid leak is placed in the circuit between the grid and filament. The use of a grid leak is imperative in transmitting circuits and care must be exercised in selecting the correct value. For Western Electric tubes of the type shown in Fig. 25, the grid leak resistance value should be approximately 10,000 ohms. Such resistances are easily obtained from stock at very little expense. In case the reader desires to construct one, the necessary details will be found in Fig. 27. Another alternative is to fill a glass tube 5 inches in length and having an inside diameter of 3/32 inch with pure lampblack, packing it lightly in the course of filling, and sealing the ends with brass plugs. The measured resistance of such a unit is approximately 10,000 ohms.

In Fig. 23, the resistance of the modulation transformer secondary is utilized as the grid leak.

By way of explanation to the experimenter who is operating a vacuum tube transmitter for the first time, it may be stated that more or less patience is required. A number of factors which influence the operation of such apparatus may not be in evidence physically. This will be found to be the case especially in a low power equipment. For example, the mere substitution of another tube for the one in use will turn what is apparently a failure, into success. The constants of the antenna seriously affect the operation of vacuum tube transmitters—particularly, the resistance. It is a good plan to study a transmitting circuit involving low powers by using an artificial antenna consisting of a small variable capacity and a resistance of 3 to 10 ohms, in series, across the antenna and ground connections.

Operation of the One-eighth Watt Phone Set

Place the artificial antenna circuit between the tap A, Fig. 25, and the ground connection (negative side of plate supply is grounded on this particular case) and cut out all resistance in dummy circuit. Manipulate filament rheostat until filament reaches correct temperature and cut in plate supply current. Select an arbitrary position for the plate tap B, Fig. 25, about half way between antenna tap and the lower connection to the variable inductance. The milliammeter will indicate a current of approximately 12 milliamperes flowing to the plate. Next, adjust the variable capacity and observe the pointer on the plate current milliammeter. It will show an increase or decrease in deflection when the limiting capacity is reached.

Oscillations will start on one side of this point of limiting capacity, depending upon the initial setting of the condenser. As this circuit contains no antenna ammeter, it will be necessary to resort to some other method of determining when the circuit is oscillating. If the circuit is oscillating properly and the antenna tap A, Fig. 25, is touched with the finger the milliammeter pointer will be displaced.

Assuming that the circuit is oscillating, we will next turn our attention to its adjustment. The "cut and try" method with a small previously calibrated receiving circuit may be used, but, the more expeditious and more accurate manner of tuning with a wavemeter should be used for best results. In this connection, any ordinary wavemeter having a current-squared meter or other equally sensitive indicating device may be employed. The procedure is not unlike that of tuning an ordinary spark transmitter, i. e., by coupling the loop of the wavemeter to the variable inductance C, Fig. 25, and adjusting A, B, and the variable capacity until the desired wavelength is obtained.

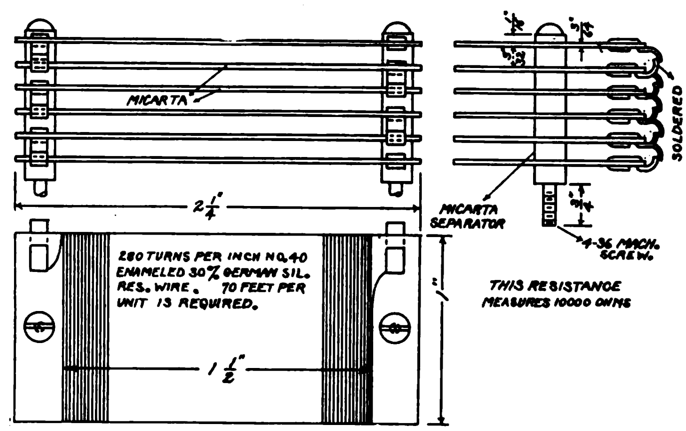


Fig. 27. Details of 10,000 Ohm Grid Leak

Up to the present time, we have been using the artificial antenna with practically no resistance in the circuit, and it may have been observed that as the resonance point was reached in the adjustment of the wavemeter, the circuit suddenly failed to oscillate. Gradually cut in resistance in the artificial circuit (two rheostats like the one shown in Fig. 25, in series may be used), and follow up this operation with a corresponding adjustment of the taps A, and B, and the variable capacity, and note that the wavemeter does not seriously influence the oscillating quality of the circuit as heretofore.

Study the circuit in this manner and when a sufficient knowledge of its operating characteristics is obtained and when good stable oscillations are produced with 6 to 10 ohms of resistance in the circuit, replace the artificial circuit with a regular antenna. (It must be remembered, here, that 6 to 10 ohms of resistance is the form recommended above, is equivalent of 10 to 15 ohms of high-frequency resistance.)

As previously stated, the upper limit of operating frequency is governed primarily by the resistance, and often, the failure of a given circuit to oscillate may be traced to some object which introduces resistance into the circuit. Among these may be classed: leaky insulators, metal structures in the vicinity of the antenna, trees, and in fact anything that may introduce the condition of an imperfect dielectric in the vicinity of the antenna.

The use of a counterpoise is one of the best means of lowering the resistance of an antenna. The advantage of a low resistance antenna may be realized by a moment's thought to the following: The power circulating in the radiating system is, in general terms, equivalent to the product of the current squared times the resistance. Assuming in Fig. 14 that the resistance of the variable inductance plus that of the variable condenser is 2 ohms, and that of the antenna is 8 ohms, the total is 10 ohms. Now, assume that by using a counterpoise, the antenna resistance may be decreased to 4 ohms, the total will be 6 ohms. If the antenna current in the first case was 1 ampere, it would be approximately 1.7 ampere in the second. The result would be an output of 17.34 watts in the second case as compared to 10 in the first, and this, by halving the antenna resistance.

Up to the present time, the attention of the reader has been confined to a small assemblage of equipment constituting what might be termed a three mile set.

The Design and Construction of a Simple Inexpensive Five Watt Radio-Phone

Fig. 11 illustrates a circuit previously explained, wherein one 5 watt tube is used with a Hartley circuit as an oscillator, and another similar tube is used as a power modulator. This circuit will be used in the development of the 5 watt set, shown in Fig. 28, and, as will be seen by referring to this figure, several pieces of apparatus, the construction of which was explained heretofore, will be utilized.

This apparatus includes the variable inductance, the grid leak, modulation transformer, and the 250 turn honey-comb (in center of figure and back of the vacuum tube).

The factors governing the design of this experimental set may be stated as follows:

1. A source of direct current having an e.m.f. of 350 volts must be used. No details will be considered now as to the matter of obtaining this. It may, however, be obtained from a direct current generator, or from rectified alternating current in a manner to which the readers' attention will be called later.

2. The apparatus will be designed to operate at wavelengths between 200 and 375 meters.

3. It is assumed here, also, that the builder contemplates using this apparatus in connection with a small antenna, the limiting capacities of which will be found noted among the factors governing the design of the 1/8 watt set.

In view of the greater potential used in the operation of the 5 watt tubes, two 1/2 micro-farad paper dielectric telephone condensers must be used in series in the plate coupling lead to the variable inductance. It must be remembered that condensers of the type suggested above, are used to promote economy only. If, the constructor desires, he may use any other type of condenser capable of withstanding the impressed e.m.f. and having a capacity not less than 0.01 micro-farad.

The grid condenser upon which the grid leak resistance is mounted (Fig. 28) consists of three pieces of copper foil 2 by 3 in., separated by thin mica and mounted within a small wooden base.

The audio-frequency choke coil shown in the upper center of Fig. 28, is used to prevent fluctuations in the plate supply current at voice frequencies. It is necessary to use such a

Continued on page 60

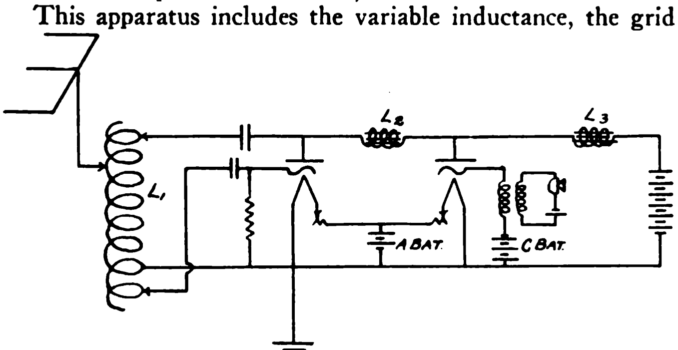


Fig. 11. Power Modulator Method of Control for Hartley Circuit

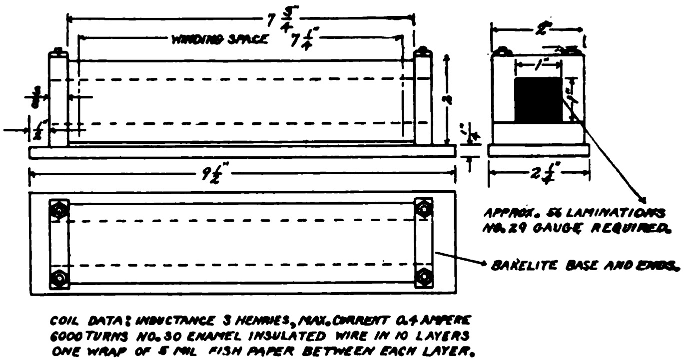


Fig. 29. Construction Details of Audio-Frequency Choke Coil

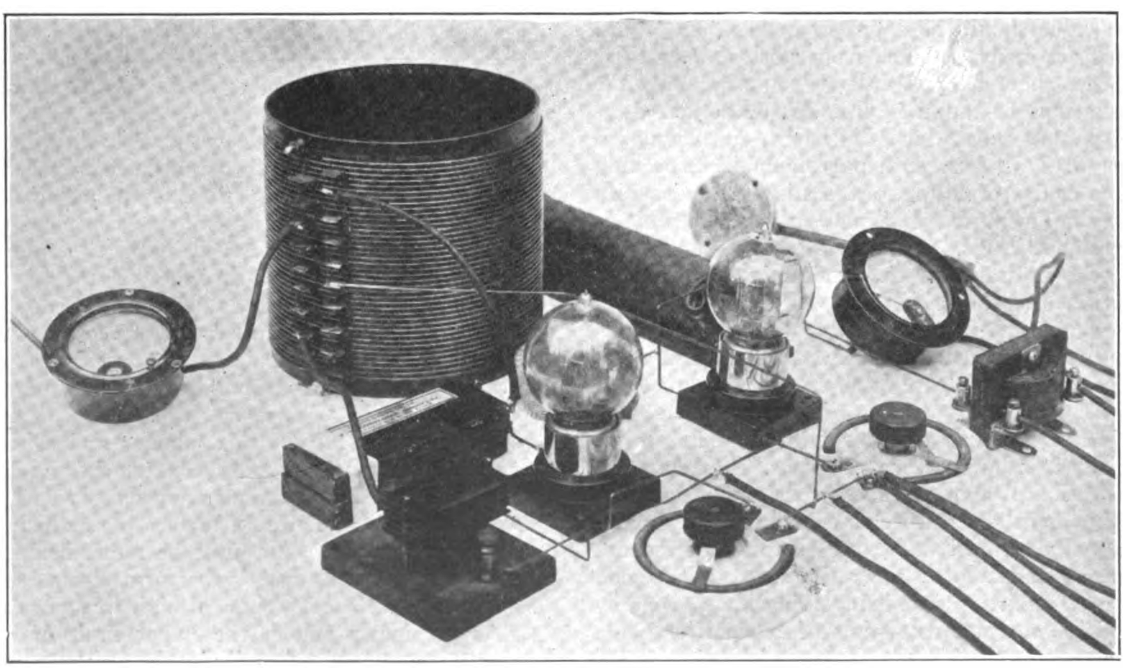


Fig. 28

The Care and Use of Electric Meters

By D. B. McGown, Assistant Radio Inspector

OF all the instruments used around most radio stations, the meters usually receive the least care and attention, considering their quality and value, despite the fact that there are few parts which are so costly and serve their purpose with so little attention.

Meters may be divided into two general classes, portable, and switchboard types. The portable types are usually rugged and are mounted with convenient binding posts, or terminals, with suitable leads, which makes it easy to connect them into any circuit it is desired to measure, the whole being encased in a strong box or carrying case. The switchboard types, on the other hand, are made for mounting on or in a switchboard or instrument, and are designed for connection into a circuit permanently.

These types are divided into the numerous kinds which are used on every known voltage, and under all conceivable conditions, many of which would be entirely unknown to the average man trained in radio work only, and which have no place in a radio set of any kind. Generally, we are interested in the following classes when operating or using radio apparatus: Voltmeters, both d.c. and a.c.; ammeters, both d.c. and a.c.; wattmeters, usually a.c. only, and frequency meters.

Most voltmeters of ordinary type are instruments of high

Portable Voltmeter

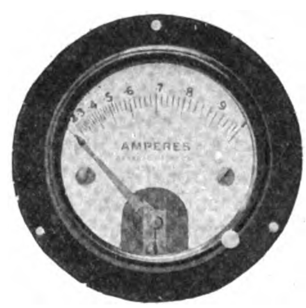
resistance, and may be connected across the line, and left permanently, while the measurements are being made. Such instruments are sensitive and delicate, and all operate on some more or less simple principle of applied electro-magnetism, usually in the form of a coil which is attracted or repelled by the current flowing thru it, due to the coil's being placed in the field of an electromagnet (with d.c. meters), or due to the attraction of a small mass of iron by a coil, one member or the other moving (with a.c. meters).

Ammeters may also be of either of the two above mentioned types, or they may be of some more complex design. In d.c. ammeters, owing to the heavy currents often used, it would be impossible to pass the whole line current thru the coil inside of the meter case without making the instrument hopelessly bulky and clumsy, as well as inaccurate, so a device called a shunt is used. This is merely a conductor of a certain fixed resistance connected in series with the line. When a current flows across this shunt there will be some drop in voltage, due to the resistance of the conductor. If a very sensitive voltmeter is connected across this shunt, we will get a *voltage* reading which is proportional to the *current* flowing in the shunt. This voltmeter is then calibrated by sending a known current thru the shunt, but is marked in *amperes* on the scale of the indicating voltmeter, and we have a complete instrument which will read amperes, wherever it is connected.

For alternating current we may use several methods. We may use the same scheme as that described above, but it is much simpler to use a transformer, of the type called a current transformer, for reasons which will be explained. If we have a wire carrying an alternating current of any frequency, we will have current generated in a coil, which is placed adjacent to, or around the wire. The amount of this current, or rather e.m.f. set up in the coil, will depend on two things—first the current flowing in the wire, and second on the number of turns in the coil. Now if we connect the output of this coil to a small a.c. voltmeter, and if it is calibrated, when so connected, as was described in the calibration of the d.c. meter, by setting up a current of known value in the wire, we have an alternating current ammeter.

Besides this there are the thermo-element and hot wire types of ammeters. The thermo-element type of meter is much used in radio work, and would be used more if it were not for its rather high cost, which is, however, well justified, owing to the peculiar and delicate construction of the instrument. If we pass any current thru a wire, or other conductor we set up heat therein, due to the resistance of the wire, or rather due to the electricity forcing itself thru the wire. This heat may be used in two ways.

In the case of the hot wire instrument, the heat causes the wire to expand or increase in length, this expansion in-



Switchboard Type Ammeter

creasing as the current increases, and being read directly in amperes. There are special means of magnifying this expansion, so that the result can be read directly on a scale, the meter being calibrated as described above. This heat may also be used to warm a thermo-junction, which consists of two small wires, or strips of dissimilar metals, with their ends joined together (usually copper-constantin, or similar metals). This thermo-junction (which together with the heating wire is usually called a thermo-element) generates a small amount of low voltage direct current. This again is proportional to the heat generated in the heating wire. If this system is calibrated, as described, we will have a thermo-element type of ammeter.

These last described types of ammeters are used exclusively for the measurement of radio frequency currents, as they are not, if properly constructed, affected by the frequency of the current flowing in them. That is, they could be used on a current of ten million cycles frequency, just as well as they could be on direct current. The ordinary type of meter could not be used on high frequency, however, owing to the extremely high impedance the coils of the magnet would offer to current flow, and also due to the fact that, generally speaking, we cannot successfully use iron in any form on the higher frequencies.

The commercial types of hot wire ammeters are not, however, as dependable as the thermo-junction or thermo-element types, first because it is extremely hard to produce a metal of a material and shape that will have the same resistance at all frequencies, and second because these meters are affected by every temperature change in the surrounding air. Calibration at radio frequencies would eliminate the first error, but it is practically impossible to eliminate the second. Furthermore, it is often necessary to use high resistance material for the heating element in meters of this type, which is objectionable in many cases. They have the advantages of simplicity, cheapness, and durability, together with a reasonable overload factor, which tends to prevent their burning out.

The thermo-element type of meter is the best, so far produced, for the measurement of alternating current having frequency values up to and over several million cycles per second. These meters are accurate, of low resistance, and are not affected by the temperature of the surrounding air. They are also very quick acting, and where the proper method of damping is used, will come to their maximum reading in negligible time, while it may, and usually does, take several seconds for a hot wire ammeter to come up to the full scale reading. They are not as simple as the hot wire type, and are more expensive, first because of the greater number of parts, and also because of the more delicate and sensitive adjustments required. The greatest care should be taken *never to overload them beyond their capacity,* as this will result in almost every case in a burned out meter, as they cannot be designed to work on heavy overloads. Their chief claim to use and popularity is that they are accurate on all frequencies, within reasonable limits, and on d.c. as well as a.c.

Wattmeters are, generally speaking, combinations of the volt and ammeter systems; that is, they have two coils, one of which is connected in series with the load (called the current coil) and the other across the line (called the potential coil). These meters are only used on d.c. and low frequency a.c. circuits, it being obviously impossible to use them on radio frequencies. In using them, the chief points to remember are to connect them so that they are of the right polarity (both on d.c. and a.c., as they give the effect of polarity on a.c.), and not to get the terminals connected opposite to the normal connection scheme, i. e., not to connect the current coil across the line, or the potential coil in series with the line, the first blowing the fuses, and possibly burning out the meter, and the second opening the circuit. Besides this type of wattmeter, we have the ordinary recording wattmeter, which is used to measure the total amount of power drawn on a line. These meters are simply small motors, made without iron, and so designed that their potential coils act as the fields, and the current coil causes the armature to rotate, which turns a recording dial. The Sangamometer as used on battery charging panels is a recording wattmeter, of a special type, fitted with a scale marked in ampere-hours.

Frequency meters of the ordinary type are usually fitted with vibrating "reeds." A small electromagnet is so arranged that there are a number of steel reeds held between the poles. These reeds are loaded with lead, or other material, so that they have a definite period of mechanical vibration. When the electromagnet is supplied with alternating current, a varying, or alternating magnetic field is produced, which will vary exactly in accordance with the alternations of the supply line, and if the alternations happen to be of the same frequency as the mechanical period of the reeds, they will also vibrate. Actually, the row of reeds is loaded in such a manner that all the periods are different, so a variation proportional to the limits of the adjustment of vibration of the reeds can be obtained. For example, if the frequency is 520 cycles, the reeds marked 510 and 530 cycles will vibrate only slightly, while that with the 520 cycle period will vibrate rapidly. This can be easily seen, and read, from a scale provided for the purpose. The chief precautions to be taken with frequency meters are not to connect them to lines carrying too high voltages, which might burn out the coils, or damage the reeds, and not to damage the reeds themselves. The frequency meters are all arranged to be connected directly across the supply line, and but little attention is required by the meters themselves.

Any and all of the meters described should have the best of care that it is possible to give them. A number of "don'ts" have been listed, as the descriptions proceeded, but there are several other points which are worthy of serious attention. Great care should be taken never to jar or pound a meter, or subject it to a sudden shock, as this is very likely to do serious damage to the working parts. The small coils, bearings, springs, and other small portions of the meters' mechanism are as delicate as those in a high grade watch, and should have as good care, altho unfortunately they do not always get it. Many meters are sealed by the manufacturers, when assembled, and should not be opened again unless absolutely necessary. Many people think that these seals are put on the meters to keep the purchaser from looking at the insides of the instrument, but such is not the case. The seals are put there to protect the user from defective or broken parts, and if a broken or burned out meter is returned with the seals unbroken, the maker usually will and does assume all responsibility for the repairs which are often made free, provided the maker finds the fault is his, and not due to misuse. If a meter is sealed, it is usually made air and dust proof by the same action, and for this alone, if for no other reason, the seals should be left intact, whenever possible.

Very few attempts to repair meters should be made by persons unskilled in the art. The delicate inner working elements of a meter should never be tampered with by anyone but a competent meter-man, or in case of emergency, by a skilled watchmaker. It is usually a hopeless job for one unskilled in meter work to try any repairs, unless they are of obviously simple nature, like re-soldering of leads, or lugs, or the like, and even then, it is generally a ticklish piece of work, due to the absence of proper tools and appliances. If a meter is damaged, it will in almost all cases be cheaper and better to return it to the factory or to a specialist for repair than to attempt to do so with the ordinary tools on hand. The few instances where it is possible to do the job at home are so rare that it is practically a fixed rule, and a very safe one, not to try any repairs at all.

Above all, meters should never be overloaded. The folly of this is apparent. In the first place, it is a useless and silly practice, as if a meter is overloaded it will simply swing beyond the maximum scale reading and hit the "peg," making any kind of readings impossible. Furthermore, it is very liable to burn out the meter, or seriously damage the moving parts, and it is almost certain to ruin the calibration, which is almost the most valuable part of the meter.

When connecting to an unknown or unmeasured circuit proper precautions should be taken to see that the line voltage is not greater than the maximum reading of the meter. All direct current meters should be carefully checked up before turning the current on them, to make sure the correct polarity of the line and meters are connected. Meters with external shunts should be connected so that they will not read "reversed," and furthermore, the leads from the shunt to the instrument should always be those supplied by the maker, as the meters are calibrated with these same leads in the circuit. The same refers to thermo-element meters, with external elements.

All high voltage d.c. voltmeters are provided with external resistance coils, and these *must* be connected in series with the indicating element, or the latter will be burned out. Some types of wattmeters are provided with similar resistances, usually in the form of multipliers (which give twice, or three times the normal scale reading), which must be connected in circuit for proper results.

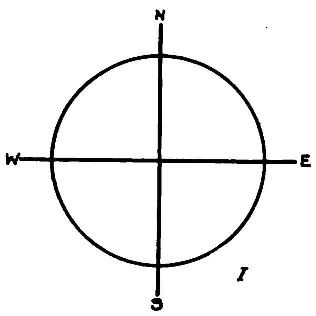
Above all, common sense and intelligent care are required for the use of ordinary electric meters, and if a reasonable "dose" of each is taken, together with realization that a sensitive meter is one of the finest mechanical and electrical appliances produced, there should be but little trouble with electric meters in ordinary service in a radio station.

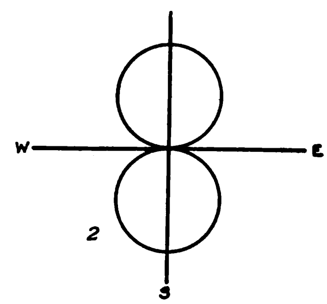
Directive Reception and Interference Elimination

By Hugh R. Sprado

THE coming of radio frequency amplification for short waves has brought with it innumerable advantages, among the most important of which is reception by means of loops. A certain manufacturer speaking of radio frequency amplification, says: "This is the most important advance made since the introduction of the vacuum tube." The experimenter will realize the significance of this statement more and more, as he works towards the elimination of interference. Before the advent of radio frequency amplification, the elimination of interference usually meant a decrease in signal strength of the station with whom communication was desired. Now, however, radio frequency amplification allows any desired amount of selectivity providing we gain through radio frequency amplication what we lose through selectivity.

As loop reception is the first step toward the elimination of interference, the writer will describe a system that has





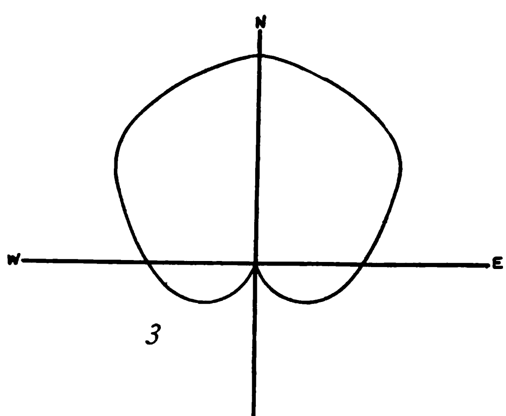


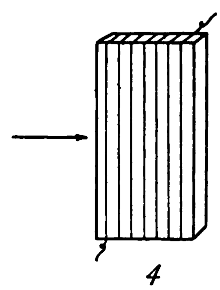
Fig. 1. Antenna Receiver *Fig. 2. Loop Receiver*
Fig. 3. Antenna-Loop "Barrage" Receiver

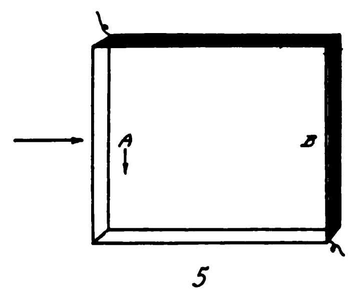
many advantages over the use of open antennæ or loops alone, a system whereby any station can be tuned out completely providing this station is not in direct line with the station desired. Under certain conditions, a strong interfering station may be entirely eliminated and a weaker station on exactly the same wavelength can be read as clearly as though the interfering station were not operating.

Fig. 1 shows diagramatically the directive properties of an open antenna. As shown, the open antenna receives equally well from all directions, that is, it is non-directional. Fig. 2 shows the directional properties of a loop antenna. It will be noted that the loop receives equally well from only two directions. The reason for this is as follows: Suppose we have a loop so placed, Fig. 4, that an oncoming wave strikes the plane of the loop, cutting all the turns at the same instant. The e.m.f. induced in the end turns will be equal, but 180 degrees out of phase. In other words the induced forces will buck each other with the result that no current flows in the loop.

However, if we were to turn the loop 90 degrees one way or the other, the plane of the loop would be in line with the direction of the traveling wave, Fig. 5. The wave would first cut the turns on side A inducing a downward current, then cutting side B and inducing a current upward in that side. As these two currents would be in phase, there would be energy flowing in the loop. If we turned the loop through 180 degrees there would still be energy in the loop, but in the opposite direction. The following system depends upon this reversal of current in the loop for its operation.

Fig. 6 gives a schematic circuit of the "antenna-loop barrage" system. It consists essentially of an antenna and ground system, a variable condenser shunting the antenna and ground, a coupler having primary winding L and secondary winding L_1, and a double pole double throw switch





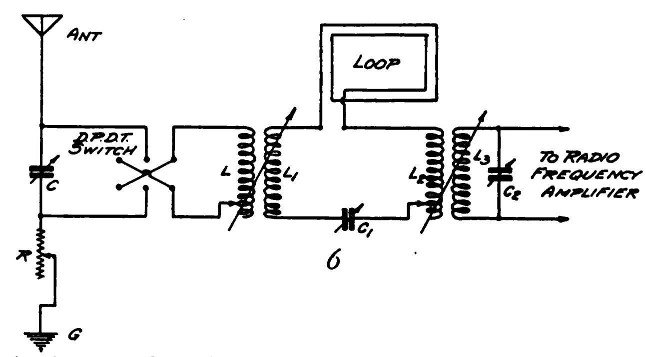


Fig. 4. Loop with Winding at Right Angles to Direction of Wave Travel. No Signal. *Fig. 5. Loop with Winding in Line with Direction of Wave Travel.*
Fig. 6. "Antenna-Loop Barrage" Receiver

for reversing the primary coil L. The loop is connected in series with the secondary of the first coupler, the primary of the regular receiver coupler and a variable condenser C_1. This forms the loop tuning circuit. The secondary L_3 of the second coupler is connected to a radio frequency amplifier of two or three stages, depending upon the distance to be covered.

The operation of the circuit is as follows: Let us assume that the current in the antenna circuit at any instant is in the downward direction. At the same instant we will assume that the current in the loop circuit is as shown in Fig. 7. A downward current in the primary coil L will induce an upward current in the secondary coil L_1 as shown in Fig. 8. It will readily be seen that the current in the loop circuit will then be in phase with the energy induced by the antenna circuit and the two currents will be additive. This condition is only true when the signal is in the direction shown by the arrow.

Should another signal from the opposite direction cut the loop and antenna, the current in the loop would be reversed, while the current in the antenna would still be in the same direction or downward. When this is the case, the current flowing in the loop circuit will be exactly 180 degrees out of phase with the current induced from the antenna circuit. The two currents, if equal, will neutralize each other and no signal will be heard. The directional properties of such a circuit are shown in Fig. 3.

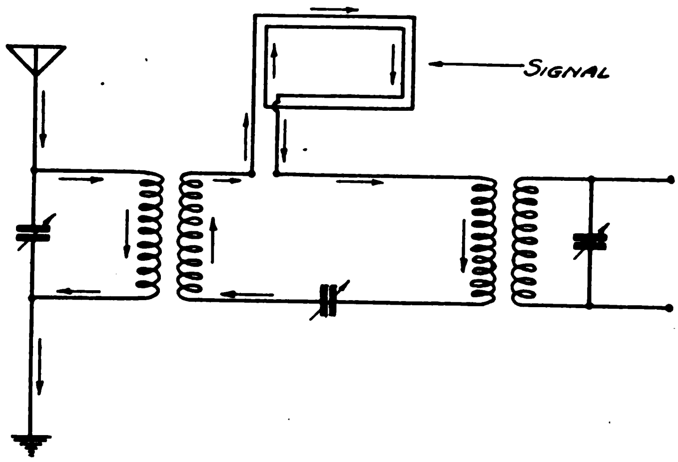


Fig. 7. Direction of Current Flow in Circuit When Antenna and Loop Circuits are Additive

By studying Fig. 3 it will be found that any signal can be "barraged" out, providing it is not in the direction of the desired signal. In the elimination or reduction of interference, the advantages of this circuit are obvious.

The adjustment of this "barrage" is comparatively simple. To tune in a desired signal, the double pole double throw switch is opened and with the loop circuit tuned to the desired wavelength, the loop is revolved until the station wanted is at a maximum. The antenna circuit is now connected into operation by closing the switch, first to one side and then the other, at the same time tuning with the antenna condenser. The antenna variocoupler should be adjusted to fairly tight coupling during this adjustment. When the antenna approaches resonance, it will be noted that with the switch on one side the signals become louder, and with the switch on the other side they become weaker. The switch should be thrown to the side where signals become weaker and the antenna circuit and coupling variometer adjusted until the signal is completely cut out. When this has been accomplished, the switch should be thrown to the other position and it will be found that signals are at a maximum and the "barrage" is in balance.

Any signal, static or arc mush coming from the direction opposite to that of the station being copied will be entirely eliminated. Should the interference come from some angle slightly off the zero balance, this can also be eliminated by revolving the loop until the interference is "barraged" out, without greatly diminishing the strength of the desired signal.

It is important that the energy in the antenna be the same amount as the energy in the loop circuit. If this is not the case a true balance cannot be obtained. It is advisable to make the open antenna large enough to supply more energy than the loop and then balance the two currents by means of a variable resistance in the antenna circuit. This added resistance also has the advantage of broadening the tuning of the antenna circuit, thereby covering a wider band of wavelengths to "barrage" out.

The operator will find numerous combinations of loop positions and coupling adjustments that will practically eliminate any source of interference. This requires practice and a thorough knowledge of the circuit and its operation.

For greatest selectivity, the circuit shown in Fig. 6 is recommended; however, very good results as far as directional effect is concerned, can be obtained by using the simplified circuit shown in Fig. 9. In this circuit a regular regenerative receiver can be employed, the only change necessary being an arrangement whereby the loop may be connected directly in the secondary circuit of the receiver. Although radio frequency amplification is required when great distances are to be covered, a regenerative detector and two stages of audio frequency amplification can be used with fair results for short distance work; that is, not over fifty miles.

As previously stated, there are numerous additional methods of obtaining extreme selectivity in receiving work, but they all depend upon the "loop antenna barrage" for their first step toward the elimination of interference.

In conclusion, a few actual results in interference elimination on long waves may be of interest to the reader. In one instance it was possible to completely "barrage" out one station radiating 500 amperes only 20 miles away and clearly copy another station 5000 miles away using identically the same wavelength. Another instance was the copying of this same station, 5000 miles west, while static coming from the east was so severe that wearing the telephones was unbearable. By use of the "antenna-loop barrage" this static was completely eliminated and the distant signal brought in clear and distinct with double the intensity. Still another instance was that of barraging out two nearby high power stations lying at different angles and at the same time copying a medium power station 2000 miles away. All these results were obtained in daylight and in the tropics.

The secret at the bottom of all these phenomenal results was the use of radio frequency amplification to regain the energy lost through selective tuning.

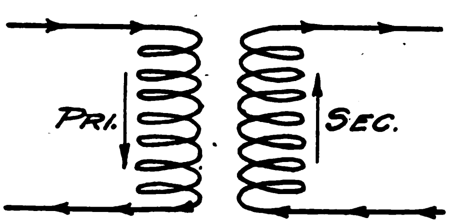


Fig. 8. How Downward Current in Primary Induces Upward Current in Secondary

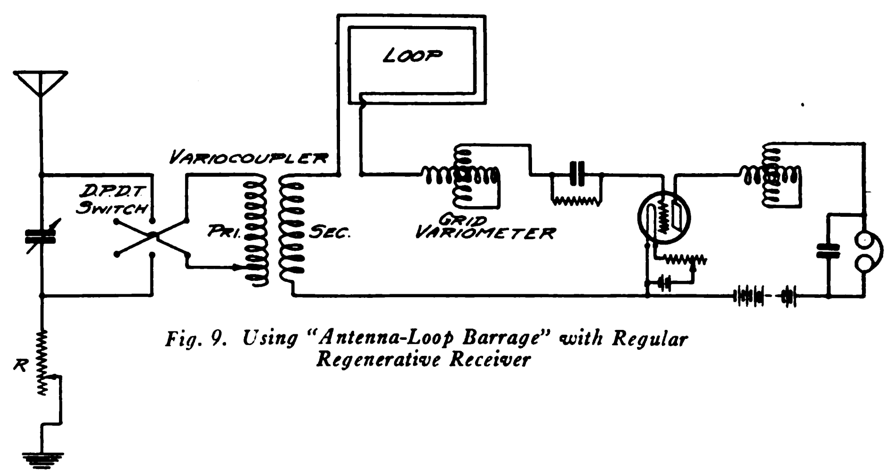


Fig. 9. Using "Antenna-Loop Barrage" with Regular Regenerative Receiver

A "Stand-By" and "Tuned" Continuous Wave Receiver

By R. E. Lake

THE reception of continuous waves is accompained in many cases by equally strong signals from transmitting stations using damped waves. A simple method of lessening this interference is to use a very loose coupling between an aerial circuit and a closed oscillatory circuit slightly mistuned. The distance between the circuits may be about 3 ft., in which case the spark interference is almost entirely eliminated. The strength of the continuous wave signals is of course lessened at the same time, but not enough to seriously affect them.

In Fig. 1 is shown two circuits, A and B, separated by 1 ft. The circuit B is an ordinary simple regenerative circuit which, by tightening the coupling between the aperiodic coil L_1, may be set into self-oscillation at a frequency mainly determined by the position of the variable tapping from L_1 and the value of the condenser C_1. The plate oscillatory circuit consists of an aperiodic coil whose natural wavelength should be less than that of the smallest wavelength to be received on the circuit.

Detector action is obtained by means of the condenser C_3 shunted by a resistance of about 2 megohms. This resistance may conveniently consist of several scratches on a piece of rough ebonite or bakelite filled with graphite by rubbing an ordinary lead pencil across the grooves until a resistance

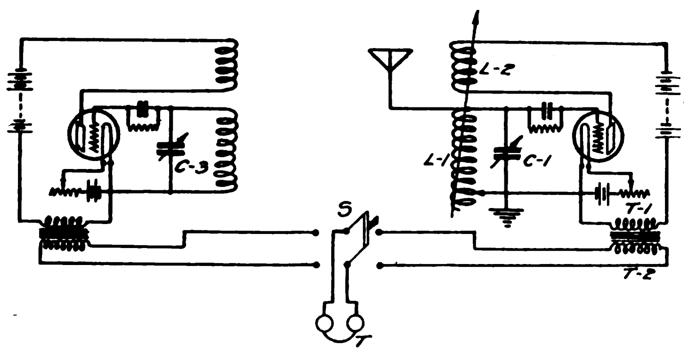


Fig. 1

tester connected across the terminals indicates the correct resistance. Instead of a pair of high resistance receivers in the plate circuit, a step down telephone transformer T_1, T_2 may be used, the high resistance winding of which may have a value of, say, 10,000 ohms. The low resistance winding T_2 should have a resistance equal to the resistance of the 'phones. It should be of heavier wire than the winding T_1 which latter may have about five times as many turns as T_2. The switch S when swung over to the right brings the telephones into the circuit B.

The circuit A is a similar one except that no aerial or earth connections are made to it. The coupling between L_4 and L_3 is variable and the vacuum tube is used to rectify and produce regenerative action or self-oscillation.

When the phones are connected in the B circuit, the latter of itself is capable of receiving continuous waves. The coupling between L_2 and L_1 is tightened until the tube starts oscillating. On touching the aerial, a sharp click is heard in T. If L_1 is variable by taps, a sharp click should be heard on moving the switch blade over them. Since these effects are not produced when the tube is not oscillating they may be used as indications of its oscillating.

When receiving continuous waves, the circuit B is made to oscillate at a frequency slightly different from that of the incoming waves by a suitable adjustment of L_1 and C_1. The beats produced will be rectified by the tube and will give signals in T. This circuit has at least two disadvantages. The first is that the strength of the local oscillations in B are not smoothly variable. A certain amplitude (greater than that of the incoming waves) gives the best results. The second is that since we have mistuned our local circuit, the aerial circuit will be slightly out of tune with the incoming waves. This results in a weakening of the incoming oscillations which, however, retain their frequency and force their way into the circuit. The higher the beat note received, the greater will have been the mistuning of the aerial circuit and consequently the greater the opposition to the incoming waves. This effect lessens the strength of weak signals considerably and explains why the lower beat notes are the loudest on this type of circuit, whereas the most pleasing frequency is about 1,000 cycles per second. When the aerial circuit is perfectly in tune with the incoming signals, the local oscillations will have the same frequency as the incoming ones and no beats will be produced.

Continuous wave signals are easily picked up on this type of circuit which is, therefore, convenient for use when standing by or searching. Once the station has been picked up we may eliminate interference by using the "tuned" circuit brought into operation by moving S to the left. The circuit B is first adjusted for no beats with the incoming signals. The filament current (or the plate voltage) is then decreased until the tube ceases to oscillate of its own accord, the coupling between L_2 and L_1 might be loosened if desired. The tube is now acting in a regenerative manner and is strengthening the incoming signals. These are then induced in the circuit A which is in a state of self oscillation. Interfering spark signals are lost in the coupling, but the continuous oscillations interact with those of A and cause beats which are audible in T.

A rapid method of adjusting these circuits is as follows: Switch S to the right, increase the filament current of A until the circuit oscillates, tune C_2 till signals are heard, tune to the silent point of these signals so that the latter will be heard if C_1 be varied either way. Switch S over to the left, see that the circuit A is oscillating of its own accord, tune C_2 until a beat note is heard due to the oscillations of B. Decrease filament current of B until the circuit ceases to oscillate, the loud beat note in T due to B will cease, but by careful adjustment of C_2 the incoming oscillations will produce audible signals. The circuit A should be removed as far as possible from B, without reducing the signals in T too much. If, while signals are being heard in T, the condenser C_1 is slightly turned either way, the strength of signals in T will decrease (owing to the mistuning of B), but the frequency of the beat note will remain the same since it depends on the local frequency of A.

The same disadvantages which applied to the B circuit alone still apply to the loose coupled arrangement of A and B with the telephones in the B circuit. A considerable amount of spark interference may, however, be successfully eliminated. Moreover by suitably adjusting the coupling between L_2 and L_1 the incoming oscillations may be considerably strengthened by regenerative action. The signals in T will be weaker if advantage of this effect is not taken.

Having adjusted the tuned arrangement, change back the phones to the B circuit. Very loud signals will now be heard —probably twice as loud as those heard on the B circuit alone, and three or four times as loud as when the switch was thrown over to the right. The action of the circuit is now as follows: The B circuit is now accurately tuned to the incoming frequency and no loss is experienced through mistuning, also the oscillations are reinforced through the regenerative action of the coupling between L_2 and L_1, the degree of this coupling being just less than that required to set the circuit in oscillation. The A circuit which is oscillating at a frequency slightly different than that of the incoming waves, induces oscillations in B which, acting on the oscillations already existing there, produce audible beats. The circuit B is not as receptive to local oscillations from A as it might be, but this is no disadvantage since the amplitude of the induced oscillations forced into the circuit may be adjusted to any value by varying the distance between the circuit A and B.

In the above circuits if high resistance telephones are used the use of the step-down transformers may be dispensed with. There is no objections to lighting the filaments of both tubes from the same battery.

In Fig. 2 is shown a circuit intended for use as a general receiving circuit for damped or undamped waves. It has particular advantage in that it does not radiate continuous waves while receiving this class of signals from outside.

With the two circuits of Fig. 1 used in conjunction there is practically no radiation of continuous waves when receiving since the B circuit does not generate oscillations. With the circuit of Fig. 2 there is no radiation. Continuous waves pass inwards but are prevented by the first tube from passing out. The arrangement is therefore, effective as a trap.

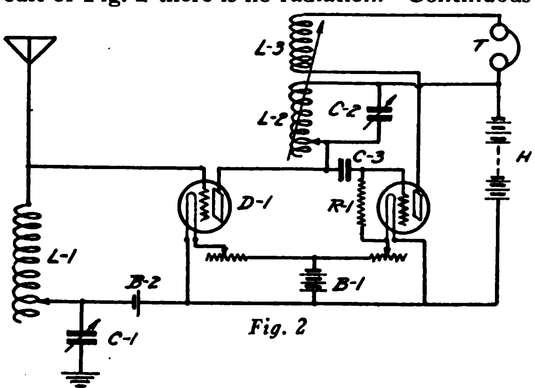


Fig. 2

The circuit consists of two vacuum tubes, the first one used merely as a radio frequency amplifier and the second as a combined amplifier, heterodyne and detector. The aerial circuit is shown directly connected to the grid and the filament of the first tube, in the grid circuit of which is a small dry cell, B_2, connected so that the grid is made negative and therefore prevented from taking a prohibitive current. Magnified oscillations are set up in the plate circuit of the first tube which consists of the plate P, the oscillatory circuit L_2, C_2, the battery H and the filament. Oscillating potentials are set up across L_2 and are communicated to the grid of the second valve through the condenser C_8 of about 0.0003 m.f.d. A resistance R_1 of about 2 megohms is connected across the grid and filament and serves the usual purpose of the grid leak. If connected across C_3 (the usual position) the plate battery would affect the grid potential. This form of connection is applicable to many similar circuits.

In the plate circuit of the second tube is a small aperiodic coil L_3, a pair of high resistance telephones, and the battery H. The coil L_3 is coupled to the inductance L_2 so that coupling may be smoothly variable. By tightening the coupling, the circuits may be made to oscillate continuously at a frequency determined by the values of L_2 and C_2. These oscillations will not be communicated to the aerial circuit as has been explained above.

When standing by for spark signals the capacity of C_2 is adjusted to zero and the value of L_2 is kept fairly low with loose coupling between it and L_3. All tuning is now done on the aerial circuit. The coil L_2 is then aperiodic and responds to all waves which are then rectified by the second tube.

When continuous waves are to be received, the aerial tuning inductance is varied and search is made on the condenser C_2 which varies the frequency of the local oscillations which are to interfere with the magnified incoming oscillations passing through L_2. The coupling between L_2 and L_8 is of course tightened sufficiently to cause the second tube to oscillate of its own accord.

The inductances used may be usual single layer coils, bank wound coils, or the tapped honey comb coils now on the market. If the latter are used it must be borne in mind that the coil L_1 is not to be placed in inductive relation with L_2. The size of inductances used will obviously vary with the wavelength desired to be received.

A NEW TELEPHONE INVENTION, THE "SUPERPHONE"

By MAJOR GENERAL GEORGE O. SQUIER
Chief Signal Officer of the Army

A new telephone invention, the "Superphone," has been developed under the direction of R. D. Duncan, Jr., chief engineer of the Signal Corps Research Laboratory, Bureau of Standards, assisted by S. Isler, assistant radio engineer, and is described in Information Bulletin No. 12 of the Signal Corps. It is based on the original invention of "wired wireless" or "line radio" invented about ten years ago by the writer.

The new device consists of a small portable set of instruments which may be installed in any office or residence in a few minutes and connected directly to existing telephone lines, and conversations carried on in the usual way. It will only be necessary for the subscribers to close a switch or press a button to connect in the superphone in place of the ordinary phone.

This superphone provides a means for absolute secrecy of communication without any chance of the conversation being overheard, interrupted or broken into on the line by anyone else. It is obvious that this invention will prove of the greatest value for military purposes in case of war where secrecy in communication is absolutely necessary, but it may also prove of great utility for ordinary commercial purposes where important business houses, such as banks, brokers, etc., may desire to have private channels for confidential communication with their branch offices or with any business establishment and insure secrecy of the conversations carried on.

The principles involved in this invention are those of "wired wireless" by which high frequency alternating currents are employed which are modulated at the transmitting end by speaking into an ordinary microphone and detected at the other end by the usual radio instrumentalities which finally passes on to an ordinary telephone receiver. The speaker, however, or the listener in, is not concerned with any of the additional instruments; they are installed and properly adjusted once for all, and the people carrying on the conversation have no more bother than in the use of the usual telephone system.

Another advantage of this method of telephone communication is that it makes multiplex telephony possible. Quite a large number of secret telephone conversations may be carried on simultaneously over the same line without interferring with each other.

The transmission of speech by the utilization of this invention is even clearer than ordinary telephonic speech. The power required for carrying on conversations over even considerable distances is of the order of one-tenth of a watt, which is about 1/500th of the power required to light an ordinary electric lamp.

This novel development is only one of the many which are coming to light almost daily in the application of the broad principles of "wired wireless" or "line radio."

Crystal Detectors

By B. F. McNamee

BEFORE taking up the subject of detectors, it will be well to consider the nature of the current in the receiving aerial. Let us take a 200 meter "spark" signal to illustrate. Each time that a spark occurs at the sending station, a group of waves is sent out, causing current to flow up and down the receiving aerial several times, gradually decreasing in strength until it finally dies out.

It is plain that there are two frequencies involved here. The "high" frequency refers to the rate at which the waves strike the aerial, causing the oscillating current. In the case of 200 meters, this frequency is 1,500,000 cycles per second. The other frequency is called the "group" or "spark" frequency and refers to the number of groups of waves in one second, which is of course the same as the number of sparks per second at the transmitting station. This number is generally between 100 and 1000.

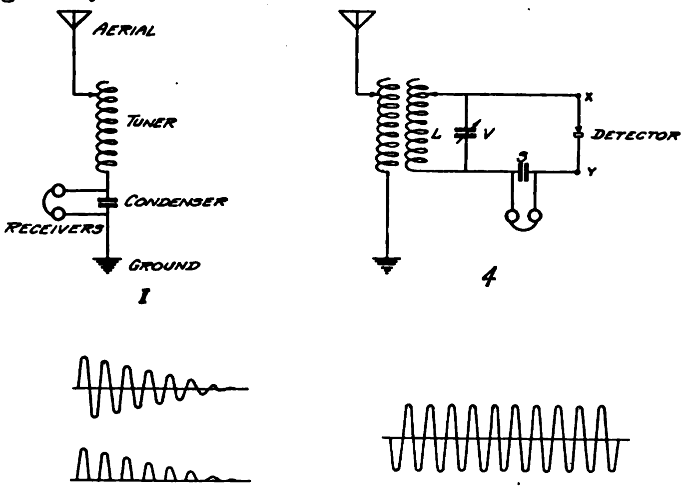


Fig. 1
Fig. 2

Fig. 4
Fig. 5

If a pair of telephone receivers is connected as shown in Fig. 1 and the 200 meter signal tuned in, there will be no sound for two reasons. The first is that the high inductance of the windings of the receivers offers an enormous resistance to the high frequency current so that the amount flowing could have no appreciable effect on the diaphragms. The second reason is that even if it were possible to move the receiver diaphragms in and out at a rate of 1,500,000 times per second, there would be no resultant sound, since the highest note that most people can hear is about 20,000 vibrations per second, and for good reception the notes should be much lower. If each group of oscillations is made to cause a single movement of the diaphragm, a good sound results.

It has been found that some minerals conduct electricity much better in one direction than in the opposite. This rectifying action is generally improved when one of the contacts to the mineral consists of a fine point resting very lightly. The action is usually confined to "sensitive" spots on the crystal, which can be found only by trial. Fig. 3 shows a common type of crystal detector. The mineral employed is galena, a compound of lead and sulphur.

Fig. 2 shows how a detector can be used to produce one movement of the receiver diaphragms for each group of waves. Above is shown one group of the received high frequency current. B shows what happens if a detector of the rectifying type is placed in the circuit. There are several current impulses, but they are all in the same direction, the current in the other direction being stopped by the crystal. These impulses serve as a series of small charges to condenser S in Fig. 4, which then discharges a single impulse through the receivers. Thus, if there are 250 groups of waves per second, there will be 250 movements of the receiver diaphragms per second or a note about as high as middle C.

A convenient test in locating a sensitive spot on the crystal can be arranged by connecting a buzzer to a battery through a push button. A wire is connected from one of the buzzer contacts to one of the detector terminals. When the buzzer is turned on, it will be heard in the receivers when a sensitive spot is found.

A detector of the rectifying type such as described above will not work on undamped waves (Fig. 5). Since these

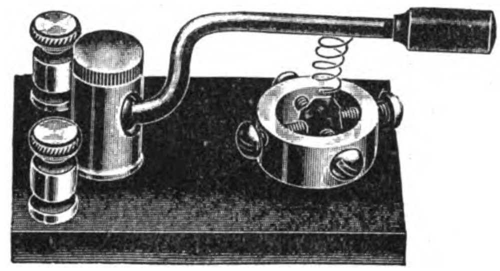


Fig. 3—Crystal Detector

waves produce in the receiving aerial currents of constant strength and not broken into groups, there will be no musical note in the receivers when a crystal detector is used. Undamped waves may be received if the crystal detector in Fig. 4 is replaced by a "tikker." This is a mechanical device for rapidly opening and closing the circuit between the points X and Y. It usually consists of fine spring wire resting lightly against the surface of a revolving metal pulley. The circuit from wire to pulley will rapidly make and break.

Condenser S should be considerably larger than the tuning condenser V. When the tikker contacts are apart so that the circuit is open between X and Y, the circuit LV is tuned to the signal, thus giving condenser V a maximum charge. When the tikker contacts close, condenser S is connected across condenser V, from which it is charged. Condenser S now discharges through the receivers, and the process is repeated. It is evident that the tikker can also be used for spark signals, although it will spoil the clear note.

RADIO 7YJ

Continued from page 10

The transmitter consists of a 1 kw. Thordarson transformer, a .01 mf. Dubelier condenser, and a synchronous gap secured by a 9 in. disk with eight 1 in. electrodes driven by an induction motor. With a 10 in. coupling this gives 5 amperes radiation from the aerial. A counterpoise on the roof, 30 ft. below the aerial, assists in producing this radiation. The oscillation transformer primary is made up of heavy 2 in. brass strip and the secondary of ½ in. brass strip.

The receiving set on the left, constructed by Mr. Jordan, was originally designed for wavelengths from 200 to 16,000 meters. The set on the right is an army C. W. transmitter and receiver, type BC 32A. The small set on top is a Grebe CR 3A.

The tray on the floor is a "B" battery made of 5 oz. bottles. The plates are old automobile storage battery plates cut into strips. The only cost for this 100 volt battery was $7.00 for bottles.

A LIST OF STATIONS HEARD AND WORKED BY 7YJ

6AFB, (6AJF), (6AV), (6CV), (6EB), (6FI), 6IK, 6OC, (6XAD), (6XAC), 6XG, 6ZX, 6ZB, and Avalon phone.

(7BH), (7BK), 7BU, 7HScw, (7GO)cw, (7MF), (7YA), (7YL), (7YS), 7PZ, (7ZJ), (7ZE), (7ZU).

9AB calling 9BE on cw, 9AX heard without aerial, 9AVV, 9AMBcw, 9BD, 9DTHcw, 9JQ, 9NXcw, 9OOC, 9WU, 9YA.

Scratchi Comes Ashore for a Trip

Decoded from the Walsirwinese

By David P. Gibbons

TO EDITOR "RADIO" (which dispel pleasure by the month to all bugs and bugesses who have forwarded free coupon with proper sum):

DEAREST SIR:—

Since hearing from you before several little things have passed me by which I desire to place in front of you for illumination. For some reason or no other the Magnastocks Corporation which employ by Cousin Scratchi donate him generous vacation on beach, and in order to modulate high living cost I impose him to share my hilly apartment on Ashbury Street. When he arrive he bear along considerable excessive baggage such as motorgenerator, type 106 receiving box, transformer, complete battery and so forth, which he inform me he have picked up at special bargain. I inspect to find makers title-plates and numbers but do not, and Scratchi think perhaps these drop off on uphill route from ferry. Mightbe you think likewise, Mr. Editor? I am interest to know if any more such bargains are to be grabbed at, but Scratchi say "No, these are everything. Old scow-maru are now quite outside of commission."

"What position will you again assume when entirely refreshed?" I demand him in cousinly speech.

"I would highly enjoy a brief space of enlistment in glorious navy," flareback Scratchi.

"But all navies are now pointing toward grand scrappy pile," I project.

"Maybe pointing towards with full speed astern," quip Scratchi, "but such ticktacks chops no ice with me, as I aspire to regain rapid discharge, and then with envious supply of high navy grade vacuum tubes I shall make fingersnaps at all sparking and arking clutter from hence on."

"How do you arrive at that conclusion?" I confuse.

"I shall become good-standing member of the I. C. W. W., which are motely organization of picnic hams and lady friends," Scratchi obscure and peruse further, "these Continuous Workers are highly opposite to the Won't Workers, which are chiefly composed with soupbone and catmeat style of members and entirely devoid of juicy hams."

"What are object of such combine?" I query.

"Oh, many such," report my cousin, "but main one are to discover which member most fancy liar. For instant, one member compose communication like these, 'Last night I pick up Moscow on one piece of radium crystal so loud I can hear him on one foot away from fones which are disconnected from aerial with A and B batteries shunted in serious.' Then other member take floor away from him thusly, 'Last night I catch KICZ which are four days out from Frisco. He come in so strong on my loud-mouth hitchup I can hear operator scratch his head over abstraction!' He forgot to inform that KICZ always return himself back to Golden Gates after four days out. This continue until referee count ten o'clock."

"Are not very model station necessary to mingle up with such classy progressors?" I quip.

"Truly so," are response from my cousin, "but I hope to possess latest advanced model. I now pursue carefully special offerings in aft section of radio magazines, and have arrived at far end of wits to make buying decision. I enjoy so clever word pictures of the Pyramid Receptor, Type 14AD92, with micrometer binding posts, that I nearly neglect the Greenee short waving set, Type EZ2C, with rubber-tired ticklers and finished in shining walnuts. On next page writing expert have quite exhausted Hon. Webster's bridgeless volume, so he introduce Dr. Wu Zee, who shake magical stick while dispensing following Chinee adverbs, 'You can fool all the people quickly if you can sling the Durham slickly.' On other page the Glee Frost Company set out glib details of most modest radiophone fitout which only cost 2 or 3 hundred cash dollars, excluding tubes, batteries and everything."

"Why not employ very simple serkit which you have perfectioned and have expert insert it in small, neat set?" I propose. "All you must purchase for such are one vary condenser, one honey coil with rheostat and socket."

Scratchi agree to this as he have exalted this up-hook most unbelievingly, and we move along down to Market Street radio dealers to inquire for cost prices and etceteras. We reached there in short time after several skippings from under tintype jumpabouts which Mister Ford issue in wholesale quality when not otherly engaged in pepping up some stockbroke railroad. We make converse with very superior clerical gent who are safe behind glassy counter and he jot down what we desire. He add these up and it show twelve dollars. We then require how much cost it would become to put same in small box, six inch in all directions. He rapidly jot down 13 additional dollars, which he explains are for labor, time, roomrent, income tax and so forth. We leave him and approach some Mission Street radio places and collide with result very similar if not more so. My cousin Scratchi and self have by then exchanged our pep for pip and decide to oblivion such foolish misconstruction idea and we corrugate deeply how Hon. Mister Postmaster can secure himself husky marines to protect mail orders from upsticking bandits, while poor bug can obtain no such armored guard to go forth with him when radio shopping. I require intelligence on this angle, Mr. Editor. Mightbe you have some?

While wending gloomy footsteps towards our homely shack I inquire of my cousin how soon he figure to join up with the I. C. W. W. order.

"Never at all," he respond peevily. "Instead of it I desire to join the Q Cluck Canners and distribute tarfeather overcoats to highbounding wireless magnates."

When we arrive back home again Scratchi make hasty connection of my aerial to old type 106, and plug in motorgenerator to chandelier lamp. He then adjust potentiometer around the rumdum crystal and as buzzer have stripped gear he lean elbow on key while he hunt sensive spot with flowery oriental language.

He are still hunting, Mr. Editor, and hoping you are likewise, I remain,

Your Affected Reader,

HILOLI NOGO.

RADIO AUTOMOBILE GUIDE

Raymond F. Yates, a New York inventor, has produced a radio device which promises to eliminate the use of guide books, sign posts and road maps. High frequency electric current is made to pass through a wire running along the road. This current sets up an electromagnetic field and the passing car has attached to its hood a coil which cuts through this field. The current produced in the coil is amplified with a radio vacuum tube and from this point it passes to an instrument on the dash. The wire at the side of the road carries a definite signal and each road equipped with the system will be characterized by a certain signal. For instance, the wire along the road between New York and Albany may be emitting two dots and one dash. A car passing along this road would pick up the signal and the two dots and one dash would appear in red on the face of the instrument which has become known as a directometer.

The Small Person

By Lawrence Mott

HE was a queer sort of an elderly little man—a very *little* man, structurally speaking—not much over five feet in height, and narrow in proportion.

The other passengers of the first class, voyaging on the great liner from New York to Southampton, could make nothing of him, and—as is often the case under similar circumstances—proceeded to ridicule, at first covertly, and then because the Small Person—for so he was dubbed by popular acclaim—made no offer of self defense—open chuckles were in order when the strange little figure appeared on deck, an odd-shaped cap pulled well down over large ears, an old-fashioned muffler tight-wrapped about the thin neck, and a sort of a "duster" coat falling to his heels and flapping about his scrawny legs as he walked—with very droll effect.

The Small Person was sensitive of his personal appearance, and although he kept a bold front, the soul of him writhed in hushed pain.

"I can't help the way God fashioned me!" he would mutter to himself, pathetically. "And it seems kind o' hard to be made fun of *all* the time! 'Milk of Human Kindness'—huh! A helluvalot there is—*not!* The cow that gave it dried up long ago! Gosh, but I wish I had a little nerve!"

He kept—for the above reasons—entirely to himself, usually curled up in the sun behind a ventilator on the boat deck, his sparse-blue eyes roving the endless distances of eternally rolling waters, his thin hands tucked in his sleeves, fuzzy cap jammed over ears. A strange, Small Person—to be sure.

One morning he ventured to look in the radio room, and the operator on watch grinned cheerily.

"Come on in, Uncle! Chilly wind today!"

The *"Uncle"* rasped, but the Small Person hoisted himself over the brass-bound sill and sat himself gingerly on the settee within.

"A radio Op's life is not what it's dolled up to be—not by a long shot! People seem to think that all we have to do is to sit here and do nothin'!"

"Well—that's about right isn't it?" queried the Small Person gently, and the operator looked at him hard, wondering whether this odd specimen of humanity was making fun of him. But so guileless were the blue eyes that no one could accuse the mind, whose windows they were, of any levity whatsoever.

"Yes, but the doing *nothing* becomes tiresome! Time signals—weather reports—a few messages—press—watch on and off, reading trashy bunk between times—that's what it amounts to."

"Why don't you do something else, then?"

Again the operator studied the Small Person carefully, but could find nothing at which to take umbrage.

"Oh—I dunno. Sort o' get used to it, I suppose. Want to have a look 'round? I'm standing double watches, as the other operator's had some kind of a stroke—weak as a cat—off his head most of the time since yesterday. Doctor's got him in the sick bay. Great life—isn't it?"

"That's too bad. Why—er, yes, I don't mind lookin' 'round."

So—and in the most simple language at his command—the somewhat self-important operator condescended to explain, very cursorily, the workings of the bright-glistening radio apparata, while the Small Person listened deferentially, with expressionless face.

"Come in again—whenever you're up here," said the youth, "and mind that the wind doesn't blow you away!"

Again the soul of the Small Person writhed, as the wind literally blew him aft—for it was freshening fast from the nor'east.

By 8 bells that night it was blowing hard, and the huge vessel rolled ponderously to unusual degrees. The decks were dangerously wet and slippery, and the wind easily bit through the stoutest of over-clothing.

The Small Person did not like the loneliness of his cabin. Gregarious was he, when he could not see the sun, or the moon and the stars—and the beauties of nature that these revealed to him.

"Outside—all of you! I'm running this show from now on."

At such times he preferred nature to the society of his kind. But when weather conditions shut off his supply of the Creator's handiwork he was lonely, and crept—mouse-like—among men.

He attempted the music room, but a ponderous female was being firmly held on the piano stool by two men—whom, he thought, should have had better sense—and the noises that she made, in efforts toward song, drove him forth.

So it was that he edged his way in the smoking room, and slipped in an as obscure corner as possible.

No one paid any attention to him—which was a relief in itself. Even the steward in whose particular tip-territory he had projected himself, merely gave the table top before him a con-

Continued on page 42

How to Make a Good Radio Receiver

By D. B. McGown, Assistant Radio Inspector

COUNTLESS and endless descriptions of radio apparatus, showing circuits, complete instruments, and what not, are published for the guidance(?) of the growing radio amateur. Many, possibly most, of these descriptions and instructions are very good, but they are not always complete, or specific enough to give the "dope" on the actual building of the apparatus. Or, again, the instrument or apparatus may be perfectly well suited to certain requirements, or the peculiar requirements of a certain station, but are almost useless for another. Or, as is very often the case, a complete machine shop, with many fancy tools, is required to perform some operation, so that instead of making it, the amateur finds it cheaper to buy the set ready-made. In this, and succeeding articles, apparatus will be described, that while not necessarily new, will be of such design that it is possible to duplicate it with a very modest equipment of tools, altho the proverbial "hammer and saw" will not suffice.

We will first consider the construction of a good receiver. This instrument is almost an exact duplicate of a popular type now offered for sale by several enterprising firms, and no credit is claimed by, or due, the writer for any originality in its operation or design. The instrument will receive on all wavelengths from about 175 to 2,500 meters, with an average antenna, and with a larger, or smaller one, its range will be increased, or decreased correspondingly. The circuit used is the so-called "single-coil" one, which is not quite as selective as some others, but is very sensitive, and is especially valuable if used for receiving C. W. signals.

The following material will be needed for the construction of the instrument:

1 bakelite panel 3/16x6x15".
1 4" dia. cardboard, or bakelite tube 7" long.
8 binding posts, of type to suit builder.
2 instrument dials.
1 filament rheostat.
1 tube socket.
1 grid condenser (.00025, approx.) may be made up.
1 bridging condenser (.005 approx.) may be made up.
1 small switch, with two arms.
10 switch-points.
1 3¾" variometer ball.
2 ft. brass strip ⅛x⅜".
1 ft. 3/16" brass rod.
Wire for connections, a few small screws, nuts, etc.
1 lb. No. 22 DCC wire.

The circuit of the receiver is shown in Fig. 1. We have the antenna connected, thru the condenser C_1 to the inductance L, which is varied by the two bladed switch, and connected thence to the ground. Rough tuning is accomplished by varying the switch, and fine tuning is accomplished by the use of the antenna condenser C_1. Two blades are provided on the switch, to short circuit the two adjacent sections of the inductance L. This seemingly strange procedure is actually very useful, as it gives the effect of a "dead end" switch, without the complications necessary for its use, as, by short-circuiting, it throws the natural period of the unused coils so far out of resonance with the wavelength of the incoming signal and of the coils in use for reception, that no effect of any kind can be noted from their proximity. The grid of the vacuum tube is also connected to the antenna circuit, thru the condenser C_2, which is shunted by a grid-leak of proper value.

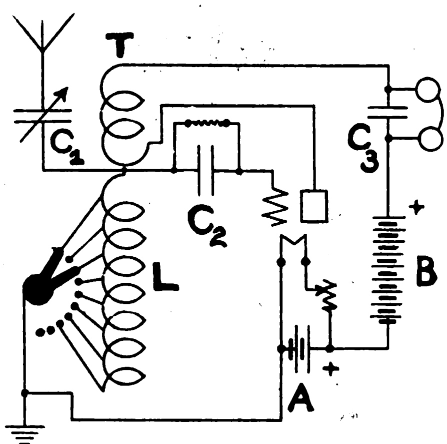


Fig. 1. Receiver Circuit

Oscillation is accomplished by the tickler T, which is mounted within the inductance L, as shown in Fig. 2. Here we have the long tube, wound with wire, which represents the inductance L, and the ball at the right end, marked "tickler." This ball may be rotated, so its coupling with L may be varied from maximum to minimum, and thus, by careful manipulation, either plain detection, regeneration, or oscillation of the vacuum tube may be obtained at will.

A front view of the receiver, as mounted after its completion, by the author, is shown in Fig. 3, and a rear view is shown in Fig. 4, which shows the arrangement of the ball tickler.

The main inductance L is wound, as shown in Fig. 2, after certain necessary mechanical operations have been performed. First four small brass brackets are made up of the brass strip, and the tube L is mounted so that about 1½ in. clearance is left between it and the panel. A quarter inch hole is drilled 1¼ in. from the right hand end of the tube. Then another is drilled at the same distance from the end on the opposite side of the tube. Small strips of brass are fitted to these sides of the tube, with a 3/16 in. hole over the ¼ in. one, and screws are passed thru the tube, into holes provided for the purpose in the strips, to secure them to the tube.

Starting ¼ in. from the right hand end, wind 20 turns of No. 22 wire, which will take nearly ¾ in., skip a space of ½ in., and wind 20 more turns, as shown in Fig. 2. Leave a space of ⅜ in. or a little less, and wind the main inductance. This is wound in "three layer banked" winding, which is done as follows: Start and wind two turns on the tube; now at the point where the third turn starts, bend the wire over a little, and wind the third turn on top, and in the space between the first

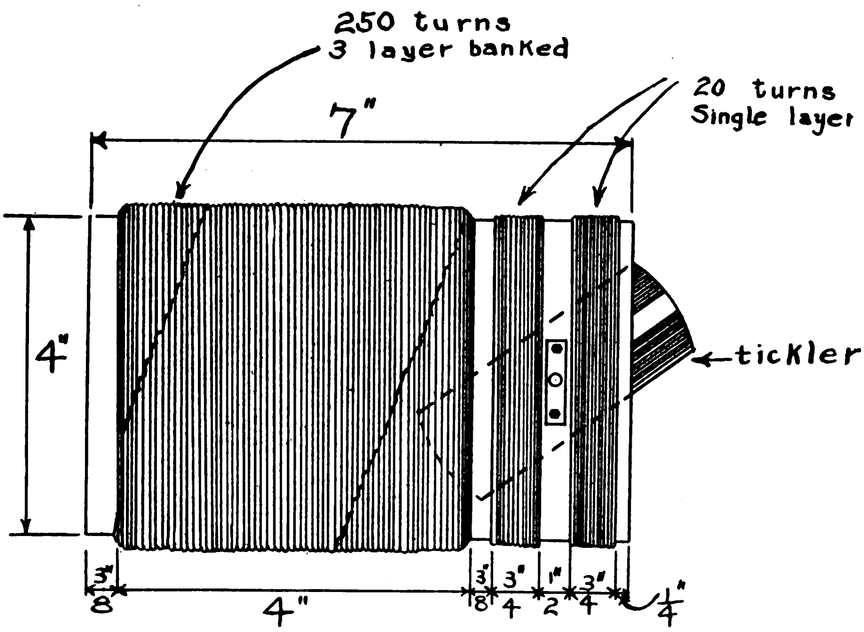


Fig. 2. Tickler Mounting Within Inductance

two. When this turn is completed, hold the wire already wound with one hand, and bend the wire so the next turn, number 4, will be down on the tube. Wind turn 5 on top of 4, between it, and 2, and wind turn 6 on top of 5 and 3. Then drop to the bottom again, and continue the winding, as described, turn 8 resting between 7 and 4, and turn 9 between 8 and 5, after which the same process is repeated, until the tube is wound. The winding order, and the position of the separate wires is shown in Fig. 5.

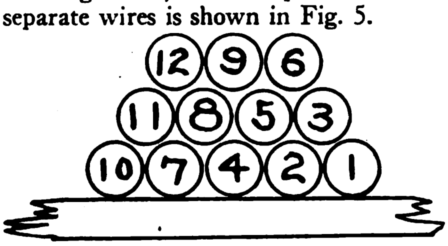


Fig. 5. Bank Winding

While winding it will be found difficult to hold the wire in place, unless great care is used, and, in any case, it will be necessary to coat the wire with something after winding, to hold it in place. Shellac may be used for this purpose, but common collodion, as sold by druggists, will be found much more suitable. It should be applied with a small brush, after each "bank" is wound, and its rapid drying qualities will hold the wire in place securely, and almost instantly. If no collodion is available, small pieces of celluloid may be cut up, and dissolved in acetone, which will make a varnish nearly as good. (Caution: Keep naked flames and lights away, as all these substances are extremely inflammable).

The tickler, as shown in Fig. 6, may be a wooden variometer rotor, or "ball," if obtainable. However, a piece of common cardboard tubing will answer nicely, and will probably be easier to obtain. The dimensions of the ball are given in Fig. 6, and should be wound, as shown, and mounted inside of the inductance coil, the brass strips acting as bearings, and the 3/6 in. brass rods acting as journals, as well as conductors from the tickler to the tube circuit. If a cardboard tube is used, there should be a couple of more turns wound on each half winding, to make up for the looser coupling between the coils, due to the smaller diameter necessary for the cardboard tube.

The grid condenser C_2 may be purchased, or can be easily made by the builder. The capacity is not critical, and may be made variable, if desired. A fixed capacity may be made by taking two sheets of copper, or tinfoil, ½ by ¾ in., and separating them by a sheet of mica about .001 in. thickness, and clamping them between two pieces of bakelite. A bridging condenser may be made by taking a dozen of such pieces of foil, and mica, and making them up in similar manner, which may be used as condenser C_3 in Fig. 1.

Taps should be taken off the inductance L, and connected to the ten point switch. Only 8 points are taken off the inductance, leaving two dead taps on the panel to accommodate the extra, or short-circuiting switch lever. The first tap will be taken off at the end of the first 20 turns, and the second tap at the end of the other single layered coil, or at turn 40. The remaining 6 taps may be taken off at equidistant points along the bank wound coil, or they may be, and preferably are, taken off in about the following order, considering the start of the banked winding as turn 41: Turn 60, 90, 130, 180, 220 and 250. The exact points need not be

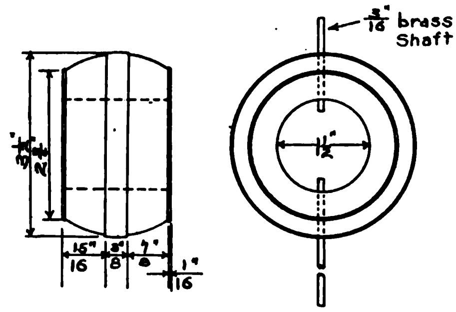


Fig. 6. Tickler

marked, as the "overlap" is enough so that no difference will be made if these exact numbers are missed. It is best to wind the coil completely, first, and then mark the points to be tapped, and then either carefully scrape the different turns, and solder a lead to them, or lift each wire to be tapped with a sharp point, as a scriber, and scrape and solder each wire where lifted. These taps are brought to the respective switch points and soldered thereto.

The mounting of the coil, tube socket, switches, condensers, etc., are left to the design of the maker. The antenna tuning condenser C_1 should not have a maximum capacity of more than .0005, and may be mounted within the tuner itself, and on the same panel, or, a ready-mounted "table" type condenser may be used. If tuning for much C. W. is contemplated, it is desirable, and advantageous, to cover the panel behind the condenser and tickler dial with thin sheet metal, which should be grounded, taking care *not* to ground the condenser or tickler shaft to or thru the shielding.

The sizes and dimensions, etc., given herein are not exact, and can be varied without seriously affecting the operation of the instrument. A smaller coil may be used, or a single layer coil could be substituted for the winding L, if it is not desired to go to the trouble of bank winding the complete coil, altho the wavelength range will be greatly reduced, probably to a maximum of about 800 or 900 meters. A common "vario-coupler" of the type designed for the ordinary two-variometer regenerative set may be used, with the same circuit shown, and good results obtained with it, within the limits of wavelength, which will not be very large. It may be neces-

Continued on page 64

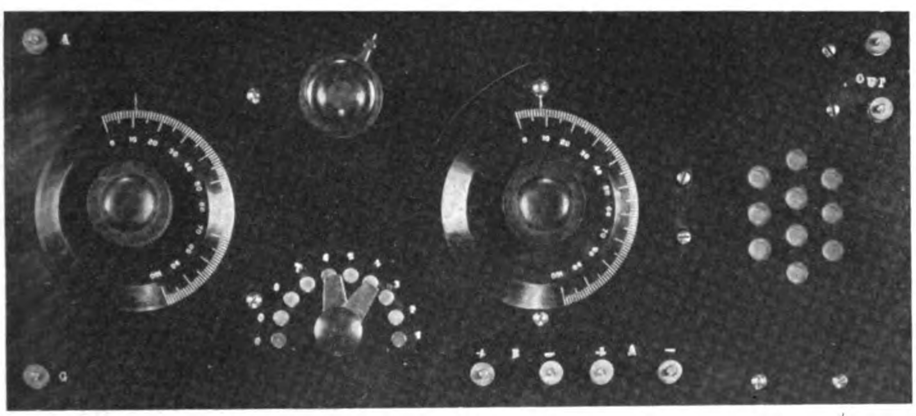


Fig. 3. Front View of Completed Instrument

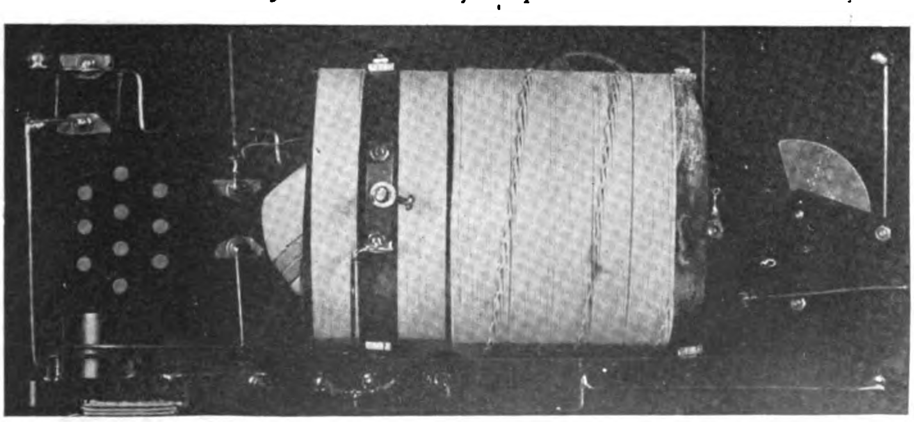


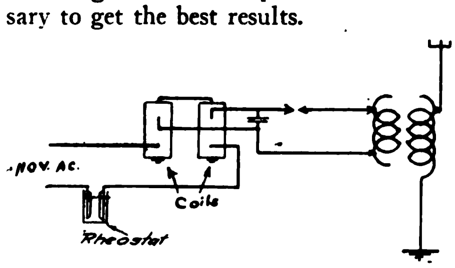
Fig. 4. Rear View of Completed Instrument

Use That Old Spark Coil!

By Chas. Dalziel

IN spite of the commercial-amateur sets that pop up now and then, most beginners still possess a Ford coil transmitter for local work, as the H. C. L. of high tension transformers is still above the average amateur, especially if he has blown himself for a good receiver. It is for him that this article is written.

By using the simple hook-up shown herewith 1½ to 2 in. sparks may be secured from two Ford coils, thus greatly increasing the range, as the average coil gives only a half inch when going full blast on a storage battery. As the hook-up is self explanatory, a brief account will be given as to the precautions necessary to get the best results.



Spark Coil Hook-up

Connect the end contacts of the regular Ford coil together by means of binding posts soldered on all the contacts. The current is supplied to the top front contacts, while the high tension is taken from the top back contacts, where it is used as in any standard set. An oscillation transformer is absolutely necessary as the whole set must be insulated for ½ in. to ground, the one bad feature of the set, but it can be done. But be careful when operating, so as not to get a kick out of the key.

The set will work on 40 to 70 volts, 5 to 8 amps. If you don't possess the d.c. voltage but have 110 volts a.c. handy, just get an ordinary fruit jar and two metal strips 1 in. wide by 6 in. long, so as to nearly touch the bottom. Connect the rheostat in series, as in the figure. Fill the jar to the rim with a weak solution of some electrolyte, add more until the vibrator contacts show some current, disconnect the oscillatory circuit leads and place the spark gap across the high tension binding posts. Adjust the vibrator contacts until the spark jumps at least ½ in. Be very careful as the contacts will burn out if they should get an excessive amperage. If the set does not show much pep add more electrolyte (this can be made by dissolving any salt or acid in water). Stir well before adding more. It will be well to practice on an old pair of contacts as the ones used for sending must be in first class order.

As to the contacts, the regular Ford KW points will do, but Fordson tractor points are much better, and not much more expensive. They will stand up much longer without excessive heating and are much heavier.

Both vibrators must be kept going at once, contrary to general opinion, in order to get the most efficient results. This keeps the set running smoother, and will be much more conservative on vibrator contacts, as the two buck against each other and thus split the amperage, so as to keep it above the safety mark. If you fail to note this part you will be liable to see your contacts get red hot in no time. Keep them always square to each other, and about 1/32 in. from the core.

If you have only one coil at hand, the range may be increased by using the same hook-up with one coil in series with the 110 volt mains with the rheostat and other essentials as in the diagram. In this case the high tension will be taken off the top two binding posts. The middle one is the hot one.

An oscillation transformer is not absolutely essential to the one coil set, but will be found to give much better results, especially as to sharp tuning. One is liable to get in bad with the radio inspector if the wave is not sharp or pure. I have had good success with both sets, reaching ten miles with one coil, on a crystal detector. The report was very QSA on two coils.

A HOME-MADE C. W. TRANSMITTER

C. C. Brown of Manton, Calif., submits the accompanying pictures of his continuous wave transmitting set, built up by himself, including the motor-generator set. He employs the Heising circuit and obtains a normal radiation of 1.1 amperes.

The generator was made from a 220 volt d.c. 1700 r.p.m. motor by rewinding the fields for 500 volts and running at 3450 r.p.m. It is direct connected to a motor and gives 100 watts output at 500 volts.

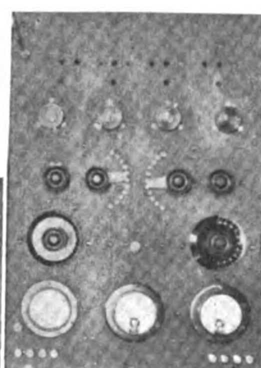
The inductance is wound on a 4½ in. grooved tube with 50 turns of No. 14 bare copper wire. It is tapped every 5 turns, the taps being connected to a switch on the front of the panel.

The filter seen at the rear of the panel is also home-made. Each choke coil has 2 lbs. of No. 24 D. C. C. wound on a 1 in. square laminated core. The condensers are 1 mf. Western Electric Busbar type wiring is used thruout the station. The meters were placed at the bottom of the panel so as to make connections as short as possible.

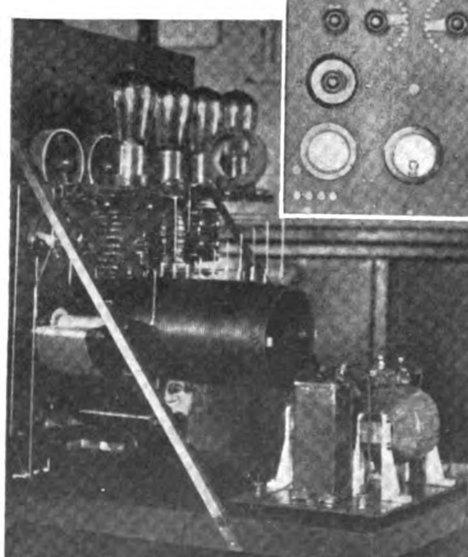
The receiving set at this station employs a regenerative variometer for short waves and honey-comb coils for long waves. It has a three stage power amplifier with both a Magnavox and Baldwin phones.

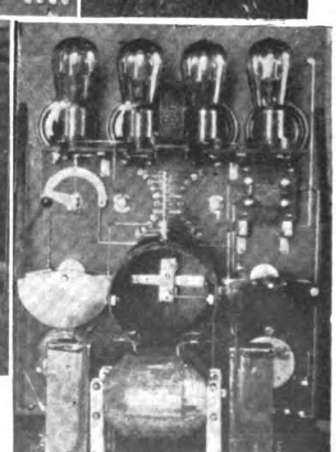
Continued on page 50

Picture at Upper Center Shows Front View of Panel.



A Home-Made C. W. Receiver





Lower Left Shows Side View of Panel Rear.
Lower Right Shows Full-on View of Panel Rear.

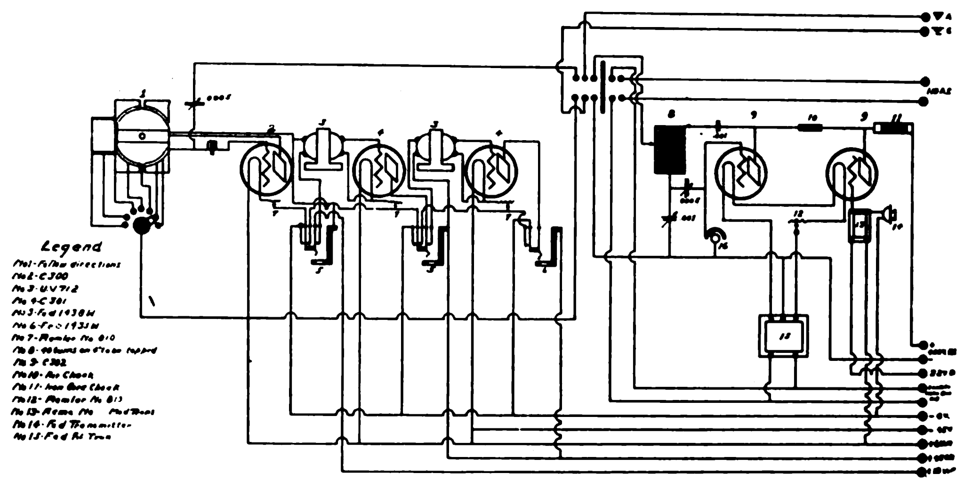
The Design and Building of a C. W. Set

By E. A. Ames

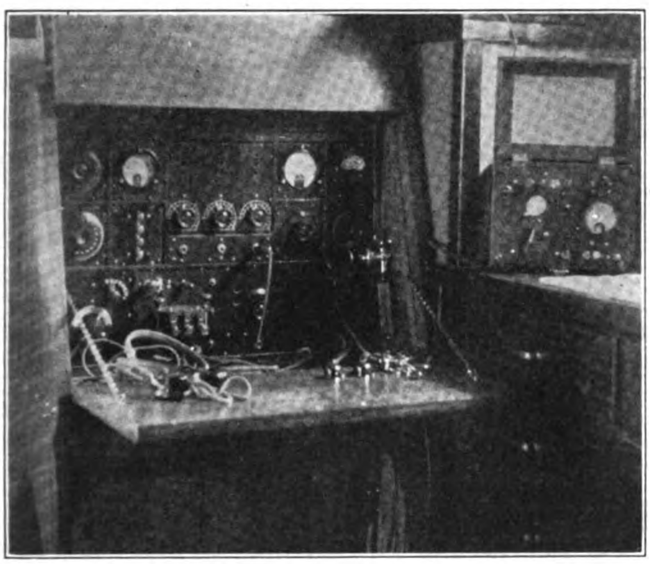
Instructor of Manual Training in the Fullerton Union High School, at Fullerton, California

ABOUT one year ago, because of the insistent demand of our students, we decided to let them build radio sets as manual training projects. This was one of the best moves that we have ever made as we have interested boys whom we had failed to reach by any other means. With the reaching of this decision I started to design a C. W. set, both receiving and sending, incorporated in a desk that would be an attraction in one's library or living room and be of value as a manual training project. It can be built complete for about $250, exclusive of labor cost, but inclusive of the motor generator set.

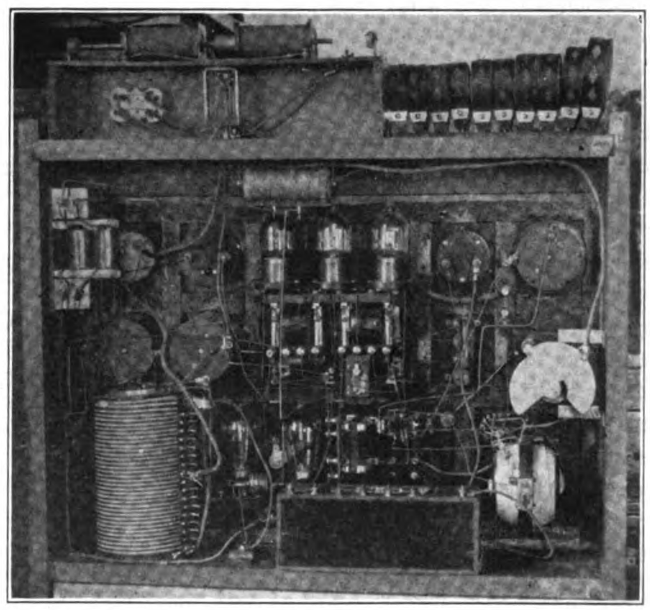
Before I reached a decision as to the hook-up, I had interesting conferences with Mr. Noonan, of the Western Radio Electric Co., and with the data and good advice received from him, I built the set which developed into the one illustrated and described in this article.



Wiring Diagram of Set



Front View of Set

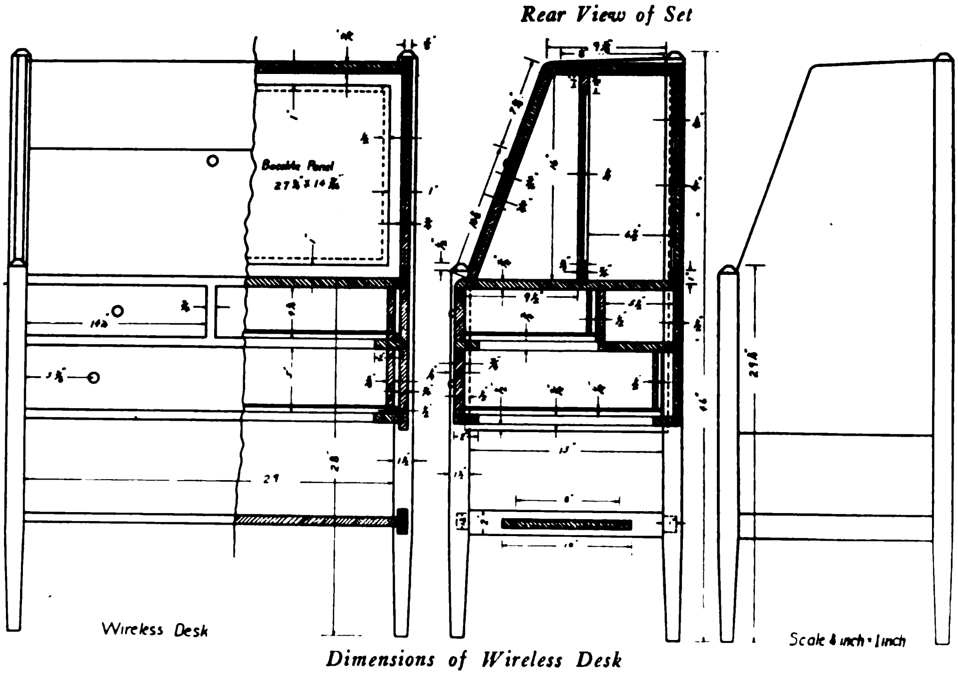


Rear View of Set

The tuning element consists of an especially built variometer having very close spacing between stators and rotor. One stator has 36 turns tapped every 6th turn; the other 36 turns tapped center and end. On the high wave side of this variometer we fasten a three inch tube that has been bank wound four layers deep, 20 turns to the layer, tapped center and outside end. The inside end of this coil is soldered to the high wave end of the stator winding, making one continuous inductance. The rotor has 18 turns on each side. All windings should be of No. 22 d. c. c. magnet wire. Do not use more shellac than is necessary to hold the winding in place.

A wiring diagram of the entire set is shown herewith. The rotor is used

Continued on page 56



Dimensions of Wireless Desk

Why, the Cage Antenna?

By J. B. Dow, Ensign U. S. N.

A NUMBER of experimenters have come forward from time to time in the past with spontaneous outbursts of pretentious literature aimed to encourage the use of cage antenna systems as a means of promoting greater efficiency, increased range, etc., *ad-infinitum*. These outbursts have come from experimenters, young and old, and many readers, amazed at the wonders of the "new" type of antenna, have discarded the more efficient flat top in favor of the most artistic cage.

Ah! gentle reader, aren't they artistic, and isn't that the reason our Navy Department adopted them for their potent dreadnaughts? Wrong, decidedly so, and in matter of explanation, let us drop back a few years. Some will recall, others (including the author) must resort to history. Marconi in his early experiments found that by suspending a single vertical wire in the air and connecting it to an induction coil et cetera, he could send signals which could be received at a distance with no intervening wires, upon a similar vertical wire connected to an arrangement of apparatus which he called a receiver. He also found that the higher the point of the suspension for this vertical wire, the greater the distance he could transmit signals. But he soon reached a limit, for even in those days yon trees were not so high.

He found further, that by using two or more vertical wires instead of one, a greater range could be covered. These vertical so *found themselves* arranged around the peripheries of hoops spaced at intervals. Hence, the cage antenna.

For quite some time the cage reigned supreme until it was discovered that the effectiveness of an antenna system was dependent upon the height of the center of capacity, the capacity, and the resistance. This brought forth other types including the flat top which, because of superior performance, soon placed practically all the others into the discard, so where directional qualities are either desirable or not looked upon with disfavor the flat top aerial has held its place in the field of good engineering.

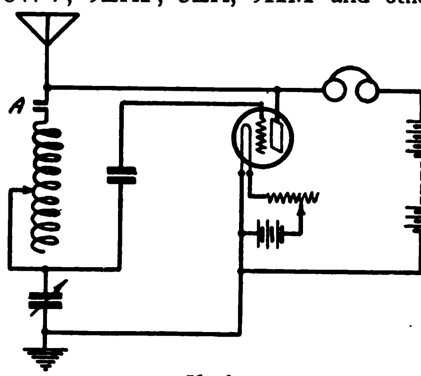
As radio engineering progressed thru the first decade of its history under the able guidance of Marriott, Lowenstein, Hertz, Austin, Pickard, Stone, Kennelly and a host of others, and its scope of utility increased, other influences began to bear. Not the least important of these influences were those of the tacticians who sought to develop the military usefulness of radio.

The cage antenna came back, not as a more efficient device, for the story goes quite the contrary. Some thoughtful tactician discovered that a single shell from the gun of an enemy could cut down all wires in a flat top antenna. He also discovered that if one wire of the ordinary flat top antenna was severed, the ends would surely fall, grounding the remaining portion of the antenna in the rigging or on deck. Yes! the cage came back to its own as a military expedient to overcome the first difficulty because of its physical make-up and the second by virtue of the "hoops" placed at intervals along the cage.

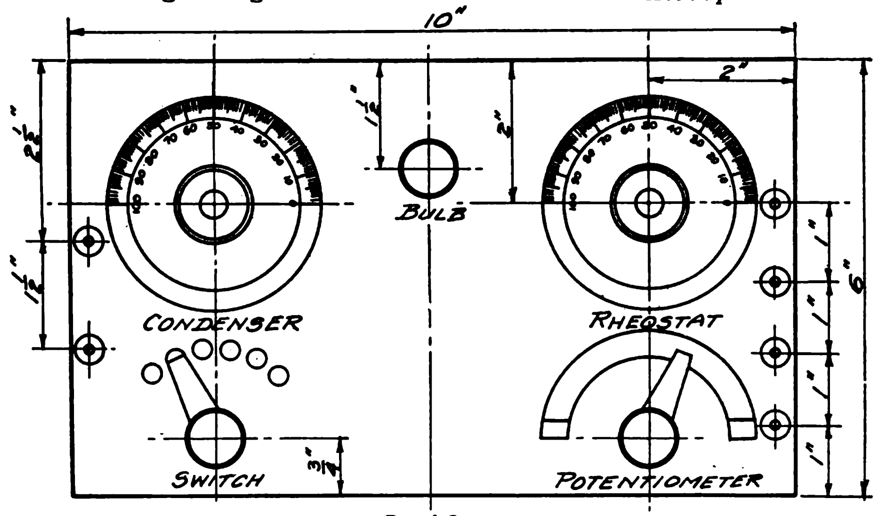
SHORT AND LONG WAVE RECEIVING SET

By CHAS. L. BARKER

The average amateur does not have the money necessary to buy or build the equipment for a set that regenerates, oscillates and detects over the entire range of 175 to 25,000 meters. The set which I am describing has been built and it is very efficient for arc and spark on long and short waves. As to fone music, 2XB, KDKA, WJZ, KYW, 6WV, 9ZAF, 3ZA, 9XM and others have been copied here in Iowa with only detector. For long waves European stations come in QSA with only one step.



Hook-up



Panel Layout

The following is a list of material needed:

1 Formica panel 6x10x3/16. 2 dials and knobs.
1 Formica tube 3½x4. 1 rheostat.
1 23 or 43 plate condenser. 1 bulb and socket.
1 switch, 1½ inch radius. 6 binding posts.
1 potentiometer with switch. 6 switch points.
1 grid condenser.
1 honeycomb coil plug for panel mounting.
1 honeycomb plug for terminals connected on back.
1 Remler tapped honeycomb coil.

The main inductance is composed of 72 turns on No. 22 S. C. C. wire wound on the Formica tube and tapper at the 20, 35, 50, 58 65, 72 turns.

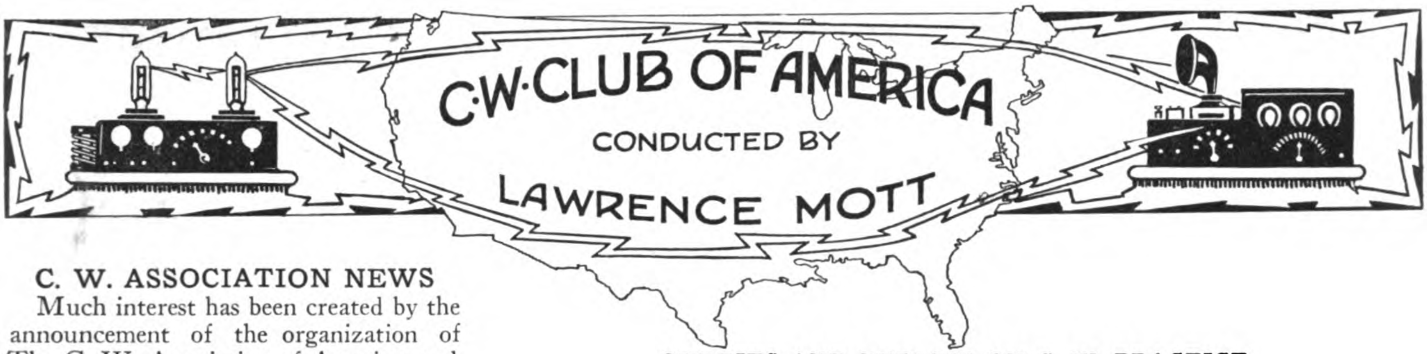
As shown in the hook-up the panel mounting coil plug is connected in the circuit at A. In using long waves the big honeycomb coil is inserted and for short waves the plug with the terminals connected on the back is used.

The remainder of the details are so simple that no explanations are necessary.

WHY IS IT?

Why is it that every U. S. Navy arc station has to fizz and spit and ding and dong and clong and bang and buzz and hiss and beller and wail and pant and rant and howl and yowl and grate and grind and puff and bump and click and clang and shug and moan and hoot and toot and crash and grunt and gasp and groan and whistle and wheeze and squawk and blow and jar and jerk and rant and jingle and twang and clack and rumble and jangle and ring and clatter and yelp and howl and hum and snarl and puff and growl and thump and boom and clash and jolt and jostle and shake and screetch and snort and snarl and slam and throb and crink and quiver and rumble and roar and rattle and yell and shriek like hell on every wavelength from ten meters up to infinity, and then can't get their traffic through?

A VICTIM.



C. W. ASSOCIATION NEWS

Much interest has been created by the announcement of the organization of The C. W. Association of America, and many applications for membership have already been received by Secretary G. G. Griffeth. The board of managers have drafted a complete constitution and by-laws and are selecting vice-presidents for each of the nine radio districts. J. B. Dow, 6ZAC, is acting vice-president for Hawaii, and E. T. Jones, radio inspector for the U. S. Shipping Board at New Orleans, is vice-president for New Orleans.

The other officers are: President, Lawrence Mott, 6XAD, Avalon, Calif.; secretary, G. G. Griffeth, 6AA, 625 Sheldon Bldg., San Francisco, and treasurer, H. O. de la Montanya, 6AUL, Oakland, Calif. The board of managers is made up of A. H. Babcock, 6ZAF, G. M. Best, 6JX, L. B. Benjamin, 6XAQ, W. W. Lindsay Jr., 6ALE, J. J. Karr, 6ZA, and H. L. Gooding, 6ZZ.

The objects of the club are "the advancement of the theory and practice of radio communication by means of continuous waves. Among the means to this end shall be the encouragement of experiment and investigation by mutual exchange of experience and assistance. Furthermore it is intended to provide a medium whereby the government can be assured a reserve personnel thoroughly trained in radio communication should national emergency require."

Any person who is interested in or connected with the study or application of radio communication is eligible for membership. The initiation fee is $2.50, the dues are $3.00 per year. Among other advantages, members are entitled to service from the association's advisory engineering staff without charge, this staff consisting of G. M. Best, chairman; A. H. Babcock, R. C. Tavers and Ralph Heintz.

Lawrence Mott,

Reference your letter January second please accept congratulations on your most remarkable achievement on transmitting across the continent with but twenty watts power on wavelength of two hundred ten meters. Astonishing results like these compel all radio engineers to seriously modify their views in regard to radio transmission and foreshadow in the near future great developments both in pure radio and in long radio messages.

GEORGE O. SQUIER,
Major-Gen. Chief Signal Officer,
U. S. Army.

QUERIES AND REPLIES ON C. W. PRACTICE

By Gerald M. Best

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Question: Please publish a regenerative circuit with detector and two stage amplifier, using filament control jacks.

W. B., Redding, Cal.

Answer: The circuit requested is shown in Fig. 1.

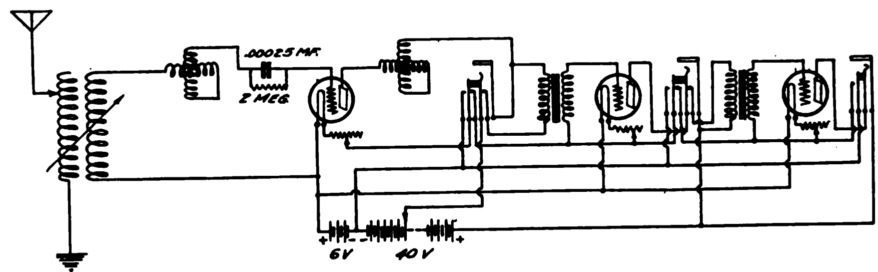


Fig. 1

Question: I am sending you a drawing of my 50w C. W. set. I cannot get it to work. I have tested out all parts and found them working. When the tube is connected to the set, it doesn't light. Please tell me what is wrong.

P. B., Quincy, Calif.

Answer: Your circuit appears to be correct, but your sketch does not show the apparatus very clearly. If possible, the plate voltage should be kept off the antenna circuit, and Fig. 3 shows a method of accomplishing this. If your tube is O. K. when tested, and yet doesn't light when placed in the set, you have trouble in your wiring, and the best method of detecting the trouble is to start at the source of filament supply and by means of your a.c. voltmeter check each wire in the circuit until you find the defect.

Question: Will you please tell me where I can buy a book on the construction and operation of radiophones or plans for making same?

B. L. T., Exeter, Cal.

Answer: The Radio Corporation has recently published a very good book on this subject. It may be purchased for 25 cents, either direct from the publisher, or from your nearest radio supply house.

Question: D. D. M. requests the dimensions and winding data for a C. W. power transformer to supply two 50 watt tubes, using the Hartley self rectifying circuit as was illustrated in December RADIO. Also the data on 3 millihenry chokes for the plate circuits or his two transmitting tubes.

Answer: Based on the assumption that core iron is available, a core of the di-

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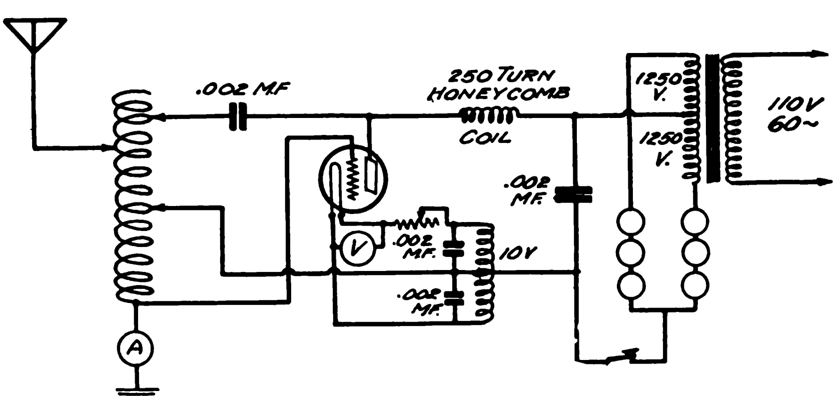


Fig. 3

Numerous Stations Heard by 6ZAC, Hawaii

So much interest has been created by the reception of radio signals by Clifford J. Dow, 6ZAC, at Wailuku, Maui, Hawaii, as reported in February RADIO that additional logs are here reproduced. Inadvertent omission was made of a number of reports including 6ZAF at Berkeley, Calif., and 6ZB at San Diego, Calif, 5ZA at Roswell, N. M., also reports that the log of messages quoted from 5QA are recognizable as having been transmitted from 5ZA.

Further logs received from Mr. Dow follow:

January 5, 1922.

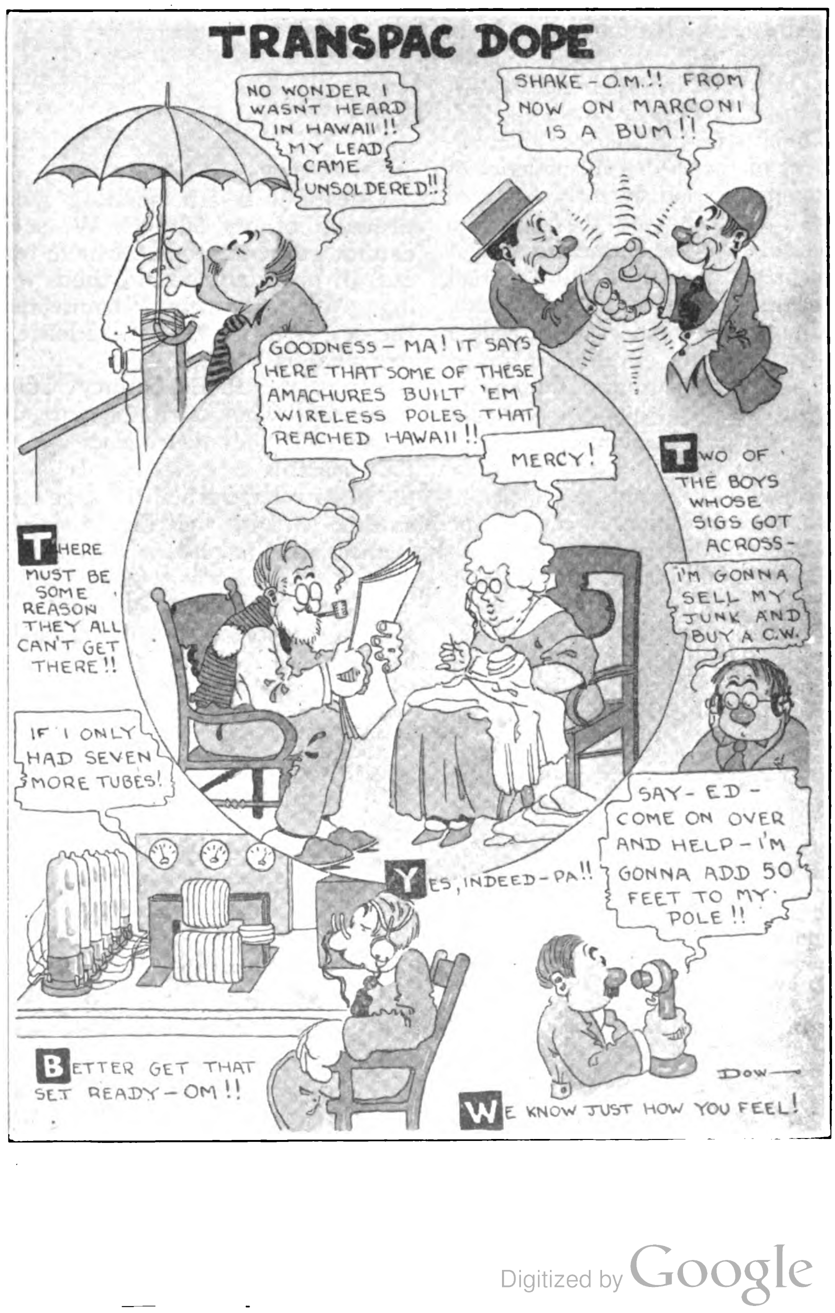
6:30 p.m.—6ZZ de 6ZR.
7:37 p.m.—CL8 de 6ZAD.
7:39 p.m.—7MF de SC3.
7:40 p.m.—7MF de SC3.
7:42 p.m.—7PD de 7YA.
9:58 p.m.—9YAE de 7YA.
9:59 p.m.—7YA de 7ZJ. "QSQ pse."
10:01 p.m.—9YAE de 7ZJ.
10:05 p.m.—7ZJ de 7YA. "QSQ 9YAE."
10:06 p.m.—9YAE de 7ZJ.
10:08 p.m.—9YAE de 7ZJ. "QRA? QRA Mumford Bros., Vancouver, Wash. QRA?"
10:15 p.m.—9YAE de 7ZJ. "Ship QRM. Park OK. I am in Vancouver, Wash. Pse QTA ur QRA OM K."
10:22 p.m.—9YAE de 7ZJ. "Where did you say you were located? Rest OK. U very QSA when QRK but QSS very slowly."
10:24 p.m.—7ZJ de 9YAE. "9YAE is Lemars . . . (QSS) . . ."
10:25 p.m.—9YAE de 7ZJ. "R U very QSA now OM. Well if I had a msg wud try one but will C U at schedule." (NPM arc in on 'em.)
10:27 p.m.—7YA de 7ZJ. "Tnx OM."
11:35 p.m.—7ZP de 9YAE. "Rpt GA Roseau to end in msg rpt GA Roseau and end."
10:45 p.m.—7YA de 7ZJ.
10:46 p.m.—7ZJ de 7YA. "OK Nil."
10:47 p.m.—7YA de 7ZJ. "Nil GN."
10:49 p.m.—CQ de 9YAE.
10:50 p.m.—7YA de 9YAE. "U say while ago QSQ 8ZP?" (9YAE QSS slowly.)
10:57 p.m.—9YAE is arranging for a test on a different aerial, 7YA to QRX for him.
11:04 p.m.—7YA de 9YAE (Very QSA nw). "Could you hear me?"
11:04 p.m.—9YAE de 7YA. "GM 73." (Unsaid if heard him or not.)
11:07 p.m.—CQ de 9YAE.
11:08 p.m.—9YAE de 7ZJ. "GM 73."
7ZJ de 9YAE. (Very QRZ now, can just hr him in.)
9YAE de 7ZJ. "Sorry ship QRM. You very QSA tho'."
11:11 p.m.—7ZJ de 9YAE. "R Very QSA OM. Did you say you heard me often?"
11:13 p.m.—9YAE de 7ZJ. "Tnx OM 73."
7ZJ de 9YAE. "R 73 was glad to work you. C. U. again CUL."
11:15 p.m.—9YAE de 7ZJ. "QRD Hay, GM."
7ZJ de 9YAE. "GM. dit dit dit dah dit dah."
11:16 p.m.—CQ de 9YAE.
11:19 p.m.—CQ de 7ZJ. (Too many CQ's for me, so G. N.)

January 6, 1922.

6:00 p.m.—4CB de 7ZT.
6:15 p.m.—Phone just finished "Over the Waves." Music fairly QSA, and very distinct, but 7ZJ in most of the time.
6:19 p.m.—Phone just finished "I want to go to the Land Where the Sweet Daddies Grow!" (Very pathetic.) (Did not get the announcements of either of the above, but recognized them in playing.)
6:20 p.m.—"Hello—Hello—" (Fone talking now, but talks too fast and can't understand it all. Following are few excerpts I was able to scribble down from speech): " . . . 7YA of Boise, Idaho . . . The Country that God forgot . . . I enjoyed the nice concert also . . . (Saying Hello to a bunch of stations, presumably in QSL to their letters) . . . Pittsburg . . . Hello . . . Modesto, Calif. Hello . . . Santa Clara . . . Hello Dr. . . . Petaluma . . . Hello Mr. Carter, Sacramento, Hello Carter, how's everything in Sac. . ." (Unable to ascertain what station transmitting.)
6:28 p.m.—4CB de 7ZJ. "R Nr 2. QRU K."
6:32 p.m.—4CB de 7ZJ. "Yes, glad to work u. QSQ 7ZT on 375. Best 73's."
6:34 p.m.—? de 6ZAF. (Just got him signing off.)
6:37 p.m.—8AQF de XFI (CW).
6:40 p.m.—7ZJ de 6ZAF.
6:41 p.m.—5IF de 5XU. "Agn please, O. M. QRM bad here K."
6:42 p.m.—4II de XF1 (That's XF-One.)
6:47 p.m.—1BKQ de XF1.
6:51 p.m.—1BKQ de XF1.
6:53 p.m.—CQ de 5ZZ (Low pitched rotary, very QRZ).
7:03 p.m.—CQ de XF1.
8:07 p.m.—9UU de XF1.
8:12 p.m.—9OX de XF1.
8:15 p.m.—9XI de NOF (ICW?). "R Tnx, QRA NSF Washington, D. C. QTC?"
8:16 p.m.—9XI de NOF. "QRA Washington, D. C. NSF QRU NSF QTC?"
8:18 p.m.—9XI de NOF. "73 G. M. LC."
8:22 p.m.—5ZZ de 5XU. "1421 Laura Ave., Wichita, Mich. Now HW?"

Continued on page 40

Ye Skeptics' Mental Vision of Hawaii Hearing the Mainland



With THE U-S-Radio Inspector

CONDUCTED BY MAJOR J. F. DILLON

A MONTHLY DEPARTMENT OF INFORMATION FOR OUR READERS

Questions and Answers

Question: What is the largest antenna system that is allowed for work on 200 meter wavelengths?

K. L. B., S. F., Cal.

Answer: In general, an inverted L antenna of four wires should never exceed 120 feet, over all, including flat-top, lead-in, and ground lead. A T type antenna may have a slightly longer length of the flat-top, but a total length, as computed as a total of the parts mentioned above, should be 120 feet, or less. In most cases, however, much better results will be obtained by using a smaller antenna, and adding inductance in the secondary of the oscillation transformer, than by using a very large antenna, and very few turns in the secondary. For maximum efficiency the total length should not exceed 80 to 90 feet, overall.

Question: May two brothers obtain two licenses and two call letters for the same station, and use their own call letters when working?

T. Y. O., Elko, Nevada.

Answer: It is not the policy to issue two licenses to one station for the same class of service. If two brothers wish to operate a station, they both must have operator's licenses, and the station license may be made out in the name of one brother, or in the name of both, if they make application for the same, when the license is applied for. The different operators may indicate their operation by adopting a personal "sign," of two letters, which will indicate who is operating.

Question: What advantage has a "cage" antenna over one of ordinary type?

Y. I. L., Oakland.

Answer: Generally, there is no advantage, except that the cage, so-called, is easier to construct than the flat-top type, and may be, if properly constructed, better, and stronger, and able to withstand windstorms better. The type used by the Naval Stations is simply built up in its present form to act as an additional protection in battle. If a cage antenna is damaged by gunfire, it will have to be shot away, or have all wires cut before it would drop to the deck, while with the ordinary type, the cutting of one wire will render the antenna useless, due to its immediate grounding, when the loose wire hits the steel deck. A cage antenna, due to the number of "hoops" does not allow the wire to drop in this manner, unless all wires are severed.

Question: Is the filament current counted as "power input" when figuring the power supplied to a C.W. transmitter?

H. K. L.

Answer: According to general custom, the filament current is not counted as the power supplied to a tube set, altho strictly speaking this is incorrect. If the over-all efficiency of the set is to be included, the filament current should be included.

Question: May amateurs operate on a wavelength below 200 meters, and can they play music if this does not interfere with others, on, say 150 meters?

Answer: Amateurs may transmit on wavelengths below 200 meters. They may not, however, play music, or broadcast concerts, etc.; this class of work can only be handled by a limited commercial station, on a specially assigned wavelength.

NOTES FROM THE RADIO INSPECTOR

Ship operators who have been disconnecting the regular receiving equipment of their stations on show board and installing miscellaneous private apparatus are cautioned to discontinue that practice and to conform to the regulation which reads:

"The apparatus shall not be altered or modified in respect of any of the particulars mentioned in the schedule submitted with the application, except with the approval of the Secretary of Commerce."

Hence, before any change effecting the installation is made, except in an emergency, the Radio Inspector should be consulted and his approval obtained.

Under date of January 11th, the Assistant Secretary of Commerce authorized the insertion of the following on all general and restricted amateur radio station licenses:

"This station is not licensed to broadcast weather reports, market reports, music, concerts, speeches, news or similar information or entertainment." Signed by C. H. Huston, Assistant Secretary of Commerce.

All licenses issued from the radio inspector's office in the future will contain that insertion and the operators of all amateur stations should govern themselves accordingly.

The Bureau of Navigation suggests the following general idea of what may be considered "broadcasting" as it relates to radio communication:

"The transmission by radio telegraph or radio telephone of any message, communication or signal for the information, entertainment or instruction of the public, not sent to or intended for the use of any particular party or radio station."

Limited use can be made of phonograph records for testing purposes only, in stations licensed for experimental use, where such tests are solely for the scientific development of radio apparatus.

Because of the rapid development of radio broadcasting during the last three months, the value of such service to the public and the limitation of wavelengths which can be assigned for this service, it has been found necessary to take precautions to protect the broadcasting service from interference.

It was decided first to regulate broadcasting by the larger stations by requiring special authority to do so on special wavelengths.

It later became apparent that some restriction must be placed on amateur stations, and the privilege of amateur broadcasting was temporarily withdrawn pending the adoption of a plan which would be acceptable to the amateurs engaged in radio telegraphic communication.

Two plans have been suggested. First, the use of 200 meters between certain hours each day; second, the use of the wavelength of 175 or 225 meters for broadcasting only.

If the second plan is agreed upon with the wavelength of 175 meters, this authority could be given in the ordinary amateur licenses.

The use of 225 meters will require special licenses.

The bureau would like to have any practical suggestions from radio inspectors and amateurs which will be helpful in reaching a satisfactory solution of this question.

THE VALUE OF CO-OPERATION

By J. F. DILLON

Is the mutual assistance and co-operation of citizen operators and the radio inspectors of the Department of Commerce essential to the effective co-ordination of amateur communication in the United States? Is so, how can it best be effected in order that the operators of amateur stations may derive the maximum return from their investment of time and money, in pleasure and experimental knowledge?

From the view point of the inspector, the experience of the past several years would seem to justify an affirmative answer to the first question, beyond any possible doubt, for without the active co-operation and assistance of that splendid body of young men constituting the advanced amateur class, the maintenance of and semblance of order or decorum in the ether would be exceedingly remote and discouraging, to say the least.

The writer became a confirmed convert to the co-operative plan soon after entering the radio service, in 1912. Upon assuming supervision of the Eighth District with headquarters at Cleveland, Ohio, I found the amateur situation in a chaotic condition from which it seemed impossible to rescue it. About the second day of my incumbency several young gentlemen from the amateur ranks called at the office, and after discussing the general situation, proffered their assistance in adjusting matters. Briefly, within a few days the perspective was changed from one of gloom and discouragement to hopeful cheerfulness, and I may say that the warm friendship resulting from our pleasant association and intercourse has endured through the passing years.

However important the understanding between the inspectors and the amateurs may be regarded, co-operation of operators themselves is equally important and essential. If polite courtesy is regarded as indispensable in the transaction of ordinary commercial business, it is doubly so in the conduct of amateur or radio communications. So intimate is now the connection between all radio communities and centers of activity, that the scientific progress of one group is sure to reflect more or less on the other; also, any serious infraction of the traffic rules in force must affect every receiving station within the range, in direct proportion to the strength of the interfering signals.

The problem of organizing the operators of the various communities into clubs for mutual help and co-operation must, necessarily, be solved by the citizens who are chiefly concerned. It ought not be difficult, however, to convince any intelligent person that such co-operation is vitally essential to the welfare and progress of amateur communication in their zone. The authors of the existing regulations contemplated the co-operation of all amateurs, for they stated clearly that "It is not the intention of the Dept. of Commerce to continue in force the license of any person who maliciously interferes with the communications of other operators, nor those who refuse to larger group, whose motto was to Let George recognize the rights of others to the ether circuit."

Continued on page 47

DIGEST OF RECENT RADIO PATENTS

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

Cornelius D. Ehret, Pat. No. 1,400,591; Dec. 20, 1921. Electrical wave transmission.

A wireless telephone transmitting system is described, in which there are radiations only when the telephone transmitter m is actuated by sound waves. This is effected by interposing an oscillating tube O between the antenna R and the telephone circuit, which tube receives all its energy by way of the telephone circuit; that is, there are no batteries in the plate circuits of the oscillator. The result is that no oscillations can be produced except when the telephone circuit is active. The oscillator O is made to produce waves of a frequency suitable for radiation, and these waves have amplitudes varying in accordance with the sound waves transmitted by the telephone m. Amplification if desired may be had between the telephone circuit and the oscillator O, or between this oscillator and the antenna circuit.

P. C. Hewitt, Pat. No. 1,402,931; Jan. 10, 1922.

A scheme is described for producing oscillating current of controllable frequency and variations in amplitude, by means of a tube 1 having unidirectional conducting properties. This tube has a voltage impressed upon it by the source 11, and has connected across it a circuit 16, 17, 18 having capacity and inductance. By varying the constants of the circuits various effects may be obtained. The main control however is effected by electrically influencing the path of current flow in the tube by the aid of one or more conducting tubes 8 or 9 interposed in the path. The potentials impressed on these may be varied by variable resistors 23 and 25. Signaling may be effected by a microphone inductively coupled across both tubes 8 and 9.

P. C. Hewitt, Pat. No. 1,402,933; Jan. 10, 1922. Method of and apparatus for controlling electric current.

A relay or amplifier is described, using a gas, vacuum or vapor device having anode 2 and cathode 3. Supplementafy electrodes 11 and 12 are used operated from their own source 13. By influencing the flow of current through the tube, as by electromagnets 17 and 18, the current flowing in the circuit connecting electrodes 11 and 12 is correspondingly influenced. The variation in the magnetic field may be produced by a microphone 20; and the telephone 14 reproduces the variations in the sound waves influencing the microphone.

Harold Jorgenson, Pat. No. 1,402,235; Jan. 3, 1922. Oscillation generator.

A three-electrode device is described, in which these electrodes are constructed and arranged to secure high voltage amplification and comparatively high efficiency. To insure these results, the patent states that the grid 1 must be located as close to the filament 2 as it is possible to do so; the anode 3 must be spaced relatively far from the filament; the grid 1 must have a relatively large conductive surface compared to its open surface; and the impedance of the entire device should be of the same order of magnitude as the impedance of the external consumption circuit.

André E. Blondel, Pat. No. 1,400,517; Dec. 20, 1921. Recording apparatus for radio-telegraphic signals.

Reception of signals from antenna A by a vibrating galvanometer G is obtained, by mechanically tuning the period of vibration of the conductor of galvanometer G so as to be equal to that of the groups of received waves. The electrical circuit R′, L′, and C′ are also tuned to this frequency. For beat reception, a heterodyne H may be provided in proximity to the galvanometer. In order that the damping of the received signals be reduced to a low value for the best operation of the galvanometer, the output circuit C, R, L, of the detector D should have low resistance.

Harold D. Arnold, Pat. No. 1,398,665; Nov. 29, 1921. Thermionic amplifier.

A spark set is described, in which the rotary disc 15 carries two conducting segments 18 and 19 which are in series to form the primary coil for the coil 4. This latter coil is adjustable on pivot 5 and is adapted to be connected to an antenna circuit. The segments 18 and 19 also carry the spark electrodes 22 and 23 which pass between the stationary electrodes 7 and 9 as the motor 3 rotates. The patent states that due to this arrangement, the apparatus may be very compactly arranged.

Ernst F. W. Alexanderson, Pat. No. 1,400,847; Dec. 20, 1921. System of radio communication.

A system is described for maintaining the frequency of the radio waves transmitted from antenna 1 so nearly constant that the reception of these waves by the heterodyne system may be recognized as a musical tone of fairly constant pitch. This is secured by maintaining the speed of alternator 3 constant, by proper control of the driving motor 9. This motor is fed from mains 10 in which are interposed the coils 12. These coils are wound on iron cores 11 which have other windings 13 fed from a direct current source

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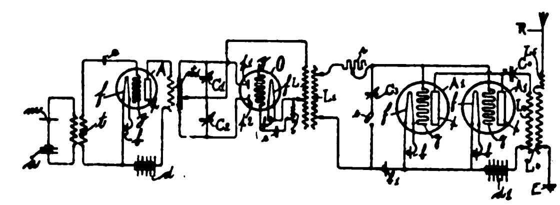

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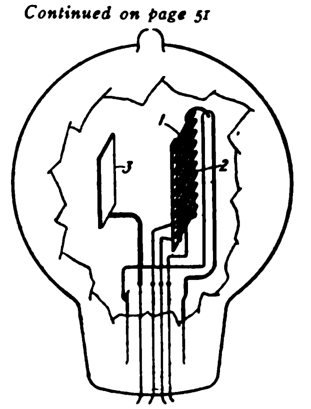

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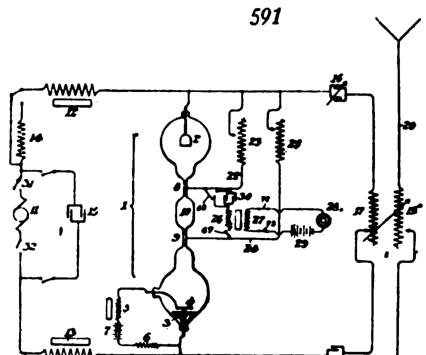

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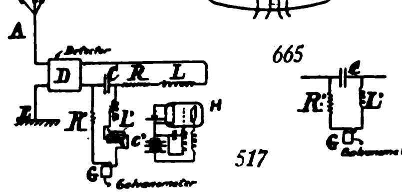

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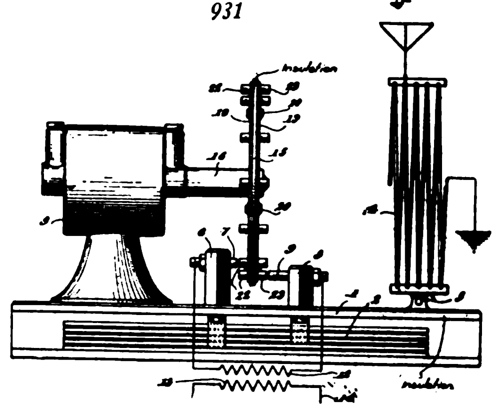

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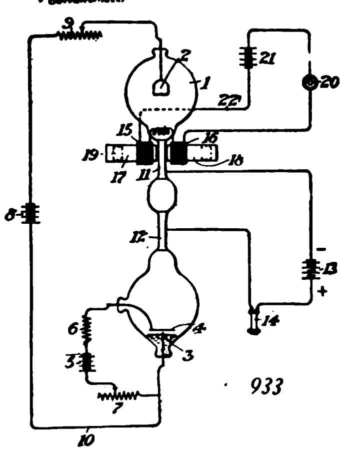


933

One out of every six homes in Pittsburg, Pa., is reported to have a radio receiving set.

The new radio regulations of the Canadian Government are expected to allow amateurs to use a wavelength of 200 meters for spark and 250 meters for continuous wave transmission.

To make it harder for bootleggers and other criminals, Sheriff Matt Starwich of Seattle, Wash., will soon be able, with the use of radio phones, to direct his men in armed automobiles as far as a hundred miles away. An electrical expert has installed two sets of phones on two automobiles, with one phone in Starwich's office. The cost will be approximately $2000, which, Starwich says, will be saved in greater efficiency and telegram bills.

Tests substituting automatic wireless signals for SOS signals have been so successful that it is predicted that the familiar SOS soon may disappear. The tests, which have been entirely satisfactory within a radius of 100 miles, are now being made over longer distances. The principle is an automatic signal with a four second beat repeated three times instead of using the old Morse code. The beat when given on a sinking ship rings an alarm bell on vessels within reach in such a way that it is really an automatic alarm. The important advantage over the SOS is that it won't enter other signal combinations and cause confusion. Ten English vessels are already equipped with the new alarm and twenty-five more are being fitted. The vessels are in different fleets in order to conduct experiments in the widest possible range. Two stations—North Foreland and Niton on the Isle of Wight— will be fitted up with the alarm systems.

Washington housewives now get "tips on the food market" by radiophone from the Department of Agriculture. The service consists of information secured by "listening in" on a general grist of market produce news broadcasted by wireless all over the country. Local papers print pictures of women "wising up" in their kitchens before starting out for the grocery and the butcher shop.

The information available concerns the prices charged by wholesalers to retailers so that the consumer who has her own radio installation knows whether the prices charged her are exorbitant or otherwise. Installations must be supplied by those who want the service.

The exchange of news between Oregon Agricultural College, and the University of Oregon in the future will be made by wireless. Steps have been taken to connect all the colleges on the coast using the Pacific Intercollegiate News Service by means of the wireless. O. A. C., University of Oregon, Stanford, and the University of California now have radio outfits.

OBITUARY

Arno A. Kluge

Died, in Los Angeles, on New Year's Eve, 1921, Arno A. Kluge, at the age of 23 years. It is with deep regret that we chronicle the passing of so promising a young man at such an early age. Born at Ravenna, Neb., where he had his early schooling, finishing high school in 1916, when he removed to Lincoln in the same state for the purpose of attending the university. He had two years of that work, during which he also served as instructor in the Signal Corps of the U. S. for drafted men from Nov., 1917, to July, 1918. In Jan. of the latter year he had his first break-down, and came on to Los Angeles in Sept., disabled by paralysis. In March, 1919, after a stay of five weeks in the hospital, he came home in a helpless condition and was always thereafter confined to his chair when about the house.

Wanting to do something for himself, he engaged in the sale of radio apparatus, often assembling sets for his customers, and built up quite a trade. He also did typewriting and wrote articles for the magazines. He had a wireless telephone, and his concerts, under the call 6XN, which had become a regular thing, will be missed greatly by his many friends.

Ellery W. Stone, formerly general manager Atlantic-Pacific Radio Supplies Co., B. F. McNamee, formerly chief engineer Moorhead Laboratories, and Edward M. Sargent, formerly chief engineer for the A.-P. Co., have resigned their connections with the Atlantic-Pacific Radio Supplies Co. and the Moorhead Laboratories. Mr. Stone is now making an extended trip through the Orient where he will do some radio work in China. Mr. McNamee is now engineer with the Roentgen Appliance Co., and Mr. Sargent has joined the Western Radio Electric Co. at Los Angeles.

Wireless telephone instruments will be installed on a number of important German express trains, and receiving instruments will be placed in hotels and embassies, according to an announcement made recently. Experiments conducted in a moving freight car have shown that the wireless system works well, the men engaged in the testing of the instruments being able to hold conversations with friends in Berlin. The tests were made under the observation of engineers, military attaches and the diplomatic representatives of the United States and Sweden. It is said that in three weeks it will be possible for travelers on express trains to reserve hotel accommodations by radio.

Ethereal music, sermons, vaudeville, lectures and personal advertising and other non-official radio broadcasting when on its way to eager listeners must vibrate at a wavelength of 360 meters. The daily weather reports, crop and market reports and other official and semi-official announcements have been given exclusive right of way on the radio wavelength, 485 meters.

This action of the Bureau of Navigation of the Department of Commerce, the government agency that has control over radio communication and which issues regulations governing radio operators and the use of radio apparatus on ships and on land, will shortly be officially announced.

The increase in popularity of broadcasting, commercially and governmentally, has caused alloting of these ether waves to these uses.

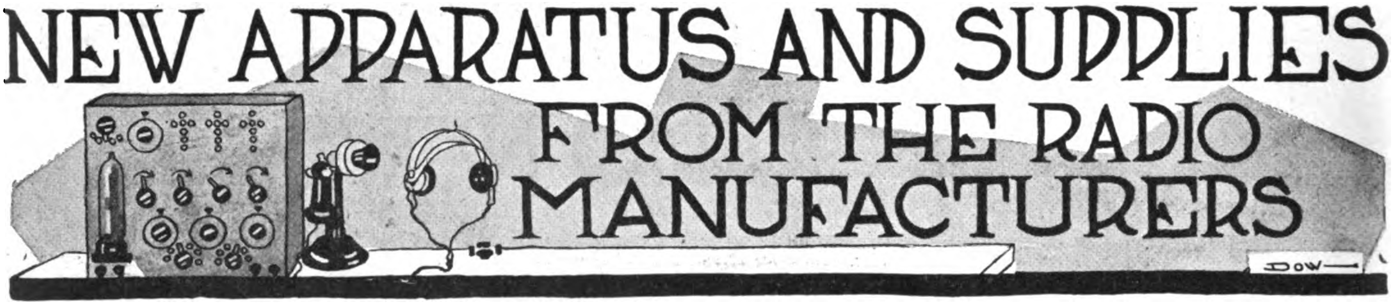
The recent Paris conference on international radio communication decided that radio telephony should be limited to wavelengths above 1550 meters and below 330 meters and W. D. Terrell, chief of the radio inspection work of the Department of Commerce, says that if this provision is incorporated in a convention adopted by the United States it will probably be necessary to change the wavelengths authorized for broadcasting.

Market reports of the Department of Agriculture are now being sent out from eight post office department wireless stations at Cincinnati, Omaha, North Platte, Neb., Rosch Springs, Wyo., Elko, Nev., and Reno, Nev. From these stations the information is sent out in dots and dashes. In addition to these there are also thirteen state and private stations which are authorized to send out this crop and weather information. Missouri state market officials have just installed a wireless telephone transmitting outfit at Jefferson City, Mo.

Licenses to use the 485 wavelength for broadcasting will be granted only when approved by the government officials in charge of distributing weather and crop reports.

The right to use the 360 meter wavelength is being granted to all stations that wish to send entertainment or other matter broadcast. In many localities this promises to cause ether mix-ups. Operators will be forced to get together and parcel out sending time in order that those listening in may receive their messages.

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



LEMCO RADIO SET

The Lee Electric and Manufacturing Co., of San Francisco, has recently placed upon the market a self-contained crystal receiving set designed specially for the reception of radio concerts. The set is practical in every way and very attractive.

The panel upon which all the controls are mounted is of grade M Formica. The assembled panel and coil is mounted within a dust-proof, handsome mahogany finished cabinet, The cabinet is equipped with eyelets on each side, through which lead-in wires and phone cords may be inserted. This permits the cover of the cabinet to be closed while

the set is in use and wires need not be disconnected while the set is not being used. Wires can be connected or disconnected very readily.

Hinges on the side of the cabinet hold the cover in an upright position. The instruction card placed within the cover is plainly visible to the operator. The detector is equipped with a sensitive mounted Radiocite mineral. The lever of the detector proper passes through a spring ball which is set in a spring clip. This gives a universal joint which permits the cat-whisker to be very easily adjusted on all points of the mineral and at the same time holds rugged enough to prevent being jarred out of adjustment.

The character of the set would appeal to those who would enjoy radio music, or desire to receive radio signals without great expense. The set is made as nearly perfect as mechanical skill will permit. With the average size antenna this set will respond to wavelengths up to 900 meters. The manufacturer also furnishes the equipment for the complete installation of the set if desired.

Acme Apparatus Company, Cambridge, Mass., in its Bulletin R, has issued a 20-page radio catalog featuring Acme transformers for all radio purposes—amplifying, spark, C. W. power, and modulation. Details are also given of the Acme amplifier and detector, anti-light blinker, choke coils, condensers, and grid coils.

A NEW LOUD-SPEAKER

A new loud-speaker, appropriately called the "Adapt-O-Phone," has just been placed on the market by J. Thos. Rhamstine, Detroit, maker of radio products. The Adapt-O-Phone uses the regular head set, the receivers being held in position against the manifold by setscrews and protected from injury by soft rubber sleeves. By using both receivers the fullest audibility is obtained, the sounds being rounded out and amplified by the horn

Adapt-O-Phone

so as to give clear, undistorted tones.

As may be noted from the picture, the Adapt-O-Phone is attractive in appearance. The base is of mahogany, the manifold is heavily plated and polished, and the horn is japanned. With the increasing custom of sending out concerts, bulletins, sermons and other messages of general interest, the need of a satisfactory, low-priced loud speaker is wide-spread, and the Adapt-O-Phone should meet with great popularity.

NEW RADIO CATALOGS

Bulletin No. 101 from the Radio Service Laboratories, Asbury Park, N. J., is devoted to Radio Frequency Transformers. This information is of value to those interested in distortionless radio frequency amplification.

RADIO TRADE NOTES

For some time past John Firth & Co., Inc., New York City, have been exclusive distributors for the famous Seibt Condensers, Capacity Meters and other precision instruments. They have now purchased all the patent rights in this Seibt line. Firco Radio products are well known to all dealers and their engineers have developed every one of their products to attain the greatest possible efficiency.

The Electric Appliance Co., 807 Mission St., San Francisco, an old-established electrical jobber, has added a radio department, in charge of H. A. Eveleth.

A new radiophone broadcasting service has been established by J. C. Hobrecht of Sacramento, Calif., on the building of the Sacramento Bee, which furnishes the news for the press service. The station was opened with a musical program from the Victor artsits and was reported as being heard as far away as Alberta, Canada. George Tett, who has charge of the radio department of J. C. Hobrecht Electrical Co., operates this new station, which broadcasts daily from 5:30 to 6:30 p.m. and on Wednesday and Saturday nights from 8 to 9 p.m.

L. B. Benjamin, president of the Southern California Radio Association, has been appointed to represent RADIO in his vicinity.

The F. E. Newbery Electric Co. of San Francisco are employing rather a novel stunt in demonstrating the wireless music received in their store by using the scientific tone chamber of the Sonora Phonograph in combination with a Baldwin phone. The quality of the music is improved immeasurably thereby. Those who are anxious to get the best results would do well to try this feature.

BOOK REVIEWS

"PRINCIPLES OF RADIO COMMUNICATION"—By J. H. Morecroft, assisted by A. Pinto and W. A. Curry; 935 pages, 6 by 9; 788 illustrations. Published by John Wiley & Sons, New York City, and for sale by RADIO, San Francisco. Price, $7.50.

This is a textbook of instruction for the college student and the radio engineer and is unqualifiedly the best comprehensive text yet published. It considers the theory and practice of radio communication from the standpoint of the electron theory so as to give an excellent visualization of what is actually taking place in radio circuits. The author is associate professor of electrical engineering at Columbia University. Starting with a general review of alternating current theory underlying radio operation, he next discusses resistance, inductance and capacity in detail, illustrating his points with many experimental curves and oscillograms. Then follows an explanation of radio wave motion, written so as to be intelligible to the non-mathematician. The laws of oscillating circuits are fully developed. The theory of electron emission and the vacuum tube is treated in detail; damped and continuous wave teleg-

Continued on page 62

PACENT PLUG AND JACK COMBINATIONS

$1.25
$1.50
$1.50
$1.50
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① 

PATENT PENDING

Universal Plug

This is a real radio plug. No solder is used to make a connection with the Pacent plug. By our patented method any increase in strain only serves to tighten the grip. A soft, velvety black finish with polished metal parts, makes the Pacent plug easy to look at—it is truly beautiful. Insist on the **original**, 100% plug. Catalog No. 50 Pacent Universal Plug—$1.25.

② 

PATENT PENDING

Twin Adapter

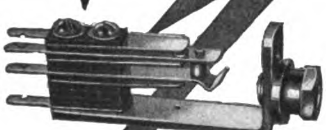
How troublesome and unsatisfactory it is to pass a single pair of 'phones about so that more than one person can "listen in"? When the Pacent Twin Adapter is used, this is quite unnecessary since a single jack can be made to accommodate two Universal Plugs. These two plugs can be connected to two sets of 'phones or one can be used with a loud speaker and the other can be used with a single set of 'phones. Thus the receiver can be tuned with the 'phones and the loud speaker can then be plugged in. It will also be found very serviceable in making rapid connection changes in C. W. work. THIS IS ANOTHER PACENT RADIO ESSENTIAL. Catalog No. 51 Pacent Twin Adapter, Price $1.50.

③ 

PATENT PENDING

Multijack

Here is another worthy member of the Pacent plug and jack combination. This is really three independent jacks built into a beautiful composition base. The Multijack can be used with Pacent Universal Plugs or Pacent Twin Adapters. The Multijack is more than a mere convenience; it is a necessity. Screwed to the side of a receiving outfit it will allow three sets of 'phones to be plugged in or two sets of 'phones and a loud speaker. It may also be screwed to the table or the testing board. All standard plugs will fit into it, but it was designed especially for use with the Pacent Universal Plug. THIS IS STILL ANOTHER PACENT RADIO ESSENTIAL. Catalog No. 52 Pacent Multijack, Price $1.50.

④ 

Pacent Radio Jacks, Automatic Types

While the Pacent Radio Jack of the standard type fulfills most radio requirements, there are certain advantages to be derived from the use of the automatic type, which permits the filaments in any part of the amplifier to be automatically cut off when not wanted, without necessitating an additional switch or touching the rheostat. Inserting the usual plug in the Pacent Automatic Radio Jack lights the filament of the vacuum tube in that particular circuit, while withdrawing the usual plug shuts off the current from the filament. Catalog No. 66 Pacent Automatic Jack, Price $1.50. Supplied in other styles.

⑤ 

PATENT PENDING

Pacent Radio Jacks, Standard Types

The Pacent Radio Jack is a fit companion for the Pacent Universal Plug. In fact, one is not fully complete without the other; for they have both been designed especially for radio work and for each other in particular.

Pacent Radio Jacks are available for a number of radio purposes, such as in amplifying equipment, in C.W. low-powered transmitting apparatus and in the better kind of receiving apparatus. The Pacent Jacks are small, neat and rugged. The Pacent Jacks are Provided with a Booster Spring—a new idea. It increases the life and service of the device.

Catalog No. 63 Pacent Radio Jack. Price $1.00. Supplied in other styles.

CONSUMERS—Your dealer will gladly supply you.
DEALERS and JOBBERS—Wire your order at once to insure prompt delivery.

Apparatus plus Service

For Detailed Information, send for Bulletin N100

PACENT

PACENT ELECTRIC CO.

INCORPORATED

150 Nassau St., New York, N.Y.

Member of Radio Section, Associated Manufacturers of Electrical Supplies

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY 7LR, 425 ELLSWORTH ST., ALBANY, ORE.

7bc, 7ch, 7kj, 7ln, 7ma, (fone), 7mh, 7mw, 7mi, 7mu, 7nn, 7nl, 7re, 7sv, 7tb, 7th, 7ts, 7xf, (fone), 7xc, (fone), 7yj, (fone, sp and cw), 7ya, 7ys, 7yg, 7zt, 7zm, 7aai, 6ah, 6af, 6as, 6ar, 6eb, 6gr, 6ht, 6hf, 6if, 6iw, 6lw, 6mi, 6nn, 6nw, 6ta, 6tf, 6tt, 6tn, 6oh, 6rc, 6uu, 6lv, 6tw, 6wj, 6so, 6wv, (fone), 6jw, (cw), 6ale, (cw), 6xad, (cw), 6abw, (acw), fone's, 6xg, 6xd, 6xw, 6xac, 6xak, 6xae, 6xaj, 9amb, 9bd, (Canadian), 9by, 9yb, 9zaf, 9ax, 5za, 5br, 5zf, 2fp, (cw), 2tt, Ibds, (cw).

BY 7TT, JAN. 1st to 20th, CANADIAN, 4CB, (CW), 9AX, 9BD.

Spark—6acr, 6xv, 6qw, 6wz, 6abw, 6zr, 6zk, 6zal, 7bh, 7bk, 7br, 7fc, 7fl, 7in, 7jd, 7mf, 7rb, 7rn, 7ru, 7tj, 7xd, 7ya, 7zm, 7zp, 7zs, 7zu, cw or fone 6ale, 6xac, 6xad, 6zaf, 6xg.

BY 6EA, H. C. SEEFRED, 343 SOUTH FREMONT AVE., LOS ANGELES, CAL.

Heard—2fp-cw, 5xu, 5za spk and cw, 6fh, 6gr-icw, 6gt, 6jj-icw, 6jx-icw, 6km, 6oh, 6pj, 6to, 6tv, 6uc, 6vm-icw, 6za-icw, 6zk, 6zx, 6zz, 6aah, 6aau, 6abx, 6afn, 6ain, 6ale-icw, 6amk, 6asv-icw, 6avb, 6awh, 6awt-icw, 6bgh, 6xaf-icw, 6zam, 7ck, 7fx, 7hf, 7in, 7jd, 7mf, 7tj, 7ya, 7zj, 7zt, 7zu, 8rl-icw, Canadian 9bd-icw, 9bex-icw, 9bji-cw, 9dth-icw, 9dva-icw, 9nv-icw, 9nx-icw, 9wd-icw, 9xaq-cw, 9xm-cw, kdpu-cw, kdpv-cw, kdpw-cw, cl8-cw and spk, and wv6—voice and music.

Worked—6ah, 6ak—spk and icw, 6as, 6dp, 6ex, 6fk, 6gx, 6po, 6pr, 6qr, 6vx, 6zu, 6abw, 6agf, 6ang, 6aor, 6xh-icw, 7xf-cw, chopper, voice and music, 7yg, 7yj, and 9amb-cw.

BY 6EB, L. F. SEEFRED, 343 SOUTH FREMONT AVE., LOS ANGELES, CALIF.

Spark—(6ah), (6as), 6cp, (6ex), 6fh, (6fk), 6gt, 6km, 6oh, 6pj, 6po, 6pr, 6qk, 6qr, 6to, 6tu, 6tv-Ariz., 6uo, 6vk, (6vx), 6wz, (6xh), 6zk, (6zx), 6zz, (6aah), 6aau, 6abr, 6abw, (6acr), 6aei, 6afn, 6agf, 6aid, 6ain, 6alv, (6amk), 6aor, 6app, 6aru, 6ath, 6atq, 6avb, 6avv, (6awh), 6zam, 7bh, 7bj, 7cn, (7hf), (7jw), 7kb, 7mf, 7tj, 7ya, 7yg, 7zm, Canadian 9ax.

C. W.—5za, 6ak, 6aat, (6ale), 6asw, 6aul, 6gy, 6jx, 6xaf, 6xw, 6za, 6zaf, 6zz, 9amb, 9dva, 9nx, 9wd, 9xaq, cl8. All those over 50 miles who have heard my spark, drop card giving date on the three tones (high, medium and low) please. Am quitting spark for "cw." Use above address.

BY 6AOW, 469 LIME ST., RIVERSIDE, CALIF.

Spark—5if, 5xf, 5xu, 5za, 5zz, 6ah, 6cv, 6ex, 6fh, 6gr, (6gt) 6hc, 6km. 6oh, 6ot, 6po, 6pr, 6qk, 6qr, 6sj, 6tc, 6to, 6tu, 6tv, 6uo, 6vx, 6wz, 6xh, 6za, 6zk, 6zu, 6zx, 6zz, 6aah, 6aau, 6abw, 6abx, 6abz, 6acr, 6afn, 6afp, 6agf, 6ahd, 6ain, 6alv, 6ani, 6anp, 6aor, 6app, 6asv, 6ath, 6atq, 6awh, 6zam, 6bfe, 6bgh, 7bj, 7ck, 7in, 7jd, 7kh, 7ly, 7mf, 7ya, 7yg, 7yj, 7ys, 7zj, 7zt, 7zu, 7zv, 9xm.

C. W.—5za, 6gr, 6gy, 6ky, 6wv, 6wz, 6xh, 6za, 6aat, 6abe, 6ale, 6asj, 6asv, 6xac, 6zaf, 9nx, 9wd, 9amb, 9xaq, 9bbf, 9bex, 9biw, 9bji, 9dtm, 9dva, 9zaf, cl-8, ag-1, db-5, fone 6wv, 6xac, 9zaf, kwg, kyj, db-5.

BY 6XAF and 6JX, 109 GREENBANK AVE., PIEDMONT, CALIF.

Spark—6ea, 6eb, 6en, 6fk, 6gp, 6is, 6kc, 6lc, 6mh, 6od, 6ol, 6ov, 6vz, 6zr, 6aah, 6acy, 6adl, 6agp, 6ahr, 6aib, 6aif, 6aio, 6ajr, 6akl, 6ald, 6amn, 6avr, 6awx, 6zal, 7bc, 7bj, 7bk, 7gj, 7hf, 7jw, 7kj, 7ks, 7mf, 7ml, 7mp, 7my, 7tj, 7ya, 7yg, 7zj, 7zm, 7zt, 7zw, 9ax, 9bd, (Canadian), cl8.

C. W.—5za, 6cu, 6cn, 6jd, 6ka, 6zb, 6zz, 6aif, 6aoz, 6aqt, 6asv, 6atg, 6xad, 6xaq, 7xf, 9amb, 9dva, 9xae.

BY 7BJ, VANCOUVER, WASH.

Canadian 4cb, 5ak, 9ax, 9bd, 6ab, 6as, 6aau, 6aat-cw 6abh, 6abm, 6abw, 6abx, 6acr, 6adl, 6aew, 6aeg, 6afn 6agf, 6agp, 6aic, 6aib, 6aif, 6aix, 6ale, 6alp, 6aor, 6ark, 6ard, 6atv, 6avb, 6avr, 6awh, 6azv, 6bm, 6bbr, 6dd, 6eb, 6en-cw, 6ex, 6fe, 6fh, 6gx, 6gt, 6hc, 6is, 6iv, 6jx-cw, 6ka-cw, 6km, 6ng, 6mh, 6od, 6oh, 6po, 6pr, 6qk, 6qp, 6qr, 6su, 6to, 6tu, 6uo, 6vx, 6wz spk and cw, 6xh, 6za, 6zaa, 6zal, 6zam, 6zu, 6zx, 7ad, fone, 7aao, 7ba, 7bc, 7bk, 7bh, 7bf, 7bt, 7bz, 7cd, 7ck, 7fi, 7ge, 7hi, 7hf, 7in, 7iw, 7iy, 7jf, 7ke, 7kg, 7kj, 7ks, 7lo, 7ln, 7ly, 7mp, 7my, 7mv, 7mf, 7mu, 7nl, 7nn, 7nj, 7ny, 7nz, 7ot, 7oy, 7po, 7tj, 7tl, 7ut, 7vo, 7vz, 7zu, 7ya, 7ys. All on 1 bulb, spiderweb tuner. All correspondence answered. Total 119 stns logged out of town.

BY 6ATN, FALLON, NEVADA.

Fones—5za, 6arz, 6aat, 6vm, 6at, 6xg, 6xd, kwd, 6xak, 6xag, gy-8, ag-1, cl-8, 6xac, 7xf, 9zaf, 7cf.

Received during daylight 6xg, 6xd, kwd, 6xac. Avalon and Long Beach fones—all with detector only.

Complete Reports of the

WASHINGTON CONFERENCE

On the regulation of radio, from our special correspondent will be one feature of the

April Issue of Radio

This feature alone, in addition to those announced elsewhere, will make this number of inestimable value to every radio operator.

Buy it on the news stands—or better yet, send $2.00 for a year's subscription so as to insure your not missing a single number of "the best radio magazine published."

BY 9BD BARRON HOTEL, VANCOUVER, B. C.

C. W.—(4cb), (5bd), 9be-Canadians, 6ak, (6aat), (6ale), (6aif), (6awt), (6jd), (6jx), 6jj, 6xac, 6xad, 6zw, 6xg, 6za, Avalon phone, 7dm, (7sc), (7xf), 7fw, 7ma, (dm), (rb), (cla), 9dva, 9amb.

Spark—"5's" to numerous, 6ah, 6abw, 6abx, 6adl, 6ajr, (6amk), (6agf), 6awb, 6agx, 6bm, (6ex), (6bc), 6fh, (6gx), (6oh), (6qr), 6vx, (6kl), 6sj, 6pw, (6wz), 6eb, 6aei, 6zk, 6zz, 6cp, (6zam), qra, pse, (6zx), (7bk), (7bh), (7bc), 7bg, (7bp), (7bj), 7ck, 7cd, 7ed, (7fi), (7gj), 7jf, 7jw, (7hf), 7jd, 7kj, 7ke, 7ge, 7nk, (7nl), 7mu, 7nz, 7rg, 7ou, 7iw, 7cn, 7zk, (7zj), (7zm), (7zt), (7zb).

BY 7KR, DEC. 20th to JAN 13th.

4cb-cdn, 6am, 6cv, 6ex, 6fh, 6gr, 6jx, 6km, 6lc, 6ng, 6oh, 6qr, 6tu, 6tv, 6vx, 6wz, 6zt, 6zx, 6aat, 6abx, 6acr, 6afn, 6afw, 6agf, 6aia, 6aij, 6ale, 6xad, 7bc, 7bf, 7bh, 7bk, 7bz, 7cd, 7cf, 7cw, 7fi, 7ge, 7hf, 7in, 7iw, 7iy, 7jf, 7ke, 7kj, 7lo, 7mf, 7mp, 7nl, 7nt, 7nw, 7po, 7tj, 7vg, 7wa, 7yj, 7zm, 7zp, 7zu, 9ax-cdn, 9bd-cdn.

BY 6ASQ, HUNTINGTON PARK, CALIF.

5za, 5za-(cw), 6ak, 6as, 6cz, 6dp, 6eo, 6ex, 6gf, 6gr, 6gt, 6hc, 6ic, 6oc, 6pg, 6pj, 6po, 6pr, 6qr, 6to, 6tu, 6tv, 6vx, 6wz, 6ze, 6zn, 6zu, 6zx, 6zz, 6abx, 6agf, 6ajh, 6ale, 6alv, 6ang, 6bak, 6bdt, 7zu.

CALLS HEARD BY KDUK

2700 Miles West of Los Angeles on Single Tube.
8iv, 6adt, 9nx, 6aif.

BY 6ASJ, OAKLAND, CAL., JAN. 1 TO FEB. 1.

Sparks—5hk, 6at, 6abw, 6abx, 6acr, 6acy, 6adl, 6afn, 6agp, 6ahp, 6ahq, 6aib, 6aif, 6ain, 6aio, 6alp, 6amn, 6asy, 6avy, 6baj, 6bgh, 6ea, 6eb, 6en, 6er, 6fh, 6ft, 6gp, 6gt, 6gx, 6iv, 6kc, 6lc, 6mh, 6mf, 6od, 6oh, 6ol, 6pj, 6qr, 6tv, 6vl, 6wd, 6zx, 6zr, 6zal, 7ba, 7bb, 7bc, 7bj, 7bk, 7fi, 7gt, 7hf, 7in, 7ke, 7kj, 7ks, (7mf), 7mp, 7my, 7nn, 7tj, 7ya, 7yg, 7yj, 7zj, 7zm, 7zt, 7zu, coli, 9ax, 9bd (Canadian).

C. W.—5ak, 6ak, 6aat, 6aif, 6ale, (6aoz)cw and voice 6atg, 6avw, 6avy, 6awv, 6en, (6gd), (6jd), (6ka), 6ky, 6rr, 6xad, 6zu, 7rn, 7xf, 7zt, 9amb.

BY 6WD

5za, 5fn, 5ae, 6ea, 6eb, 6qz, 6mu, 6is, 6bh, 6zu, 6oh, 6lc, 6zz, 6qr, 6pr, 6amk, 6ark, 6km, 7zj, 7mp, 7gj, 7mf, 7iw, 9bd, 9bz.

BY 7QL, RAINIER, OREGON.

Spark—6ab, 6af, 6ak, 6bh, 6cv, 6ex, 6gf, 6gx, 6hw, 6jx, 6km, 6mk, 6oh, 6pj, 6qr, 6ra, 6rz, 6tu, 6ui, 6xd, 6xh, 6zb, 6zk, 6zu, 6abx, 6aed, 6aag, 6aez, 6agf, 6afn, 6aid, 6alk, 6amk, 6acr, 6alp, 6atv, 6ape, 6cvk, 7af, 7ab, 7bh, 7cd, 7ck, 7db, 7dw, 7eo, 7fi, 7ft, 7gv, 7hf, 7id, 7in, 7iu, 7iw, 7jf, 7ju, 7kb, 7kg, 7kj, 7kw, 7ly, 7md, 7mo, 7mp, 7my, 7mf, 7nj, 7nm, 7nt, 7nw, 7pj, 7oh, 7ra, 7rn, 7ru, 7tj, 7to, 7vo, 7xd, 7ya, 7yd, 7yg, 7yj, 7ys, 7ze, 7zk, 7zj, 7zm, 7zt, 7zs, 7bd.

C. W. and fone—4cb, 5za, 6en, 6cu, 6wv, 6xg, 6xw, 6aac, 6aat, 6ale, 6xac, 6xad, 6xaf, 6xak, 9ax, kwc, cl8 kdq, 7hw, 7th, 7tq, 7xf.

BY 6AVR

Heard on 1 tube. (Spark)—5if, 5of, 5xu, (5za), 6ah, (6as), 6cv, 6dn, (6ex), 6kc, 6km, 6oh, 6pr, 6qk, 6qr, 6sj, (6to), 6tu, 6tv, 6vx, 6vv, 6aah, 6aap, 6aau, (6abw), 6abx, 6acp, 6aeh, 6afn, 6agf, 6agk, 6aij, 6aip, (6alv) 6amk, (6ang), 6ani, 6ath, (6aor), 6atq, 6atv, 6avb, 6avv, 6awh, (6bgh), (6bgn), 6zb, (6zx), 6zz), 7bj, 7mf, 7jd, 7tj, 7ya, 7yj, 7yg, 7zj, (7zm), 7zp, 7zt, 7zu, 7zv, 9nr.

C. W.—5za, 6ak, 6ale, 6za, 6zb, 6zz, 6xac, 6xaf, 6zaf 7yj, 9wd, 9amb, 9dth, 9xaq, 9bji.

BY 7CG, NAMPA, IDAHO, JAN. 1 to JAN. 28.

Spark—5za, 6am, 6at, 6cw, 6ef, 6ft, 6la, 61c, 6mf, 6ot, 6oz, 6pr, 6qr, 6rt, 6sj, 6tu, 6tv, 6uo, 6za, 6xi, 6zr, 6zx, 6zz, 6aah, 6abx, 6acw, 6adx, 6aez, 6afn, 6ahp, 6alu, 6alw, 6ata, 6ath, 6atq, 6zai, 6zam, 7bf, 7bj, 7ck, 7dn, 7dv, (7ft), 7jd, 7lk, (7ln), 710, 7mf, 7mp, 7nl, 7nn, 7ot, (7py), 7qt, 7ry, 7to, 7vd, 7vo, 7vz, 7ya, 7yg, 7yj, 7za, 7zm, 7zn, 7zo, 9ee, 9nr, 9pi, 9ya, 9yk, 9yr, 9axm, 9yak.

C. W.—5za, 6en, 6ka, 6ku, 6zo, 6zi, 6aat, 6xac (Concert, fone and c. w.), 7ft, 7rn, 9ao, 9hr, 9yg, 9ays, 9bji, 9bow, 9dtm, 9xaq, 9zaf, utt5 (Concert and fone).

BY 6OM

Spark—5za, 6ah, 6as, 6bm, 6cp, 6ex, 6fd, 6fh, 6gf, 6iv, 6km, 6oh, 6pr, 6qk, 6qr, 6to, 6tu, 6tv, 6vx, 6wz, 6xh, 6zk, 6zu, 6zx, 6zz, 6aag 6aah 6aau, 6abw, 6abx, 6aeh, 6afn, 6aio, 6amk, 6atq, 6avb, 6awh, 7jd, 7mf, 7ya, 7zm, 7zt.

C. W. and I. C. W.—5za, 6za, 6acb, 6aif, 6ale, 6asv, 7cs, 8xv, 9nx, 9wd, 9amb, 9dtm, 9xaq.

BY 5CZ, 937 17TH AVE. W, VANCOUVER, B. C.

Spark—6ard, 6ki, 6kg, 6lx, 6qr, 6zam, 6zk, 6zx, 7bh, 7bj, 7br, 7bz, 7bc, 7ch, 7cn, 7ck, 7fi, 7ge, 7hf, 7iw, 7jr, 7ke, 7kj, 7kb, 7ly, 7mu, 7mf, 7mp, 7nn, 7nl, 7nw, 7oj, 7tj, 7tl, 7vx, 7vz, 7ya, 7yj, 7zj, 7zt, 7zy, 7zu, cl8. All Q. S. A.

C. W. and fone—5akt, 5au, 5en, 5za, 5zx, 6aac, 6aat, 6atg, 6ak, 6bcj, 6en, 6pp, 6vv, 6xac, 6xad, 7aav, 7cf, 7en, 7ft, 7il, 7kv, 7kz, 7nn, 7og, 7rn, 7uz, 7xf, 9amb, cl8, Can. 4cb. Any correspondence gladly answered.

BY 8AGO, PITTSBURGH, PA., FROM JAN. 17 TO JAN. 30

All C. W.—1lp, 1qn, 1rz, 1ts, 1un, 1zf, (1anq), 1ary, 1azw, 1bcf, 1bea, 1bqe, 2bf, 2fp, 2nz, 2ud, 2wp, (2aab), (2afp), 2ako, (2aos), 2ayu, 2bak, 2beb, 2bgh, 2bgm, 3bz, 3cc, (3hg), (3km), 3zo, 3zy, (3aad), 3ade, (3ahk), (3anj), (3aqr), (3blf), 4bk, 4bt, 4by, 4cy, (4dc), 4eb, 4ft, 4gl, 4hw, 4id, 4ze, 5da, 5fv, 5ku, 5uu, 8bk, 8ea, (8gv), 8hj, 8hp, (8iv), (8ni), (8uk), (8vy), 8zz, 8agz, 8ald, 8aqf, (8aqv), 8bdb, 8box, 8bum, 8cab, 8yas, 9as, (9dv), 9fm, (9io), 9iz, 9pg, 9us, (9zb), 9zl, 9aas, 9aja, 9ajh, (9als), 9ark, 9bed, 9blo, (9dig).

REMARKABLE RECEPTION BY 6ZAC, HAWAII

Continued from page 30

8:24 p.m.—5ZZ de 5XU. "R QRA is University of Texas, Austin, Tex."
8:50 p.m.—7ZU de 7ZJ. (Working.)
9:01 p.m.—7ZJ de 7ZU. (7ZJ very QSA but ZU weak.) "Manuel Meyers, 730 and one-half East 14 St. Nr. 4. Nr. 5 OK. Nr. 3 sig is Jack Kerns."
9:08 p.m.—7ZU de 7ZJ. "R Nil but QSQ 7ZT." (Pau)
9:08 p.m.—7ZU de 7ZT. "1."
9:10 p.m.—7ZU de 7ZT (Sending msg, but QSS).
9:14 p.m.—7ZU de 7ZT. "R Many tnx OM N. M. 73 to 7ZN."
9:16 p.m.—7ZU de 7ZT. "ND OM QRM QTA K."
9:18 p.m.—7ZU de 7ZT. "R Thanks no more 73 to 7ZU. CLR."
9:23 p.m.—7ZJ de CL8 (500 cycle note).
9:39 p.m.—4CB de 7YA. "Say OM How does that receiver of yours work on 200 meters? I have a 200 meter wave that I would like to try to work you with, OM. QRV? for 200 meters? Hw?"

January 3, 1922.

KZY testing with 9XAB from 8:55 p.m. (my time) to 8:35 p.m. At 8:35 KZY told 9XAB to rush QSL by telegraph or phone, stating results. Told 9XAB that during test had him QSA ind period but nd other periods. Said to phone Piedmont 7768 . . . at 8:24 p.m. . . . when arc and KHK allowed me, heard 9XAB (very fluttering 500 cycle note) saying ". . . hear you very well—do the same please—I will." (KHK has no hump—comes all over tuner.) Also heard 9XAB several other times, but his wave too long and he's right on a "mush" hump. If he was on 375 instead of 395 could read him O. K. on 1 step. (Nearly all work done on 1 step as second one still on bum.)

January 7, 1922.

10:03 p.m.—6ZAC de 6ZAF. "My wife said you had me in mind when you made the picture, 'Yes, Ma! I'm in Bed!'"
Some other 6 stations will call you tonight. GN.

If 6ZAF had sent the above single, as in previous QST's, it would have been N. D. as QRM fierce from arc, and big generator at mill sparking fierce at brushes. Was unable to hear any other 6's, but got 6ZAF several times agn, and conditions very bad to test with others.

January 16, 1922.

7:37 p.m.—7CK de 6ZX. "Give name again."
7:38 p.m.—6EB de 6EBR.
7:54 p.m.—6ASR de 6TQ. "Am not QRW as told my friend here that I must send . . . (QSS) . . . 6SY is out tonight as the college is giving a play and 6SY is QRW. Yep, his wavelength was higher . . . (QSS) . . . last nite for test. Do you know who won the football" (QSS).
7:58 p.m.—6TQ de 6ASR. "R. Yep, knew that the college is giving a play but didn't think 6SY had any part in it . . . (QSS) . . . yep, wave pretty high, and we ought to let YN1 know about the plan of action next time when . . . (QSS) . . . test for I think YN1 expected answer from Dow. OM, I didn't get ur last question so pls QTA."
8:00 p.m.—6ASR de 6TQ. "6SY is the electrician . . . (QSS) . . . for tonight show. . . . (Bad QSS) . . . after action GA." (Then 6ASR's tone went bad, and fooling with it.) (Both these stations very QSA when QRK, but QSS from Very QSA to no sig at all. 6ASR slightly above 200 meters, about 215.)
9:08 p.m.—7TJ de 6EX.
9:10 p.m.—7TJ de 6EX. "QSK will try thru southern route and if OK will clear you. Hw."
9:29 p.m.—6EN de 6EX.
9:54 p.m.—6EA de 6EX. "No. 1. Dr. J. B. Olognino, 211 W. 28 St., New York. Many thanks for the check. Hope you are all well. Will write soon. (Sig) Renato."
10:00 p.m.—6EA de 6EX. "R BK me if QRM." (I went px from KHK.)
10:14 p.m.—6EA de 6EX. "Better QSK."
10:25 p.m.—9BD de 6JD (About 250 meters. Very QSA ACCW.) "My New QRA is, V. M. Bitz, 5128 South Van Ness, Losangeles."
10:31 p.m.—9BD de 6JD. "R On first part got about half. Lost u. Will be glad to hear from you. I will drop you a card. QTC? Are you going to be at 9BD very long? Yes, know you, but ur old call is in another name. Well, O. M., see you again if no QTC."
10:36 p.m.—6JP de 6EX. "Not very gud, O. M. QRU. GE."
10:40 p.m.—9AMB de 6EN. "N D. Got bad QRM. Navy having target practice and going on their CW sets on all waves. Very bad QRM. QTC?" (Very QSA AC CW.)
10:43 p.m.—9AMB de 6EN. "OK now. QTC?"
11:04 p.m.—9AMB de 6EN. "ND QRM. Please QRA of 8XV?"
11:06 p.m.—9AMB de 6EN. "OK QRX."
11:12 p.m.—9AMB de 6EN. "Thanks very much for your trouble OM if you happen to hook up with 8XV please tell him he is very QSA here. All right, C. U. L. and 73 to 9AMB."

THE SMALL PERSON

Continued from page 23

temptuous slap with his cloth, and passed on to more fertile fields of endeavor.

To the rattle of chips and the clink of glasses—for the three mile limit was far astern, and this was not a vessel of American registry—the Small Person sat on, seeing nothing, especially, but warm and as contented as circumstances permitted.

His peace was rudely shattered by an uncouth, raw-boned individual — the same, if truth be told, who was ever the leader of the covert jokes at the expense of the Small Person.

"Look who's here! Darned if it ain't the titmouse! Time you were in bed, sonny! Losing your beauty sleep—y' know!" he guffawed. And the eyes of the crowd followed the teaser's pointing finger.

"There are *others* who might profit by going to bed early—if personal looks are bettered thereby!" snapped the Small Person, galvanized into action—much as any wee animal will show its teeth, when cornered.

His voice rang clearly, and for a moment there was a surprised silence. The creaking groan of the ship's woodwork, under stress of her heavy rolling, was impressive. And ere the other could articulate reply, the Small Person had uncurled himself from the corner and bolted—rabbit-fashion.

A yell of laughter went up—at the expense of the uncouth one—who expectorated profusely. "The durn little rat! Wait till I catch him on deck tomorrow!"

The Small Person crept in his bunk—shaking with pent fury—and there he ferociously pounded his pillow. "The big stiff! The lumberin' gook! Wish I'd punched his nose!"

And presently he fell asleep.

* * *

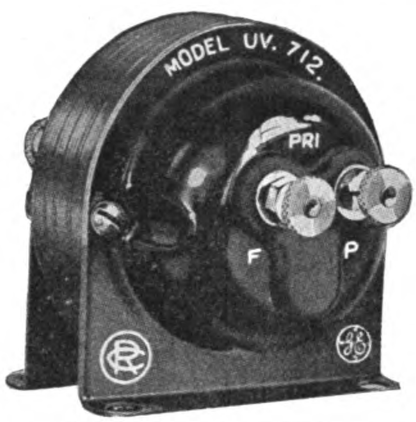
AN unusually heavy roll of the ship awoke him. And as his awakedness became more of a fact, unusual sounds came to him. He heard the rushing of feet over his head—the rattle-bang of heavy blocks being dragged along—hoarse voices—commands—the whooping of the wind—and that which brought him out of his bunk to the cabin floor in his funny little old-fashioned "nightie," was the shrill screaming of a woman—*"We're going down! I know we're going down!"*

Then he realized that the *purr-rring* throb of the engines had ceased. Climbing in his "duster" coat, and wrapping the inevitable muffler about his throat he hopped out in the corridor. A steward caromed from the alley-side, into him, nearly knocking him down.

"What's the matter?" he called after the hurrying man.

"Steering gear gone to Hell!" yelled the other, dashing out of sight.

Quality Apparatus



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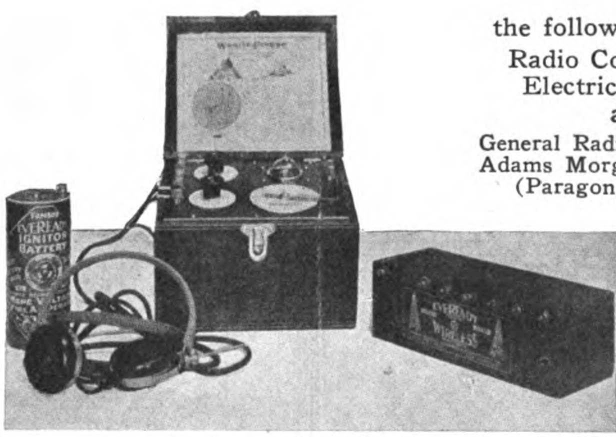

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San Francisco, Cal.
428 Market Street

Send two-cent stamp for NEW Concert Schedule.

950 South Flower Street
Los Angeles, Cal.

"Funny kind of a steward, to spread alarming reports!" soliliquized the Small Person, making for the main stairways. But long ere he reached them he was being swept along by a maddened crowd of men and women, clambering over one another in their rush for the upper decks. The Small Person was promptly knocked down, and had sense enough to stay there, shielding his head with his thin arms, as best he could.

When they had all trampled over him, he picked himself up, rubbed his sides grimly. "One good thing about bein' little—not so much to get hurt!"

The dining saloon was jammed with passengers. Officers and stewards were doing their best to still the pandemonium of sounds, all of which had been originated by the hysterical screaming of one woman. And the Small Person watched the scene, quizzically.

No headway toward quiet was being made until the captain, dripping wet, a nasty gash across his forehead, jumped on one of the tables and clung to a stanchion.

"For God's sake, stop this infernal din! You are in no danger! The rudder has become damaged in some way and the ship cannot be navigated properly. But she is not leaking a drop and the storm is rapidly abating. The stewards will serve hot coffee and sandwiches here in fifteen minutes. I wish to ask if there is, among the passengers, a radio operator? One of those belonging to the ship was taken suddenly ill yesterday, and is helpless. The other has just had the misfortune of breaking his leg in three places, and is in too much pain to operate. If there is anyone who understands radio I shall be more than grateful if he will make himself known."

Silence.

The captain clung to the stanchion, searching the sea of faces below him. And the great ship wallowed heavily, an inert, helpless mass in the rush of the huge seas.

The Small Person coughed—and timidly edged forward. "I am an operator," he said, simply. The people nearest him made room and he stood before them all, a pathetically-ridiculous picture, in his "duster," from beneath which peeped the tails of his cotton "nightie."

Captain Maters stared—doubting his ears.

"Yes," continued the Small Person, with a gulp, "I have been an amateur operator all my life—hold a special license. Maybe I can be of use?"

He said it so simply that the skipper's jaw snapped shut on the unkind words that he had been about to utter. He jumped down—

"Come on, then!" seizing the Small Person by the arm and forcing a way through the mob of staring passengers. Meekly the little man permitted himself to be dragged along, and he held tightly

to the skipper as they crossed the one open space of the gale-swept deck, to the radio room. Several of the men passengers followed.

But once inside, the Small Person's attitude changed. He turned fiercely on the others—

"Outside—all of you! I'm running this show from now on!" He caught sight of the pallid face of his erstwhile tormentor, who was craning over the others' shoulders, to see. "Hey—you! YOU, you big, rawboned stiff! Apologize for havin' made fun of me the whole trip—or not a key do I press!"

"What's this?" began the skipper.

"*He* knows darn' well what I mean!" snorted the Small Person.

"I'm sorry," mumbled the uncouth individual.

"*Louder!*"

"I say I'm sorry!"

"All right, then! And the rest of you remember that just because a man hasn't got the shape of a prizefighter, that that doesn't mean that he hasn't got both brains *and* feelings! Outside—I want room!"

And they all went, leaving but the skipper.

"Well, what's wrong, and what do you want me to do? Speak up!" snapped the Small Person, clutching at the edges of the operating table to keep his balance.

"I—I—well, can you get in touch with the nearest ship to us and explain our situation? I think that I can make repairs as soon as this wind drops, but I am not sure—and so I—"

"You don't want me to send an *SOS*—because of salvage—and yet you haven't got the nerve to take a chance—*huh?* I can tell you that an *SOS* is going out! Gimme your position!"

The captain hesitated, gaping at the little figure.

"Won't? Then I'll get it out of the operator's log—noon reading, yesterday!"

As one to ships born, the Small Person found the sheet of the day, ran his finger down it—"Ha!"—then he reached for the head phones. "Get out of here—or not a spark—sputters! I'm not afraid of going to Davy Jones! Who would be, with such a damnfool shape as I've got? OUT!"

The skipper went.

"You'll find the main switch——" came a feeble voice from the dark of the operators' quarters at the back.

"Shut up, OM—I know this set better'n you do! I made a hobby of radio long before you came in sight! Make yourself as comfortable as you can!"

Settling the phones firmly on his head, the Small Person wedged himself in the operating chair, carefully tucked his little feet in a fold of the cotton "nightie," threw the power switch, and began to call, while the injured operator listened with growing amaze—

"Holy smoke!" he grunted, between spasms of pain. "Gosh, but that two-for-a-cent is sure *some* operator! And I tried to show *him* the set!" He fainted from sheer relief of mental strain.

* * * * *

SLOWLY a strange procession crept up the Broads toward Southampton. A dingy, sea-stained freighter sturdily towing a greyhound of the seas. Whistles shrieked in salute, but the liner answered them not.

In his cabin the Small Person sat, clasping and unclasping his thin fingers. For hours, after leaving the radio room, when the helpless liner had been taken in tow by the ship that his signals had brought, had he resisted all efforts to roust him out, and repeated knockings at his door received the same, small-voiced response:

"Go 'way! Leave me alone!"

And—to himself—"Why haven't I got any nerve?" he muttered, with much pathos.

At the dockside—Southampton—he managed to dodge the entire ship's company! How—only he knew! But he did it! And that night, in a small hotel, in the backwaters of London's seething ebb and flow of humanity, he tremblingly opened an evening paper and read all about *"the vanished Mr. Beardsley, radio expert,"* who had indubitably saved the S. S. ———, with her hundreds of passengers and millions of dollars' worth of cargo! This by volunteering to act as radio operator, when the ship was in grave peril and disabled in a heavy storm, the regular operators incapacitated for duty. He read further of how it was mooted that a medal for bravery should be given him; of how anxious the steamship company was to express its great gratitude; of how the passengers desired to present him with a fitting gift, as a souvenir of the great occasion; and, finally: would Mr. Beardsley kindly come to the offices of the editor of the paper?

He read it all carefully, slowly. Then he let the sheet fall from his fingers—

"Gosh! I wish I had a *little* nerve!" he wailed softly. And, turning off the light, the Small Person crept into the narrow bed, wrapping his hands in the cotton "nightie," and tucking his feet in its lower folds.

(The end.)

VALUE OF CO-OPERATION

Continued from page 31

Occasionally complaint is heard that radio organizations are controlled by cliques or factions. It is believed that if such complaints were investigated that it would be found that the so-called clique was composed of a body of intelligent, progressive young men, who were earnestly endeavoring to advance the interest of amateur communication in their community, against the opposition of a few disgruntled critics, and badly handicapped by the indifferent lack of assistance from a Do It All. They should worry.

LETTERS TO THE EDITOR

Sir:—The writer, in looking over your issue for February, was much interested in the article on page 26 with reference to transformer designs.

The writer has in the past constructed a large number of experimental transformers both for general use, bell ringing work, and C.W. work, etc. It seems to the writer that the most important point about the ease of transformer designs was not sufficiently stressed in this article. This point to which the writer refers is the turns per volt per square inch of iron cross section.

The writer usually used a basis of sixty thousand lines per square inch, which resulted in 6¼ turns per volt per square inch of iron and he always kept this one fact in mind and with it was able to design a transformer for practically any work. If fifty thousand lines are used, this, of course, becomes 7½ volts per turn per square inch and this one fact should be remembered and the rest can be forgotten. The writer has memorized this and it has been of inestimable value in laying out transformers for himself and friends, and it would seem that this one point is really the gist of the whole thing. Yours very truly,

JOHN H. MILLER,
Electrical Engineer.

Sir:—I read with interest the log of 6ZAC in February RADIO.

Thru the report, 5QA is mentioned several times and some extracts of msgs sent are given. I recognize the transmissions as made at my station, 5ZA, which communicated with 6AIF, 6IV, 9HT, instead of 8HT, etc. Guess my sending is punk or Mr. Dow would have gotten the Z correct. Please correct the mistake. Where Q is given, it should be Z.

You may be interested to know that 5ZA has worked 2ZL, NMW at Yorktown, Va., XF1, 8ZZ, and been reported by 1TS, 1BDU, 1BOX and many other ones and twos. Fone and music has been heard by 9XM, and reported from California, Nevada, Montana, N. Dakota, Minnesota, Wisconsin, Indiana, Illinois, Missouri and Louisiana. 5ZA has now been heard in all states except Maine; also Canada, Mexico, Honduras, Hawaii and both coasts.

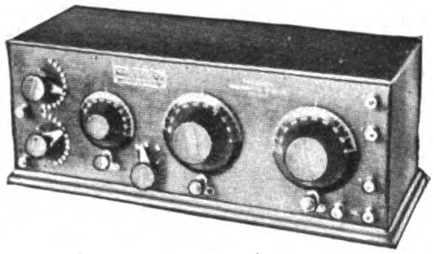
I use two 50 watt tubes for C.W. with 1000 volts on plate. For fone, one 50 watt tube is used as mod. and one as osc. A 5 watt speech amplifier is being installed and two more 50 watt tubes are to be added. The circuit is the Hartley.

While I am at it, wish to say that RADIO is some class now. You surely know what is wanted and the amount of good stuff is greatly appreciated. Please continue to give us dope on C.W. and fone as to my mind that is the future of radio.

LOUIS FALCONI, 5ZA,
Roswell, N. M.

9.A.G. recommends–

Paragon R. A. 10 Regenerative Receiver



$69.50

1. Regenerative circuit licensed under Armstrong Patent.
2. Venier attachments on all controls—particularly desirable for Radiophone reception.
3. Range 175 to 1000 meters.
4. Special moulded variometer forms insuring maximum efficiency at all times.
5. Grained finish formica panel. Condensite control dials. Inductances wound formica tubes. Machine engraved lettering with permanent brilliant white. Case, dark quartered oak. NO BODY CAPACITY.

Two Stage Detector Amplifier

$65.00

1. Special 270° dial indicators on all battery controls.
2. Potentiometer, across filament battery for adjustment of plate potential.
3. Adjustable grid leak on detector tube.
4. Best inter tube transformers used.
5. Common A Battery.
6. Maximum amplification.
7. No tube noise or howling. Cabinet dark quartered oak.
8. Plugs and jacks eliminated. Unique switch control filaments, telephone and battery.

Paragon Radio Telephone

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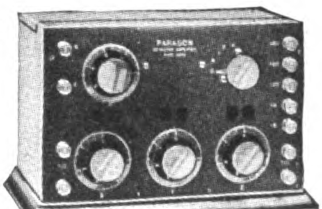
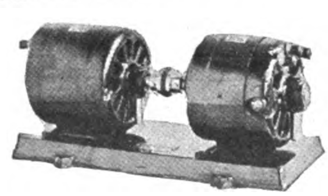


1. Range 160 to 325 meters. Seven wave lengths available.
2. Power—2 five watt tubes.
3. Provision for telephone, tone or continuous wave telegraphy. Controlled by one switch.
4. Functions on any antenna of a capacity between .00025 and .002 M. F. and resistances up to 50 ohms.
5. Greatest possible flexibility.
6. Cabinet dark quartered oak with formica panels.

RAY-DI-CO Motor Generator Type ST4



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1. Capacity 40 watts giving an excess of power of 8 watts.
2. 350 volts generated—the proper voltage for the tubes.
3. Four bearings—mounted on cast iron sub-based—flexible insulated coupling.
4. Built for constant duty.

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Tell them that you saw it in RADIO

QUERIES AND REPLIES ON C. W. PRACTICE

Continued from page 29

mensions shown in Fig. 2 will serve the purpose. For 110 volt a.c. supply, the primary consists of 140 turns of No. 12 B.&S. double cotton covered wire, and the filament secondary is composed of 15 turns of No. 12 B.&S. double cotton covered wire with a tap at the mid point, which is 7.5 turns. This will give a sec-

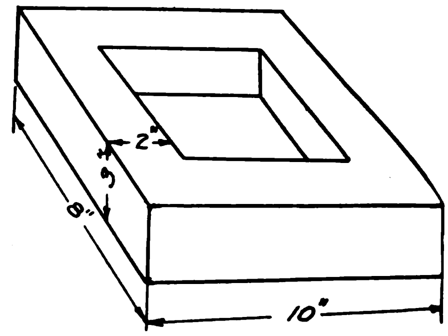


Fig. 2

ondary voltage of 12 volts. The high voltage secondary, which is arranged for 3000 volts with a center tap, is wound with 3750 turns of No. 24 or No. 26 B. & S. D. C. C. or enameled wire, with a tap at the 1875th turn. The filament secondary may be wound directly over the primary, but the high voltage secondary should be wound separately and placed on the other leg of the core. For the 3 millihenry chokes, 250 turns honeycomb coils will do very well, as they are about that value and if thoroughly wrapped with friction tape or okonite, there will be no danger of contact with other apparatus.

HOME-MADE TRANSMITTER

Continued from page 26

This set was used for demonstration purposes at the Shasta County Fair, the receiver being at Anderson and the transmitter at Redding, twelve miles away. The music was much louder than that from a phonograph and Magnavox used for a merry-go-round on the grounds.

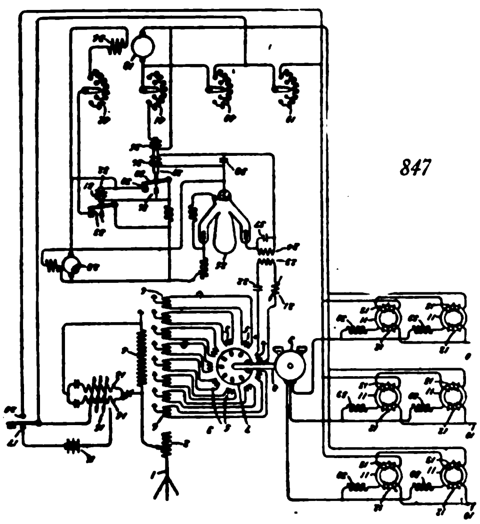
The set was also used by the Pacific Gas and Electric Co. in the course of their experiments with emergency communication between their mountain power plants. Grid leak modulation was used instead of the Heising system in this test, a radiation of 2.5 amperes being obtained from a two-wire T antenna mounted on a tin roof.

The set is now installed at the Volta power plant at Manton where a four-wire cage antenna 60 ft. long, 70 ft. high, with counter-poise ground is employed. Another set is being made for the Hat Creek power plant with which it is hoped to maintain radio communication should the power lines be down on account of heavy snow.

RECENT RADIO PATENTS

Continued from page 32

18. By varying the excitation of these windings 13 rapidly the impedances of coils 12 are also varied rapidly, and the e.m.f. supplied to the motor 9 correspondingly varied. To effect this variation in excitation, one of the coils 5 of the alternator 3 is used to supply alternating current to the rectifier 25, through a circuit 21, 22, 23 resonant at a frequency slightly greater than that which the alternator 3 must maintain. Due to the counter e.m.f. of this rectifier, current variations in the circuit 21, 22, 23 produced by changes in frequency, are magnified in the rectified current that excites coil 26 of the relay 27. This relay in turn controls the excitation of the generator 18. There is produced a rapid change in the value of the impedances of coils 12, and the relay 27 is caused to vibrate rapidly, its period of opening and closing being determined by the amount of current rectified from circuit 21,



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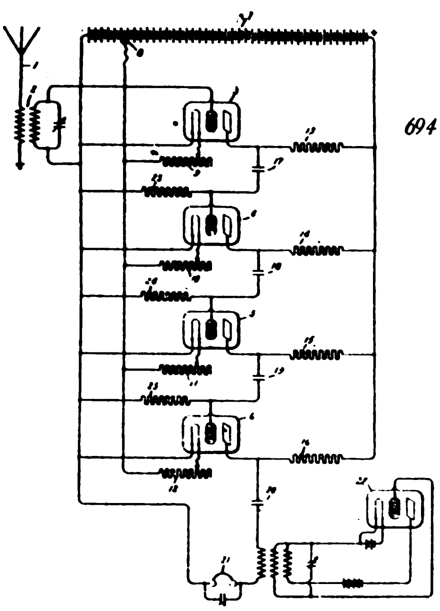

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22 and 23. A contact 20 is also arranged on the sending key 17 so that when energy is radiated, the e.m.f. supplied to motor 9 is increased so as to prevent a sudden drop in speed due to sudden increase of load.

Chester W. Rice, Pat. No. 1,401,644; Dec. 27, 1921. Method of and apparatus for amplification of small currents.

The signals received by an antenna 1 are caused to vary the potential of the grid of the thermionic device 3, the plate circuit of which includes a very high resistance 13 as

Continued on page 64

COMPARISON OF SINGLE CIRCUIT WITH INDUCTIVELY COUPLED RECEIVER TUNERS

It may be desirable to arrange a radio receiving set so there is only one circuit to be tuned instead of the two as ordinarily used. This because of the fact that in time of war a great many of the radio operators will be inexperienced in the tuning of radio sets, and because the situation at the battle front may be such that men will lack the time and mental concentration needed to effect the tuning of two circuits. In the case of airplanes where the radio operator must of necessity perform other duties, a single circuit type of receiver will be of special benefit.

By the term "single circuit tuning" is meant that the only tuning adjustments are made in the antenna circuit. A detector may be tapped across a portion of the loading reactance, and the tap may include such capacity or inductance reactance only. For practical reasons the latter method is preferable. Two arrangements are possible. The first of these may be described as comprising an inductance coil and condenser in series in the antenna circuit or else the coil only. The second arrangement is with the coil and condenser in parallel. It is thought that this last arrangement is the better one.

The following brief comparison of a single circuit with inductively coupled receiving tuner is given:

Signal Strength—The signal strength obtained in a receiver depends chiefly upon the mutual inductance between primary and secondary circuits and upon the circuit design as regarding the proportion of inductance, capacity, and resistance used. The detector or amplifier introduces into the circuits a certain resistance which is important. By properly arranging the design, the signal strength on a single circuit tuner can be made equal to and even greater than that of the two circuit type.

Selectivity—In the single circuit tuner all of the selectivity obtainable results from tuning in the primary or antenna circuit; the secondary is untuned. For this reason the primary of single circuit tuner must be exceptionally well designed to reduce resistance and obtain the best values of inductance and capacity. The use of a small condenser in parallel with the antenna inductance coil materially assists in reducing the over-all resistance and increasing the selectivity.

In the two circuit tuner resonance adjustments are made in both primary and secondary. In this type of tuner the detector, being shunted across the secondary tuning condenser, introduces into the secondary circuit considerably more resistance than is the case in the single circuit tuner. This fact is one which accounts in large measures for reduction of selectivity of the two circuit tuner for interfering signals of not too great strength which are slightly off tune.

When interfering signals are very strong they may set up currents in the antenna circuit which induce in the secondary circuit of a single circuit tuner voltages comparable to those induced by the signal to which the antenna is tuned and there being no tuning in the secondary circuit these interfering voltages are transmitted to the detector with strength comparable to that of the desired signal and thus produce interference. On the other hand when a two circuit tuner is used the comparable induced interfering voltage in the secondary does not produce currents therein of magnitude comparable to that of the desired signal on account of the high reactance offered by the tuned secondary to these off tune voltages. In this case, therefore, the two circuit tuner shows an advantage in selectivity over the single circuit one. These statements assume that the proper refined adjustments are made on the two circuit tuner.

As a matter of experience it is found that the average operator does not adjust the two circuit tuner in such a way as to secure the maximum efficiency and maximum selectivity, and thus even for the case of very strong interfering signals off tune, he obtains with a single circuit tuner about as good results as with the two circuit type.

To summarize the situation then, interfering signals which are slightly off tune and of the same order of intensity as the desired signal can be reduced approximately the same amount with either type of tuner. The two circuit tuner shows greater selectivity when properly used than the single circuit one when very strong interfering signals are encountered which are far off tune. The signal strength of tuned signals on the two types of receivers can be made equal. The far greater ease of operation and rapidity of adjustments in the single circuit type, together with the practical fact that the average operator does not have the skill or else does not have the time to adjust the two circuit receiver for maximum effectiveness, results in his being able to secure practically the same selectivity and equal signal strength on the single circuit tuner as on the two circuit type.—Signal Corps Bulletin.

News of the Radio Clubs

TOTEM RADIO CLUB

The Totem Radio Club of Seattle has elected as officers: President, H. F. Mason, 7BK; vice-president, O. Nicholson, 7KM; secretary, T. J. Bidner, 7HQ; treasurer, V. W. Payne, Air Service, U. S. A.; corresponding secretary, G. E. Kinsey, 7PO; publicity agent, S. G. Hagen, 7ON. G. E. Kinsey, 7PO, was chosen for traffic manager, Walter Hemrich, 7SC, first assistant, and H. L. Jones second assistant. The C.W. men were given a chance in this election, Mr. Hemrich being a persistent C.W. hound, and Mr. Jones both spark and C.W. Under direction of these men, it is hoped to eliminate, with the help of the tuning committee, the strife between the fones and the spark stations which has hitherto hindered the efficient working of either type of transmitter. C.W. stations will not be allowed to call and sign for nine minutes straight without listening in or interruption, as was reported against one station at the last meeting; on the other hand, they will have their chance to do DX work the same as a spark station. The club meets every Friday night in the Chamber of Commerce rooms, Arctic Building, where visiting amateurs are always welcome. All communications should be addressed to the Corresponding Secretary at 907 West 58th St., Seattle, for prompt attention.

TACOMA, WASH.

Our Friend Richards seems to be keeping a continuous watch lately. How do they do it?

Anyone wishing to talk to 7EK will please do so before 6:15 p.m., as his time is *taken* after that hour by one "fairer than radio."

Dame Rumor has it that 7CE, our promising C.W. expert, is going to enter the University of Washington. Now that our two C.W. wizards will be there, Otto and "Howdy," we are of the opinion that the students will witness some heated C.W. arguments.

The newspapers came out the other day with a lengthy article stating that the amateur wireless operators were stealing the city's watt hour meters from residences, and using them to construct apparatus. The local club took proper action and 7CE also called on the commissioner of light, and—well, what he told him we won't print here.

Miss Martha Kleiber, our promising Y L op., is getting discouraged with radio. Cheer up, Mart! Otto will be home from the "U" this summer.

7BA is trying awfully hard to hook-up with some station in Spokane. If I were you, Merle, I'd build her a set and then you wouldn't have any trouble getting those messages thru.

It would certainly do certain Northwestern stations good if they would read Mr. McGown's letter on "Instructions for Calling" in December RADIO and then comply with it. Let's brush up a bit, fellows!

Did you hear the big scrap the other night between 7BC and his three friends, 7WX, 7VX, and 7BA? It was all on HIGH power, too. Say, fellows, next time you want to scrap go on out in the vacant lot and tell the other fellow how you feel about it and let the perfectly good ether alone. Or do it by telephone—it's lots quicker.

All operators wishing to enroll in the City College School here under the direction of Professor (?) K. B. A., kindly see Karl Weingarten and he will give you all the latest "dope" on it.

Don't Forget to Read the Classified Ads on Page 74

POLYTECHNIC RADIO CLUB

The Polytechnic Radio Club of San Francisco has appointed as its traffic manager, Charles Bertrand, 6ABY (C.W. & Spk.), assisted by John Morton, 6AKC (Spk.).

They will be responsible for the control and supervision of all transmission of club members. In case of complaint against members of the P. R. C., all details should be referred to the above-named managers for subsequent action.

The following are the licensed members of the P. R. C.: 6MX, 6QC, 6QP, 6QZ, 6TK, 6AAW, 6ABY, 6AKC, 6AMA, 6AOU, 6ASL, 6ATS, 6ATY, 6AUN, 6AWG, 6BAO, 6BAQ, 6BCZ, 6BDA, 6BEY, 6BGQ. This club has an active membership of twenty-five. Its two-step amplifier and honeycomb receiver and ½ K.W. transmitter have all been constructed by the members. The construction of a C.W. transmitter is being contemplated. The officers of the club are: President, B. Greensfelder; Vice-President, H. Bartmann; Secretary, T. Graham; Treasurer, C. Tinsley; Sgt.-at-Arms, P. Fritsch; Chief Op., C. Bertrand.

RADIO CLUB TO SUPERVISE AIR TRAFFIC

The San Francisco Radio Club, Inc., has installed a complete transmitting and receiving station in the new club rooms, 709 Mission Street, for the purpose of enforcing the regulations of the new "Pacific Plan." The new station will be in operation every night from 7:30 to 10 p.m., and commercial first grade operators will be "at the key." Meetings will hereafter be held on Friday evenings at 8:30 p.m. Lectures will be delivered weekly, except on the first Friday of each month. All correspondence should be addressed to the secretary, room 702, 709 Mission Street, San Francisco.

The Burbank Wireless Club has been formed at the Burbank School, Berkeley, Calif. William Pennington is president, Thomas Clark vice-president, and Lloyd Harrison, secretary-treasurer.

The Ashbury Radio Club has been organized at San Francisco, Calif., through the efforts of John Signer of 1021 Cole St.

6TT, the Associated Radio Amateurs, 2944 Avalon Ave., Berkeley, Calif., are a group of licensed radio operators organized to promote the welfare of amateur communication. They maintain a complete experimental laboratory where research is carried on to develop new and better apparatus. Experimenters are invited to submit their difficulties.

COZY NOOK RADIO CLUB

The Cozy Nook Radio Club of Chewelah, Washington, claims to be the pioneer wireless outfit of the Northwest to be installed in a rural school. The outfit is modern, consisting of a vacuum tube outfit, with honeycomb coils, a one-step amplifier, and phonograph attachment. Musical concerts from California and Denver come in clearly. The news that is sent out is used for current events in the school. The music from other stations comes in loud enough to be heard all over the room.

THE DESIGN AND BUILDING OF A C. W. SERVICE

Continued from page 27

as a feed back tickler. This hook-up, while not as selective as the regular regenerative hook-up, seems to be the best for C. W. work, especially the voice.

In the transmitter circuit we are using two C 302 tubes, one as an oscillator and one as a modulator. The plate voltage is supplied from a motor generator set rated at 100 watts at 400 volts d. c.

No. 8, or the antenna inductance, consists of a paper tube 4 in. in diameter wound with 1/8 in. copper tubing spaced by winding chalk line between each turn. This winding is tapped every other turn. We obtain best radiation in our antenna, which is of the 6 wire T type, 60 ft. long, 50 ft. high, by placing the plate lead at the extreme top, grid and ground at the extreme bottom and the antenna lead at the 18th turn. At these points we are radiating .55 amp. at a true 200 meter wave. If the antenna top is moved up to the 30th turn our radiation would be 1.8 amps. at 275 meters.

No. 10 is made by winding 300 turns No. 32 d. c. c. on a thread spool. No. 11 is made by turning down a wooden spool 5 in. long, 1½ in. in diameter with hole in the center 3/4 in. diameter, so that the walls surrounding the hole is about 1/32 in. thick. This spool is wound full of No. 30 d. c. c. magnet wire and the hole is filled with a bundle of soft iron wires. We put the wire of both of these coils (No. 10-11) through a bath of hot wax while they were wound.

Three coils like No. 11 should be made for the set, one to be used as a tone frequency choke, and the other two are to be used in conjunction with two mfd. fixed condensers as filter coils for the generator.

All other units can be found by reference to the legend and hook-up drawing.

Our change-over switch we consider quite an institution. It is made from a Federal anticapacity switch and is operated by a solenoid plunger. This solenoid is controlled by two small push buttons fastened on the lid just beside the key.

This solenoid switch is placed on top of the desk so as to get the leads of the a. c. circuit as far as possible from the receiving set. The wiring is so arranged when the switch is on the receiving side there is no a. c. in the set except at the two poles of the change of switch. We have shielded this as best we could by removing the switch points not in use and placing a piece of zinc thru the switch at this point. You will be surprised at the ease with which this switch handles the 110 volt a. c. that supplies filament transformer and generator motor. The a. c. hum is hardly distinguishable in the phones.

S. O. S.

or Going Under at Midnight

By C. J. DOW

THE C. W. MANUAL

Continued from page 14

device in conjunction with the Heising system of modulation as previously explained. Full constructional details for this important piece of apparatus will be found in Fig. 29.

A plate current milliammeter with a scale reading to 150 milliamperes and a radiation ammeter reading to 1.5 amperes should be used with this circuit.

The battery of Fig. 11 represents the source of high voltage for the plates, and it is shown as such for conventional reasons only. The "C" battery of the same figure must be inserted in the grid circuit of the modulator tube for the purpose of maintaining a negative grid potential. The value of potential necessary for this purpose will vary with the type of tube in use, and will in ordinary cases lie between the limits of 22 and 40 volts. If the grid potential is not sufficiently negative, the plate current to the modulator tube will rise to an excessive value and the tube will overheat as evidenced by a bright red plate. If too much "C" battery is used, poor modulation is liable to result. Usually, just sufficient "C" battery to prevent overheating of the tube by excessive plate currents will be found most satisfactory. Ordinary flashlight cells as used in the plate circuit of receiving apparatus will suffice for this purpose.

Adjustment, Tuning and Operation of the Experimental Five Watt Set

By referring to Fig. 28, the reader will observe that there are one fixed, and three variable connections to the inductance. The fixed connection divides the inductance into two unequal parts: the lower seventeen turns constituting the input inductance and the twenty-three above, the output inductance. Inasmuch as this fixed connection is tied to earth (see Fig. 11), it represents a point of zero potential, and the potential impulses on either side are out of phase by 180°. This is a necessary condition in the operation of vacuum tube oscillators. The necessary input coupling and resultant impressed grid potential are obtained by altering the position of the lower variable connection on the portion the inductance below the fixed connection. The position of the antenna lead determines the period of oscillation of the circuit, which may, however, be influenced by any alteration in the position of the plate coupling tap represented by the upper flexible lead in Fig. 28.

In the initial tuning and study of this circuit, the reader is urged to make use of an artificial antenna wherein the phenomena attending the introduction of resistance into the oscillating circuit may be studied in detail.

Tuning this circuit with a wavemeter is recommended, though the ease with which the various adjustments may be made and the ease with which the circuit oscillates admits of other methods.

The following procedure is outlined for the experimenter in using the circuit for the first time (see Fig. 28):

1. Disconnect antenna lead to radiation ammeter and substitute an artificial antenna consisting of a small variable capacity, 0.001 micro-farad, and a small variable resistance device, 10 ohms, and cut out all resistance.
2. Place the various leads to the inductance approximately as shown in Fig. 28.
3. Remove the modulator tube from the circuit temporarily, and by means of the filament rheostat adjust the oscillator tube filament to the correct operating temperature.
4. Cut in the plate current supply.

Before the circuit is properly adjusted the plate current milliammeter may indicate that upwards of 100 milliamperes is flowing, and there may be no deflection of the radiation ammeter pointer. If the grid input tap (lower one in Fig. 28) is shifted, the plate current should fall off rapidly until only 30 or 40 milliamperes flow, when oscillations should be in evidence by a deflection of the radiation ammeter pointer. To obtain a maximum output current, it will now be necessary to shift the plate coupling tap until the correct position is found. Note here, that the output current (radiation) increases as the e.m.f. to the plate is increased and that the radiation increases also as the filament temperature is increased to a certain point, beyond which no further increase in the filament temperature without a corresponding increase in the plate potential, will increase the output current.

Thus far, the oscillating circuit has been one containing little resistance and abnormal output currents may have been observed.

Gradually, cut in resistance in the artificial antenna circuit and follow up each change with corresponding circuit adjustments. The radiation will fall to a fraction of its former value. After the circuit has been studied in this manner, substitute the real antenna for the artificial one, and when the circuit is readjusted for this change, cut out the supply of high voltage to the plate, and place the modulator tube in its receptacle. Adjust both filaments to the correct temperature and again close the plate supply circuit.

The circuit is now ready for use, except for the adjustment of the "C" battery and the regulation of the microphone battery circuit.

NOVEL METHOD OF SHOWING STATIONS REACHED

Continued from page 11

1ARY—Burlington, Vermont.
1BCG—Greenwich, Conn.
2ZV—Jamaica, Long Island, N. Y.
2FP—Brooklyn, N. Y.
3EM—Baltimore, Md.
3AQR—?
4BT—?
5ZV—Houston, Texas.
5X5—?
6JX—San Francisco(x).
7MP—?
7ZT—?
Many other 7's.
8AGO—Pittsburgh, Pa.
8AGZ—East Cleveland, Ohio.
8VY—Kalamazoo, Mich.
8AG—Toledo, Ohio.
8AM—Detroit, Michigan.
8EA—Pittsburgh, Pa.
8BO—Detroit, Mich.
8BR—Lansing, Mich.
8KF—Bellevue. Ohio.
8KP—Lima, Ohio.
8AIP—Charleston. W. Virginia.
8IQ—Akron, Ohio.
8VY—?
9XAQ—?
9BL—Chicago, Ill.
9XI—U. of Minnesota, Minn.(x).
9ANG—Racine, Wisconsin.
9EK—St. Louis, Mo.
9ZL—Manitowoc, Wisconsin.
9AJ—Peoria, Ill.
9AX—Chicago, Ill.
9EE—Valley City, N. Dakota.
9WV—Topeka, Kansas.
9PS—Wichita, Kansas.
9ZV—St. Louis, Mo.
9APW—St. Paul, Minn.
9APJ—Chicago, Ill.
9AVY—Denver, Colo.

Here, again, there are scores that I have heard, but I pick these "without fear or favor," as they show a wide stretch of the nation—covering it rather thoroughly and illustrating that 6XAD is in a GOOD geographic position for hearing! These stations I hear consistently.

The results that the map show—for the work at 6XAD—are very satisfying. It gives me much pleasure to call attention to the performance of 3FS—the station of Charles G. Benzing, at 2425 South 12th Street, Philadelphia. His signals come in here *very* QRK—not on one night by a "freak" happening—but I hear him several times each week! I quote, verbatim, from a recent letter to me:

" . . . Your telegrams and letters, correctly reporting my signals, certainly convey good news to me, as I am only using ten watts here. The furthest distance reported before was by 5ZL, at Little Rock, Ark.

"You are correct about the time that I was working—from 1 to 5:30 a.m., our time—on the night mentioned in your first letter. I heard you on the night of the first test. It was 12 m.—our time—and I would like to have you verify this. The signals were very QSA, but QRM broke them badly. . .

"I am using 2 five watters, 550 V rectified with a jar rectifier. Radiation 2. amps. Have just changed to 3 five watters, with a radiation of 2.6 amps., with plate V of 700. Expect to increase radiation when I increase number of jars. . .

"CHARLES G. BENZING,
"Radio 3FS.

"Antenna: 60' and 50' high, 45' long—6 wire inverted L, 3' between wires."

I think that I am entirely safe in saying that THIS is a world's record for low-powered C.W. effort, and I most cordially compliment 3FS on his wonderful achievement. My log shows that I have heard him six times in two weeks.

BOOK REVIEWS

Continued from page 34

raphy are given full consideration, as is also telephony and especially the question of modulation. In the chapter on antennæ and radiation is a logical development of radiation formulæ and of the theory of direction finders and coil antennæ. Wavemeters and their use, amplifiers of various types, and an outline of a laboratory course of radio experiments are taken up in the last chapter. While the general treatment is mathematical and requires a knowledge of trigonometry and the calculus in order to gain the fullest possible benefit, the general reader will find the book to be filled with valuable information which clears up many obscure points. Especially noteworthy is the explanation of the use of vacuum tube as a detector, amplifier and generator of high frequency current. With so much to praise, it is unfortunate that the book is marred by many typographical errors not noted even in the errata sheet. As a whole, the book is one that should be in every radio man's library.

6AFN

C. E. Warriner is the owner and operator of 6AFN, 2462 Kuhio Ave., Honolulu, which has been heard so much lately on the mainland coast. This is the first time that a Hawaiian amateur has been heard in the United States. It now remains for an officially conducted test to be carried out. Mr. Warriner will have the U. S. Navy to assist him on the Honolulu end of the test if arrangements can be made with some Pacific Coast operators to complete the test. He usually chooses wet, rainy days for distant transmitting in the dark of the moon. This is the best time in the tropics. He was a Western Union operator in Chicago, then took up railroad work and became a train dispatcher on an Eastern railroad and finally a radio operator. He was the organizer of the "Radio Club of Hawaii," and is its present secretary-treasurer. The transmitter is of his own design and ideas, although the actual construction, according to drawings, was done by a mechanic.

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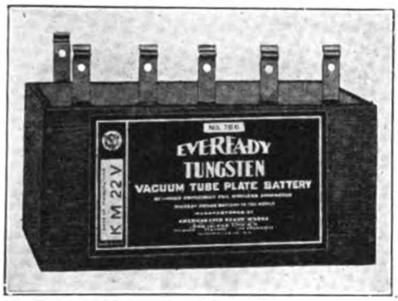

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HOW TO MAKE A GOOD RADIO RECEIVER

Continued from page 25

sary to re-wind the rotor, with smaller wire, so that 35 or 40 turns will be available for tickler. A common variometer may be made up into a regenerative receiver, of the same type, by using the ball as the tickler, and the stationary windings as the first sections of the inductance. This will give a wavelength range up to about 450 meters, which may be increased by placing a tapped coil, of a diameter equal to that of the "hole" at the end of the variometer, either bank wound or wound in single layer, with 200 or 250 turns on it.

In any case, it will be found to be a very sensitive and reliable tuner, which will work extremely well over the wavelengths within its range for both C. W. and spark signals.

RECENT RADIO PATENTS

Continued from page 51

well as the battery 7. Variations in potential of the grid will produce variations in the opposite direction of the potential of the plate and these variations are in turn impressed, by means of condenser 17, upon the grid of tube 4. The signal is finally recognized in the telephone 12, in the circuit of which may be induced a current from an oscillation generator 22, whereby the heterodyne method of reception may be used. The effect of static or strays is prevented from exceeding that of the signals, due to the well defined limits of grid potential between which variations in the plate potential can be obtained.

RADIOPHONE PLACED IN PRESIDENT'S STUDY

A wireless telephone receiving outfit has been installed in President Harding's study on the second floor of the White House. Installation was made at Secretary Denby's request, it is understood. The instrument was connected with an aerial, and hereafter, when he likes, the President will be able to put the phones to his ears and listen in to the latest news of the day.

CALLS HEARD BY 7VO, M. K. BAUGHMAN, MEDFORD, ORE.

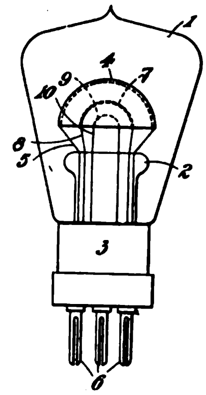
6ab, 6acr, 6ak, 6aid, 6ar, 6aje, 6az, 6ajr, 6gp, 6ale, 6gx, 6amk, 6jd, 6ape, 6kk, 6ard, 6km, 6ark, 6ku, 6atq, 6mw, 6atv, 6qr, 6avv, 6ru, 6xab, 6su, 6xak, 6sj, 6tu, 6wv, 6xd, 6xz, 6zb, 6zm, 6zx, 7ac, 7nw, 7aj, 7qr, 7ar, 7tq, 7ba, 7tu, 7bj, 7tw, 7bw, 7vk, 7cn, 7vx, 7da, 7wa, 7fi, 7xf, 7gx, 7xj, 7jd, 7ya, 7ks, 7zp, 7lc, 7zr, 7ly, 7zu, 7mf, 7zx, 7mp, 7afn, 7mu, 7nl, 7nn.

BY RADIO STATION 5ACR, BETWEEN JAN. 1 1922 AND JAN. 19, 1922

5za, 6ah, 6cu, 6cv, (6eb), (6ex), 6fh, (6gt), 6gx), 6iv, 6kc, 6ki, (6km), 6lc, 6mh, 6ng, 6od, 6ot, (6po), (6qr), 6sj, 6tj, (6tu), 6tv, 6to, (6uo), 6uv, 6vs, (6vz), (6aah), 6abx, 6acw, 6aeh, 6afn, 6ahp, 6ahv, 6aif, 6ald, 6alp, 6alu, 6alv (6ale), 6amk, 6aor, 6aoz, 6apg, 6aru, 6atq, 6atv, 6awq, 6baj, 6bcj, (6zal),7bh, 7bj, 7cd, (7ck), 7iv, 7ly, (7mf), 7mp, 7tj, 7vo, (7zm), (7zt) 9nx, 9bbf, 9xaq.

Some Recent Radio Patents

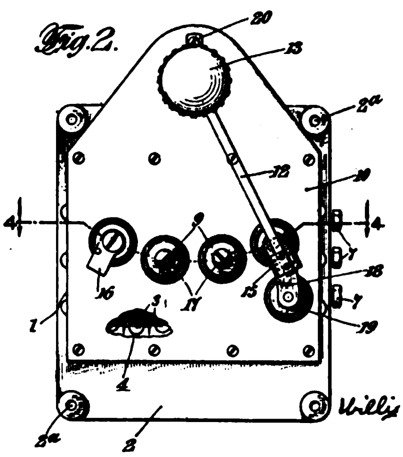
Fig.1.



Horace St. J. De Aulâ Donisthorpe, 1,391,671, Sept. 27, 1921. Thermionic valve for use in wireless telegraphy and telephony.

This invention deals with a three electrode valve of the audion type, in which the plate 4 and grid 7 form concentric hollow spherical surfaces. The filament 9 is disposed near the center of these surfaces. The cathode stream, due to this arrangement, is more uniformly distributed, with the result that disintegration is more uniform and the life of the tube is increased. It is also stated that microphonic disturbances and noises are eliminated.

Fig.2.



W. Dubilier, 1,391,673, Sept. 27, 1921. Antenna shortening device.

A condenser of special construction is described, which has a switching means co-operating with a plurality of taps from the condenser. This means is so arranged that a detachable contact piece may be placed on any one of the taps, so that the switch arm will contact with none but that tap upon movement of this switch arm. The device is described in connection with an antenna circuit for shortening the wave length of the antenna by a definite, predetermined amount.

THE WESTERN ELECTRIC TEST

The remarkable result attained in the tests conducted by L. M. Clement of the Western Electric Co. in December, 1921, constitutes additional evidence of the commanding importance of continuous wave transmission.

The Western Electric Company does not maintain a regular broadcasting station, the transmission being merely for test purposes on new apparatus of Western Electric design. The station is located in the engineering laboratories at 463 West Street, New York. The antenna system, which consists of six wires about 250 feet long, is supported by two masts on the roof of a thirteen story building.

The radio telephone set was a Western Electric vacuum tube transmitter of 500 watts output. Four Western Electric 250 watt (Code No. 212-A) tubes were used; two as modulators and two as oscillators. A 50 watt (Code No. 211-A) tube was used as a speech amplifier.

Direct current from a motor generator supplied both the filaments and the plate circuits, the filaments being operated from a 14 volt and the plate circuit from a 1600 volt source. During the tests the antenna current was about 8 amperes and rose to an average of about 9 amperes while talking.

The tests which have been conducted have been of a purely experimental nature and were completed on December 27, 1921.

The following places from which we have received letters, are mentioned to give some idea of the area over which our transmission has been received: Halifax, Nova Scotia; Miami, Florida; Vera Cruz, Mexico; Baudette, Minnesota; Denver, Colorado; Pima, Arizona, several places in California and the steamship Col. E. L. Drake, 1000 miles west of San Francisco en route to Honolulu. Voice and music were heard in these cases.

Calls Heard

HEARD DURING JANUARY AT CANADIAN 3GG, OWNED BY M. J. CAVENEY, TIMMINS, NORTHERN ONTARIO, CANADA.

1al, 1ary, 1tv, 1aj, 1bua, 2cf, 2om, 3xm, 3gn, 3hj, 3fo, 3rf, 3zy, 3bfu, 3asv, 3bo fone, 3aqr, 3blf, 4el, 6fv, 8iv, 8bl, 8br, 8aj, 8ea, 8ym, 8vy, 8bo, 8uk, 8sp, 8hj, 8aqo, 8anw, 8ago, 9ql, 9aw, 9ca, 9aj, 9fm, 9als, 9dkv, 9diw, 9dso, 9aoe, 9bbf, phones kyw, kdka, wjz, wdy, nsf.

HEARD AT 3ART, PHILADELPHIA DURING JANUARY

spark—1aw, 1hk, 1chj, 2fp, 2om, 2pl, 3aia, 4ea, 8gk, 8uh, 8vw, 8bmc, cw—1ha, 1qn, 1ts, 1afv, 1alg, 1ary, 1avi, 1awb, 1bkq, 1bqe, 2nq, 2awf, 2aws, 2bgm, 2brb, 3zm, 3zo, 4bq, 4by, 8dr, 8hj, 8ih, 8iq, 8ni, 8sp, 8uk, 8abp, 8afa, 8aio, 8aqz, 8awp, 8bfo, 8bfx, 9dwj, an5, Can. 9al, nof.

HEARD AT 6GY DURING JANUARY 1922 ALL CW

4cb (Can.), 5fv, 5za, 6aat, 6acb, (6aif), 6ak, 6akw, 6ale, 6alu, (6aoz), 6asj, 6asv, 6asx, 6atg, 6aul, 6avy, 6awp, (6awt), 6awv, (6cu), 6df, 6en, (6jd), 6jj, (6jq), 6jx, (6ka), (6ky), (6mn), 6my, 6ni, (6oo), 6pt, 6ws, 6xad, 6xw, 6za, (6zn), 6zt, 6sz, (7go), 7mw, 7nf, 7rn, 7tq, 8ea, 9als, 9amb, 9bji, 9bx, 9dtm, 9hk, 9nx, (9wd), 9xaq, an5, cl8, cl5. Would appreciate any reports on my CW signals.

A Power Amplifier for a Loud Talker

By A. K. Aster

DUE to the large number of radio telephones which are broadcasting music and news, every up-to-date radio amateur wants to install a loud talker in order to entertain his friends. Most amateurs become disgusted with the distortion produced by the ordinary amateur amplifier. So I shall describe an amplifier which will not distort. But if the input is distorted due to faulty detector operation or if the output is distorted by a faulty loud talker, don't blame the amplifier. See Fig. 1 for connections.

Probably the most important unit of the amplifier is the intertube transformer. In order that a transformer shall work most efficiently the following points must be considered:

(1) The input impedance of the transformer should be approximately the same as the output impedance of the tube from which it is fed.

(2) It must not have a leaky magnetic path; in other words, there should be no butt joints in the core.

(3) Its transformation ratio must be as high as possible without producing unstable operation.

(4) The d.c. plate current must be kept out of the primary winding in order to prevent saturation of the core, which would produce bad distortion. This is accomplished by inserting a 2 m.f.d. condenser in the primary circuit and feeding the d.c. plate current to the tube thru a 30 henry choke coil. (This choke coil will be described later.)

(5) The secondary of the transformer must not work into an open circuit but into a resistance equal to the output impedance of the transformer. The input impedance of a tube is practically infinite when the tube is working as an amplifier, that is, with a C battery.

(6) The transformer should be properly shielded so that it will not have any external field and will not be influenced by neighboring coils and circuits.

The successful operation of an amplifier depends also on the proper choice of the tubes to be used in the amplifier. Choose a tube which is suitable for an amplifier, this means a "hard" tube. A gas type tube will not do for the following reasons:

(a) Unstable operation and a distorted output due to the action of the gas in the tube.

(b) Low output due to the fact that the tube will not work on a high enough plate voltage.

(c) Remember that a gas type tube is only intended as a supersensitive detector for radio telegraph and not for telephone signals and should not be used for anything else.

(d) Choose a tube that will be large enough to take the output of the previous tube, as an overloaded tube is an excellent distorter.

(e) Always use sufficient C battery so that the grid of the tube will never become positive, for as soon as the grid becomes positive it will modulate as well as amplify and distort. At this point the reader is referred to an article in the January issue of RADIO by Mr. G. M. Best on tube operation.

GENERAL

How many steps shall I use, is always the big question. If a radio head receiver is to be used as the reproducer, two steps is all that one can use, otherwise the receiver will be overloaded and distort. But if a large loud talker is to be used, three steps will be necessary.

The next question is what size of tube shall I use? If two steps are to be employed the ordinary amplifier type tubes should be used, but if three steps are to be employed, the last step should be a 5 watt type tube, while the others should be of the amplifier type. If an output of more than 5 watts is desired a fourth step consisting of a 50 watt tube should be used, but remember that there is no loud talker on the market that will take 50 watts input.

Fig. 1 shows a three step amplifier that will be sufficient for ordinary use. I have seen amateurs use 5 watt tubes in all the steps of their amplifiers, thinking that they would get increased amplification thereby, but this idea is incorrect. The usual result is a decrease in amplification due to the fact that the amateur is unable to obtain a suitable intertube transformer for 50 watt tubes on the market. Furthermore there is no object in using a tube any larger than necessary to take the output of the previous tube and certainly there is no detector that needs a 5 watt tube as the next step.

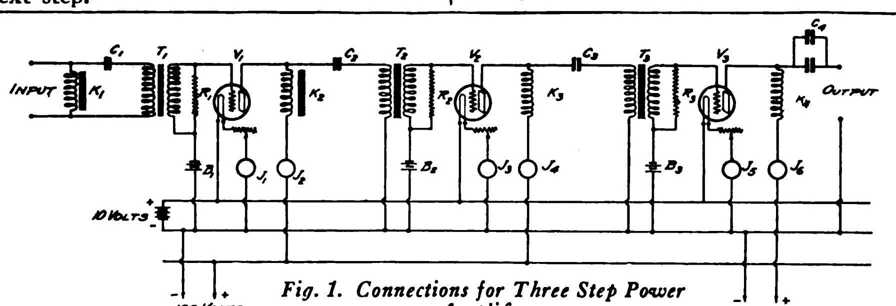


Fig. 1. Connections for Three Step Power Amplifier

C_1 C_2 C_3 C_4—2m.f.d. telephone condensers. Kellog Type 53 is suggested.

K_1 K_2 K_3 K_4—30 henry choke coil. As there is no coil on the market for this purpose I recommend the smallest size of Wayne Bell-ringing transformer, using the primary as the choke coil and leaving the secondary open. The inductance of this coil is about 30 henry, which is very satisfactory for this purpose.

B_1 B_2—For Radio Corporation or Moorhead amplifier tubes use a 4½ volt flashlight battery.

B_3—For Radio Corporation 5 watt tubes use a 45 volt B battery.

T_1 T_2 T_3—For Radio Corporation tubes use the Radio Corporation UV 712 transformer and for Moorhead tubes use the Federal 226W transformer.

J 1 to 6—Any closed circuit jack.

R_1 R_2 R_3—For R. C. UV 712 transformer use 1.5 megohm resistance (grid leak). For Federal transformer use a 0.25 megohm resistance.

V_1 V_2—Radio Corporation or Moorhead amplifier tubes.

V_3—5 watt power tube.

(Note: Radio Corporation tubes and Cunningham Audiotron tubes [I don't mean the old type 2 filament tubes] are the same, both being made by the General Electric Co.)

C_1 and C_2—8 m.f.d.s. Telephone condenser.

L_1 and L_2—These two coils may be placed on a single rectangular core of ½"x½" crossectional area. Each coil consists of 5000 turns No. 28 s. c. c. wire.

Connect terminals marked input to the telephone terminals of the receiving set.

Connect terminals marked output to the loud talker.

OPERATION

It will be noted that there are ammeter jacks in the filament and plate circuits of every tube. I don't believe that the average amateur realizes how important it is to maintain these currents at their proper values. It should be remembered that working a tube filament at ten per cent overvoltage reduces its life to half. The reason for watching the plate voltage is that the variation of the plate current while the tube is working tells whether the tubes are being overloaded and hence whether it is distorting. While working under normal conditions the variation in plate current should not exceed the following values:

One watt tubes—Radio Corporation or Moorhead amplifier tubes working at 120 volts plate voltage, variation not to exceed ¼ milliampere once in five seconds.

Five watt tubes—Variation not to exceed 1 milliampere once in five seconds when plate voltage is 350-500 volts.

A good low range milliampere meter should be used for checking the plate current such as the Weston Model 301. For amplifier tubes a range of 0 to 15 milliamperes is good, but if 5 watt tubes are to be used the range should be 0 to 50 milliamperes.

For a filament ammeter one having a range of 0 to 2.5 amperes is suitable. Don't buy a cheap meter, as they don't hold their calibration and are worse than none at all.

In case the plate current shows more variation than the allowable amount it is necessary to cut down the input into the tube from the previous tube. This may be accomplished in several ways. In case the input is derived from a detector tube the best way is to open the coupling in the tuner, while if the input is derived from another amplifier tube the best way is to cut down the plate voltage on the previous tube. The output of a tube is approximately proportional to the square of the applied plate voltage. Always remember that while an overloaded tube may give increased signal strength it distorts the output.

PLATE SUPPLY

The source and voltage of the plate supply is a thing that must not be overlooked. To get maximum amplification out of the ordinary amplifier tube you must use about 120 volts on the plate of the tubes. For 5 watt tubes you must use from 350 to 500 volts for satisfactory results. As a source of plate supply for amplifiers I consider flashlight batteries unsatisfactory, as the drain is too heavy on them for economical use. The only solution is a set of small storage batteries or a motor-generator set. See Fig. 2 for dimensions and connections for a filter for a motor-generator set.

At this point the reader is referred to an article by the author in December, 1921, RADIO on the Armstrong Super-Heterodyne for further data on the use of a motor-generator set as a source of plate supply. Remember that bad batteries or an unsteady plate source is the commonest cause for noisy operation of an amplifier.

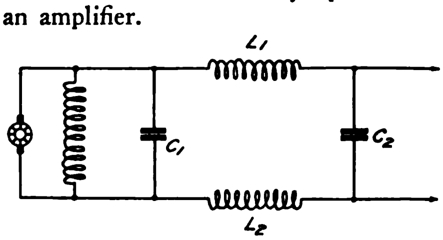


Fig. 2. Dimensions and Connections for Motor Generator Set Filter

SHIELDING

In order that an amplifier may operate quietly it must be properly shielded. The reader is again referred to the author's article in December RADIO on the Armstrong amplifier for a discussion of shielding. An important thing to remember is that in order to stop howling the input and output leads of an amplifier should be separated as far as possible.

Calls Heard

CALLS HEARD BY 6ANK, SPARKS, NEVADA

4cb(cw) calling 9aao at 9:38 p.m. Pac. time, 12-6-22, 5qa(cw), 8jl(cw) 10:20 p.m. Pac. time 11-24-21, 8uj(cw) 11-5-21 between 11:35 and 11:45 p.m. Pac. time and 11-6-21 between 8:40 and 8:50 p.m. Pac. time, 9zaf(cw and fone), 9dva(cw), 9amb(cw), 9yal(spk), 9zac(cw), 9yae(spk), 9wd(cw), Canadian 9bd(cw), 9bex (cw), 9akr(cw), 9nx(cw), 9dtm(cw), 9xaq-wc-(cw), 9aya(cw), 6wv U. S. Gen. Hospital No. 21, Denver, Colo. (cw and fone), cl3(cw), cl8 (spk and cw), "rb"(cw), kwg(fone), 4cb(cw), 5qa(cw); "sixes"—ak(cw), aif, aoz(cw), alw, atz, agf, aba(cw), ale(cw), afn, avy(cw), ahp, er, ka(cw), ky(fone), ot, pr, ru, tv, fh, oh, sj, gt, jd(cw), xw(fone), xg(fone), xh(cw), xad (cw), zam, zr, zx, xac(fone), zaa; "sevens"—ad(fone), qt(cw), nn, fn, un, jd, mf, ry, cd, ny (cw), zj, zu, zt; "eights"—uj(cw), jl(cw); "nines"—amb(cw), wd(cw), nx(cw), dva(cw), dtm(cw), aya(cw), xaq-wc(cw). yae(spk); kwg (fone), cl3(cw), cl8(cw and spk).

HEARD AND WORKED AT 6KY, S. DALTON, 121 EAST 23rd ST., LOS ANGELES, CAL.

Stations heard—1bcg(cw), 2fp(cw), 5za(cw), 5if, 5xu, 6cz, 6dp, 6fh, 6fn, 6ib, 6ii, 6ik, 6iv, 6jx(cw), 6kl, 6lu, 6pj, 6qx, 6st, 6to, 6tu, 6vk, 6wo, 6za(cw), 6ze, 6zt(cw), 6zaf, 6aak, 6aat, 6aau, 6abm, 6abr, 6abw, 6abx, 6ach, 6aeh, 6aei, 6aey, 6ahu, 6ahy, 6aif, 6ala, 6amk, 6ang, 6ani, 6atv, 6aul(cw), 6avr(cw), 6bds, 6**, 7bb, 7bk, 7hf, 7iw, 7jd, 7xf(cw), 7ya, 7yg, 8os, 8xv(cw), 9anf, 9arj(cw), 9ayv, 9ayw(cw), 9zn, 9dtm(cw), 9zac, 9xaq(cw), 9nx(cw), 9bex(cw).

Stations worked on spark—6ah, 6ak, 6as, 6ex, 6fk, 6gf, 6gr, 6gt, 6hc, 6kc, 6km(cw), 6oc, 6oh, 6po, 6pr, 6qs, 6qr, 6uo, 6vx, 6wz(both), 6xad (cw), 6zb, 6zu, 6zx, 6zz(both), 6zad(cw), 6acm, 6afn, 6agf, 6akl, 6ale(cw), 6asj(cw), 6asx(cw), 7bp, 7in, 7jw, 7mf, 7oz, 7tj, 7zm, 7zt, 7zu, wv6 voice, 9amb.

Stations worked with C. W. and voice on 5 watts—6as (voice-cw), 6ex (voice-cw), 6gt (voice-cw), 6xh (voice-cw), 6agf (voice-cw), 6aif (voice-cw), 6awt (voice-cw), 6xad (voice), 7zj (voice-cw), 7zt (voice-cw), 9wd(cw) 9dva (voice-cw), 9amb (voice-cw).

STATIONS HEARD AT RADIO 7GE, PASCO, WASH.

Spark—6ak, 6aw, 6ax, 6cv, 6dd, 6dp, 6ea, 6en, 6ex, 6ey, 6gb, 6gf, 6gq, 6gr, 6gt, 6gy, 6jx, 6ka, 6km, 6lc, 6lx, 6mh, (6qr), 6to, 6tu, 6vx, 6vy, 6wz, 6zx, 6aat, 6aau, 6abj, 6abm, 6 abx, 6aex, (6afn), 6afy, (6agf), 6aif, 6ala, 6alp, 6amk, (6ape), 6arc, 6ard, 6asj, 7au, (7ba), 7bf, 7bg, 7bh, (7bj), (7bk), 7br, 7bz, 7cw, 7ee, (7fi), 7fl, (7hf), 7hi, 7im, 7in, 7iw, 7jf, 7jj, (7jw), 7kb, 7ke, 7ks, 7la, (7ly), (7mf), 7mo, 7my, 7mz, 7nj, (7nl), 7nw, 7nz, 7on, 7oo, (7tj), 7tl, 7vo, (7vz), 7wa, 7wm, 7zj, 7zn, (7zt), 7zu, (9ax Canadian), 9bd Canadian.

C. W.—4cb (Canadian), 6aa, 7ce, 7xf.

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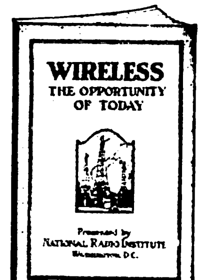

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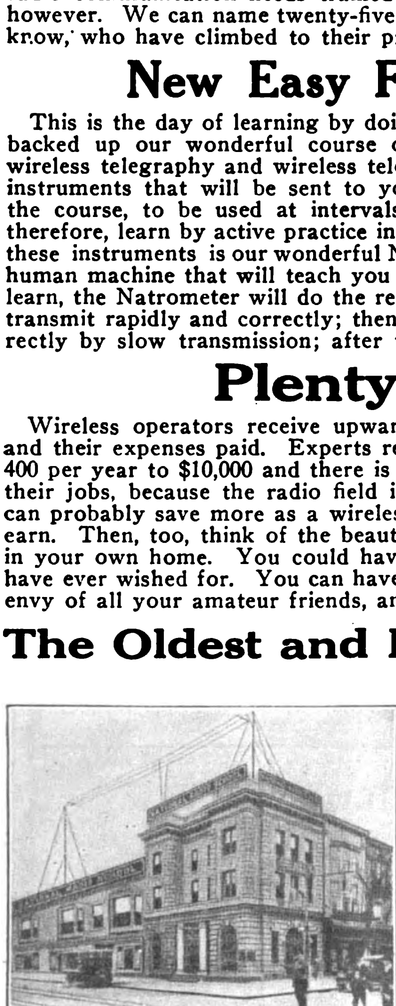

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The Price is RIGHT and is based on quantity production; it's up to you "SPARKS." Send in that "TWELVE" Quick delivery. KING "AMP-LI-TONE." See page 45.

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FEDERAL 1423 Double Circuit Jack	1.00
FEDERAL 1435 Automatic Filament Control Jack	1.20
FEDERAL 1438 Automatic Filament Control Jack	1.55
WESTERN ELECTRIC Plugs	2.00
FEDERAL Plugs	2.00
PACENT UNIVERSAL	2.00
NEW FEDERAL Universal Plug	1.75
RHAMSTINE Plug and Jack, complete	1.50

Remler Apparatus

810 Jr. Rheostats	$1.00
811 Rheostats	1.75
813 3 Amp. Rheostats	1.75
92 VT Socket	1.50
330 Audion Detector Panel	8.00
331 Amp. Panel	6.00
333 Amp. Panel	9.00
400 3 Coil Mounting	6.50
96 Variable Grid Leak	.60
97 Grid Condenser	.35
503 Variocoupler	5.40
500 Variometer	6.00

Wireless Shop Variable Condensers

	Approximate Maximum Capacity	
No. 20	2 Plate, Vernier Condenser	$2.00
No. 70	7 Plate, .0001 m. f.	2.35
No. 130	13 Plate, .0002 m. f.	2.75
No. 170	17 Plate, .0003 m. f.	3.15
No. 230	23 Plate, .0005 m. f.	3.60
No. 310	31 Plate, .0007 m. f.	4.30
No. 430	43 Plate, .001 m. f.	5.25
No. 630	63 Plate, .0015 m. f.	7.50

Remler QSA Honeycomb Coils

Type Number (No. of Turns)	Wave Length Range with .001 Mf Cond.	M't'd	UnM't'd
L25	170—375	$1.40	$0.50
L35	200—515	1.40	.50
L50	240—730	1.50	.60
L75	330—1030	1.50	.60
L100	450—1460	1.55	.65
L150	660—2200	1.60	.70
L200	860—2850	1.65	.75
L200	1120—4000	1.75	.80
L300	1340—4800	1.75	.85
L400	1860—6300	1.80	.90
L500	2340—8500	2.00	1.00
L600	2940—12000	2.15	1.15
L750	3100—15000	2.35	1.35
L1000	5700—19000	2.60	1.60
L1250	5900—21000	3.00	2.00
L1500	7200—25000	3.50	2.50

Rheostats

REMLER Jr.	$1.00
FADA—with new Knob	1.00
GENERAL RADIO No. 214 7 ohm or 2½ Amp. 2 ohm	2.50
DEFOREST, new type	1.75
PARAGON	1.75
MURDOCK 560	1.00

OUR PRICE LIST BRINGS RADIO SMILES O'ER MANY RADIO MILES
HAVE WE SENT YOU YOURS?

Northern Radio & Electric Co.

606 PINE STREET, SEATTLE, WASH.

OPERATING THE SEATTLE POST INTELLIGENCER'S RADIO TELEPHONE NEWS AND CONCERT BROADCAST

Send for Concert Schedule

Tell them that you saw it in RADIO

PERFUME BY RADIO

By JOHN P. MEDBURY

A RUSSIAN scientist claims to have invented a machine which will send perfume by wireless. A man in Boston can buy a dime's worth of perfume at the 10-cent store and sprinkle his girl in St. Louis with it.

Any kind of an odor can be transmitted. For $1.30, a husband living in New York can chloroform his wife in Los Angeles.

If he wants to wait until evening he can do it for 70 cents.

A woman in San Francisco can peel onions and make her husband cry in Chicago.

It will be a great boon for the drinking man. A friend of his in Cuba can send him alcohol messages.

Instead of his going into a bootleg joint and paying 50 cents a swig, he'll call up his friend and get it for 10 cents a sniff.

If he's got a cold that's his own lookout.

Prohibition agents will be using this instrument for looking into our cellars.

A man can point the machine toward his kitchen and find out what the wife is having for dinner.

You may think she's going to have a steak, but the machine will register corned beaf and cabbage.

Another thing about it is that we can now enjoy cheese from a distance.

A lot more people will like it when they don't have to get so near it.

This will be a great thing for doctors; they can now treat asthma by wireless.

Asthma sufferers who can't afford a doctor will be outside all day sniffing treatments which belong to people in the next state.

Doctors who send whisky by wireless will have to be careful. They may be sending it to some man in Atlanta and a prohibition agent in Augusta may get the benefit of it.

This new invention will send all alcholic rays through the air and it ought to be healthy, it will keep everybody out of doors.

PA (interested in radio) to irate wife: "Well, I'd have come down sooner, but I was listening to Marion and L. C. M. chewing the rag together on a long wave."

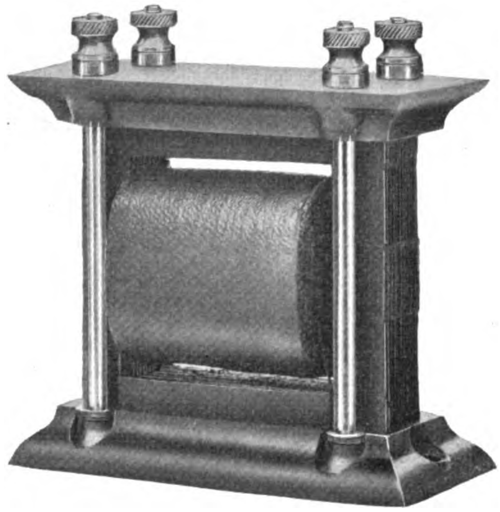
WIFE: "'Elsie M.' and 'Marion,' is it? So now it comes out whose gloves those were in your overcoat the other night." (Curtain on remainder of the proceedings.)

"CHELSEA"

No. 50 Amplifying Transformer

was designed for use with the present day models of vacuum tubes, and when so used produces remarkable amplification, with minimum noise. It is well adapted for table mounting or may be panel mounted in any position.

Terminals are marked for best connection. Only highest grade materials and workmanship employed. Its high efficiency together with its neat appearance and compactness, makes it a predominating feature in any radio receiving equipment.



IMMEDIATE DELIVERY

Price as shown, $4.50
Unmounted . . $3.75

Bulletin sent upon request. Purchase from your dealer. If he does not have it, send to us.

CHELSEA RADIO COMPANY
150-156 Fifth St. Chelsea, Mass.

SERVICE-TESTED RADIO EQUIPMENT

We have determined to secure a portion of the radio business on the Pacific Coast and realize that to do so we must offer some inducement to make our efforts successful. Our idea of the reasons that Western amateurs do not purchase from Eastern markets on a larger scale is that we dealers are located too far away from would-be customers. To eliminate objections arising from this handicap we have inaugurated our "SERVICE-TESTED" plan of selling equipment.

Every article which we ship out will be tested thoroughly in our laboratories before it is sent to our customer. There will be no such things as tubes which do not oscillate or "B" batteries which go dead in a short time for the simple reason that any of these articles will be exhaustively tested in ACTUAL SERVICE before the purchaser receives it.

Secondly we will pay all postage charges on orders exceeding $5.00. This will make our equipment even cheaper than it can be bought on the coast where prices are often higher than listed by the manufacturer. It is needless to mention that our prices are strictly list as can be seen by the following list:

Radio Corporation Products

We are distributors and jobbers for the Radio Corporation of America and always carry a complete stock of their apparatus. We list below their complete line and in addition can supply you with the Radio Corporation C. W. instruction book at 25c per copy.

Item	VACUUM TUBES	List Price
1	Radiotron (detector) UV—200	$ 5.00
2	Radiotron (amplifier) UV—201	6.50
3	Radiotron (5-watt) UV—202	8.00
4	Radiotron (50-watt) UV—203	30.00
5	Radiotron (250-watt) UV—204	110.00
	POWER TRANSFORMERS FOR C.W. SETS	
12	325-watt, UP—1368	25.00
13	750-watt, UP—1016	38.50
	A—Filament heating Transformer for UV—204, UP—1633	.....
	B—Power Transformer for UV—204, UP—1636	.....
	C.W. ACCESSORIES	
14	Oscillation Transformer UL—1008	11.00
15	Magnetic Modulator (½ to 1½ amp.) UT—1643	9.50
16	Magnetic Modulator (1½ to 3½ amp.) UT—1357	12.00
17	Magnetic Modulator (3½ to 5 amp.) UT—1367	17.00
18	Filter Reactor (160 mill amp.) UP—1626	11.50
19	Filter Reactor (300 mill amp.) UP—1627	15.75
20	Plate Circuit Reactor, UP—415	5.75
21	Filter Condenser ½ mfd.—750 V., UC—1631	1.35
22	Filter Condenser, 1 mfd.—750 V., UC—1632	1.85
23	Filter Condenser, ½ mfd.—1750 V., UC—1634	1.50
24	Filter Condenser, 1 mfd.—1750 V., UC—1635	2.00
25	Transmitter Grid Leak (5-watt tubes), 5000 ohms UP—1719	1.10
26	Transmitter Grid Leak (50 and 250-watt tubes), 5000 ohms, UP—1718	1.65
27	Antenna Ammeter, 0-2.5 amp., UM—530	6.00
28	Antenna Ammeter, 0-5 amp., UM—533	6.25
29	Sending Key UQ—809	3.00
30	Microphone Transformer UP—414	7.25
31	Filament Rheostat (for UV—200, 201 and 202) PR—535	3.00
32	Filament Rheostat (for UV—203 and 204) PT—537	10.00
33	Rotary Grid Chopper PX—1638	7.25
34	Shaft Bushings for ¼" or $\frac{5}{16}$" motor shaft	.20

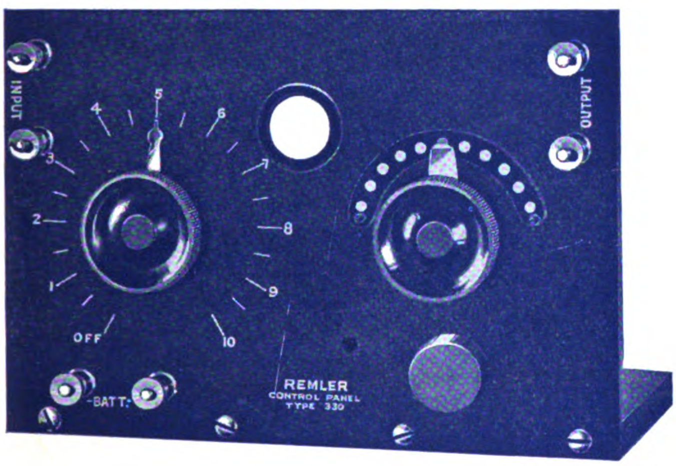
Item	KENETRON RECTIFIERS	List Price
6	20-watt Kenotron, UV—216	$ 7.50
7	150-watt Kenotron, UV—217	26.50
	VACUUM TUBE SOCKETS	
8	Porcelain Socket (for UV—200, 201, 202, 216) UR—542	1.00
9	Porcelain Socket (for UV—203 and UV—217) UT—541	2.50
10	Bakelite Socket (for UV—200, 201, 202, 216) UP—552	1.50
11	Mountings (250-watt tube) UT—501, UT—502	2.00
	SPECIAL CONDENSERS FOR C.W. SETS	
35	Antenna Series Condenser, 7500 V. .0003, .0004, .0005 mfd., UC—1015	5.40
36	Plate and Grid Condenser—3000 V. .002 mfd., UC—1014	2.00
37	Special Condenser—10,000 V. .000025 mfd., UC—1803	5.00
38	Special Condenser—.002 mfd., 6000 V., UC—1806	7.00
	VACUUM TUBE DETECTOR ACCESSORIES	
39	Intervalve Amplifying Transformer, UV—712	7.00
40	Special "A" Battery Potentiometer, PR—536	2.00
41	Tabular Grid and Plate Condenser	
	.00025 mfd. UC—567	1.20
	.0005 mfd. UC—568	1.35
	.001 mfd. UC—569	1.50
	.0025 mfd. UC—570	2.00
42	Grid Leaks	
	UP—509, .05 megohm	
	UP—510, .1 "	
	UP—511, .15 "	
	UP—512, .20 "	
	UP—513, .25 "	
	UP—514, .30 "	
	UP—515, .40 "	
	UP—516, .50 "	
	UP—517, .60 "	
	UP—527, 5.00 "	
	UP—518, .75 megohm	
	UP—519, 1.0 "	
	UP—520, 1.25 "	
	UP—521, 1.5 "	
	UP—522, 1.75 "	
	UP—523, 2.00 "	
	UP—524, 2.50 "	
	UP—525, 3.00 "	
	UP—526, 4.00 "	each $0.75
43	Grid Leak Mounting UX—543	" .50

Send 15c for our complete literature

ELECTRICAL SPECIALTY COMPANY, 48-50 South Front Street, Columbus, Ohio

REMLER

APPARATUS THAT RADIATES QUALITY



Note the exclusive Remler Features

TYPE 330

DETECTOR PANEL

PRICE $8.00

A-Battery Potentiometer Plate Voltage Control

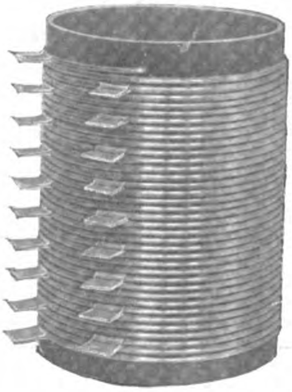
THAT "Remler Apparatus Radiates Quality" and far excels other apparatus is conclusively proved by the following specifications of a Remler Panel when compared with that of any other panel on the market. Panel is genuine molded bakelite, 5 x 7¼ x 3/16 inches, with a highly polished glossy black surface; lettering and scale recessed and filled with white enamel. The filament current is controlled by REMLER No. 810 RHEOSTAT, back mounted, and provided with an open position. REMLER No. 93 POTENTIOMETER connected across the storage battery provides close adjustment of plate potential necessary for sensitive detector action. Flexible leads for the B. Battery connection provided for terminals at back of panel. The rheostat and potentiometer knobs are polished bakelite 1⅜ in. diameter. The GRID LEAK is variable and grid condenser, back mounted, is the correct capacity for the new gas content detector tubes. Maximum filament insured by REMLER No. 92 V. T. SOCKET which is used to support the tube vertically. Induction and ground hums eliminated by its all bakelite construction. A view of filament permitted through an orifice in the panel. Binding posts and all metal parts are finished in polished nickel. The panel is mounted on a hardwood base 7¼ x 3½ inches, finished black, but can readily be mounted in a cabinet. The wiring is the approved bus bar type, and is laid out so that the input and output terminals are at opposite sides.

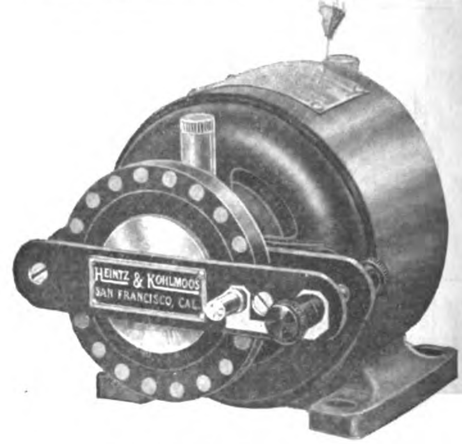
Send for Bulletin No. 1002 and 1003 on the Remler Bakelite Detector and Amplifier Panels, Types 330, 331 and 333. Two or more of these panels can be mounted in a cabinet to make any desired detector-amplifier combination.

DEALERS:—There is an exclusive and very profitable proposition for you on Remler apparatus. Write for full particulars.
AMATEURS:—Write for 32-page Remler Catalogue.

REMLER RADIO MFG. CO.

248 FIRST ST. SAN FRANCISCO, CAL. E. T. CUNNINGHAM GENERAL MGR. 154 W. LAKE ST. CHICAGO, ILL.





A-P INDUCTANCES

Pattern 10—Number 12, hard-drawn copper wire, wound on 5" grooved Bakelite Tubing, spaced 6 turns to the inch, copper taps every 2 turns. Price in U. S. A. —**$4.50.**

Pattern 5—Same as above, except wound on 4" Tubing and spaced 8 turns to the inch. Price in U. S. A.—**$4.25.**

A-P CHOPPERS

The Chopper used at KZY—listen for it in the air. Mounted on one-twentieth H.P. 110 volt, 60 cycle Westinghouse induction motor. Rotors have either 20 or 30 sigments, giving 600 or 900 cycle note. When ordering specify the note desired. Price, f.o.b. San Francisco—**$27.50.** Shipping weight 14 lbs.

YOUR DEALER A-P Choppers and A-P Inductances are two of the many standard radio lines distributed by the Atlantic-Pacific Radio Supplies Co., Inc. Your dealer should have them. If not, write us direct, mentioning the name of your dealer. These lines represent the best radio values in America today, and it is to the advantage of everyone interested in radio to become familiar with them at the earliest possible moment. Upon request we will gladly furnish folders, catalog, and complete information. Our staff includes radio engineers for designing, constructing, and installing apparatus for all purposes. Our facilities include machinery for manufacturing such equipment .

ATLANTIC-PACIFIC RADIO SUPPLIES CO., INC.

638 MISSION ST., SAN FRANCISCO, CALIFORNIA
EASTERN OFFICE, 5 KIRK PLACE, NEWARK, N. J.

HENRY M. SHAW, President

National Distributors for

MOORHEAD LABORATORIES, INC.........A-P Vacuum Tubes
HEINTZ & KOOHLMOOS.........Choppers and Inductances

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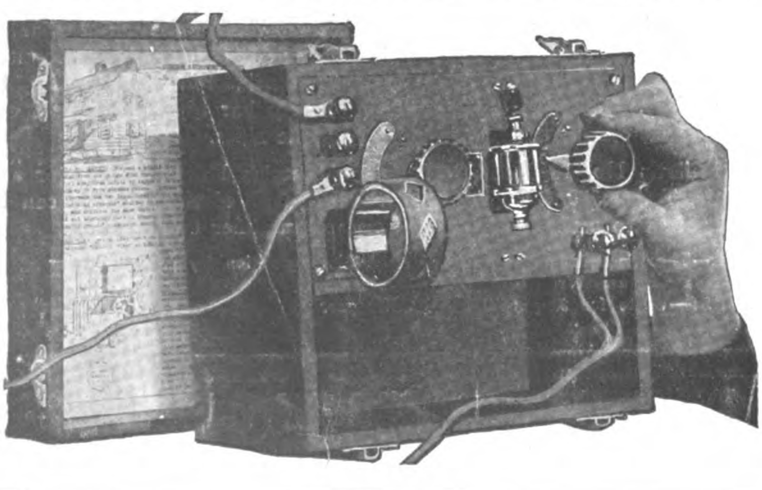
SHAW INSULATOR CO.........Moulded Insulation
DIAMOND STATE FIBRE CO.........Condensite-Celoron
REDMANOL CHEMICAL PRODUCTS CO.........Insulating Paints and Varnishes
C. BRANDES, INC.........Radio Head Receivers

Dealers Write for Proposition

de Forest Receiving Sets



THE "EVERYMAN"

A neat, compact, portable and easily operated set for receiving radio messages and signals, radio music and radio news. Instructions for operating mounted inside the cover of each set—see photograph at left.

Price, f.o.b. San Francisco...........**$26.50**

This is but one item from the complete DE FOREST line of standard receiving and transmitting equipment. Your dealer should carry this nationally advertised, nationally-used apparatus. If he does not, write us for catalog and any other information you desire.

ABBOTT-BRADY PRINTING CORP., S. F.

APRIL, 1922 CIRCULATION OVER 30,000 20 CENTS

RADIO

CUNNINGHAM TUBES

for

HOME RECEIVING EQUIPMENTS

CUNNINGHAM
C-300
GAS CONTENT
DETECTOR

$5.00

Amplifies as it Detects

The trade mark GE is the guarantee of these quality tubes Each tube is built to most rigid specifications.

CUNNINGHAM Type C-300 Gas Content Detector Tube is the ideal tube to use in Home Receiving sets for clear reception of Radio Telephone Concerts, Market Reports and other news features which are sent out daily all over the country.

Nationally recognized as the one tube which gives the most satisfactory results for any type Receiving Set applicable to wave lengths between 100 and 3000 meters for both spark and C. W. Telegraph and Telephone, this Cunningham Detector Tube is recognized as the standard tube throughout the radio field.

In addition to its remarkable detector properties, low B. battery, quietness in operation, it is a free and persistent oscillator for regenerative amplification and C. W. reception and functions without distortion of the received signals.

The unusually fine results which have come through the operation of this tube in connection with home receiving sets have brought us many enthusiastic indorsements from users.

Write for further particulars to your nearest dealer, or write to us direct.

REMLER APPARATUS RADIATES QUALITY
CUNNINGHAM TUBES MEET EVERY AMATEUR REQUIREMENT

E. T. Cunningham

Trading as

AUDIOTRON MFG. COMPANY

248 First Street
San Francisco, Calif.

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RADIO

Established 1917 as Pacific Radio News

Volume IV *for* APRIL, 1922 *Number 4*

CONTENTS *for* APRIL, 1922

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Entered as second-class matter at the Post Office at San Francisco, Calif., under the Act of March 3, 1879.

Forecast of Contributions for May Issue

Volney G. Mathison

The story of the adventures of a radio engineer in Alaska was unavoidably omitted from this issue, but will appear soon, as will also another Samuel Jones story called "A Phoney Freeze-Out." Mr. Mathison, in addition to being a contributor of fiction to the magazines, is one of the pioneer radio ship operators, his eight years of commercial experience having taken him all over the world. He holds an extra first class license. Of interest to amateur and commercial operators alike will be a forthcoming treatise from him on "The Professional Radio Operator."

In the May issue B. F. McNamee will have a simple account of the action of "The Vacuum Tube as a Detector," written for the layman.

D. B. McGown, assistant radio inspector, will have two fine articles, one on "Radio Storage Batteries," giving practical information that will enable anyone to take proper care of either lead or nickel-iron batteries, and one on "How to Make a Two Stage Amplifier." An early issue will also contain, as a continuation of his series on commercial apparatus, "Navy Standard Transmitters."

Chas. K. Fulghum, whose article on "Resistance in Radio Circuits" in this issue will be helpful to many, will present an instructive paper on "The Radio Wave," what it is and some of the fundamental phenomena associated with its propagation, for the benefit of the amateurs.

Gerald M. Best and Ralph Heintz have written a detailed account of the C. W. transmitter soon to be put on the air from Hawaii by C. J. Dow. This will give the practical details that will enable anyone to construct a set consisting of two 50 watt tubes in a Hartley self-rectifying I. C. W. circuit.

H. A. Eveleth will continue his "Radio Primer" with a talk on "Aerials." J. B. Dow has another interesting chapter ready for his "C. W. Manual," and there will be a wealth of valuable data in the usual departments of the paper.

Confucius has said:
"The accomplishment of great things consists In doing small things Well"
Perfection of detail makes the Grebe Receiver What it is —

The Grebe CR-5 Receiver

Licensed under
Armstrong U. S. Patent
No. 1,113,149

GREBE RADIO

Doctor Mu.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus to Dealers, Schools, Colleges, Radio Clubs and Experimenters All Over the World!

"PITTSCO"
SERVICE DISTRIBUTES "RADIO CORPORATION'S" PRODUCTS ALL OVER THE WORLD! TRY US AND SEE!

"PITTSCO"
NOW HAS TWO STORES! BOTH CARRY "RADIO CORPORATION'S" COMPLETE LINE. ORDER TODAY!

AMPLIFIERS

No. DA Westinghouse, Detector and two stage in mahogany cabinet $68.00
No. RORK Grebe, two stage with automatic filament control jacks 55.00
No. RORD Grebe, Det. and two stage with automatic fil. control jacks ... 75.00
No. 2634 Amrad, Det. and two stage in mahogany cabinet. Splendid value .. 47.50

AMPLIFYING TRANSFORMERS

No. UV-712 Radio Corporation 7.00
No. QO Clapp-Eastham, semi-mounted. 4.00
No. QO Clapp-Eastham, fully mounted 5.00
No. 50 Chelsea, new type 4.50

ANTENNA WIRE

"Pittsco" No. 14 Hard drawn copper (80 ft. per lb.), per lb .... .40
500 ft. special value at 2.25
"Pittsco" 7 strand No. 22 tinned copper, per ft .... .01
500 ft. 4.25
1000 ft. Special value at 7.50
"Pittsco" 7 strand No. 20 phosphor bronze, per ft .... .02
500 ft. special value at 7.50

"B" BATTERIES

No. 7628 Standard 22.5 Volts, small .. 1.50
No. 7625 Standard 22.5 Volts, large .. 2.65
No. 7600 Standard 22.5 Volts, variable 16½ to 22½ Volts 3.00
No. 7650 Standard 22.5 Volts, large, variable, 15 variations 3.50
No. 763 Eveready 22.5 volts small 2.25
No. 766 Eveready 22.5 volts large, 16½ to 22½ volts 3.00
No. 627 Ace, 45 volts, variable 3.50

COILS (Duo-lateral)

DL-25	$1.40	DL-300	1.75
DL-35	1.40	DL-400	1.80
DL-50	1.50	DL-500	2.00
DL-75	1.50	DL-600	2.15
DL-100	1.55	DL-750	2.35
DL-150	1.60	DL-1000	2.60
DL-200	1.65	DL-1250	3.00
DL-250	1.70	DL-1500	3.50

COIL MOUNTINGS

No. LC-100 DeForest 3 coil mounting with gears, reduced price 6.00
No. LC-101 DeForest 3 coil mounting with gears and wooden base 9.50
No. 400 Remler 3 coil mounting with base and extension handles 6.50

CONDENSERS (For CW work)

No. UC-1014 Radio Corp. .002 MF. 3000 volts 2.00
No. UC-1015 Radio Corp. .0003, .0004, .0005 MFD. 7500 volts 5.40
No. UC-1803 Radio Corp. .000025 MF. 10000 volts 5.00
No. UC-1806 Radio Corp. .002 MF. 6000 volts 7.00

CONDENSERS (Grid and plate types)

No. UC-570 Radio Corp. .0025 MF ... $2.00
No. UC-569 Radio Corp. .001 MF 1.50
No. UC-568 Radio Corp. .0005 MF ... 1.35
No. UC-567 Radio Corp. .00025 MF .. 1.20
No. UX-543 Radio Corp. Condenser meg. .... .50

CONDENSERS (Filter type)

No. UC-1631 Radio Corp. .5 MF 750 volts 1.35
No. UC-1632 Radio Corp. 1 MF 750 volts 1.85
No. UC-1634 Radio Corp. .5 MF 1750 volts 1.50
No. UC-1635 Radio Corp. 1 MF 1750 volts 2.00

C. W. INDUCTANCES

No. UL-1008 Radio Corporation 11.00
No. P-1 Acme 8.00

C. W. POWER TRANSFORMERS

No. UP-1638 Radio Corp. 325 watts .. 25.00
No. UP-1016 Radio Corp. 750 watts .. 38.50
Acme 200 Watt 350-550 Volts Mtd .. 20.00
Acme 200 Watt 350-550 Volts unmtd. 16.00

FILTER REACTORS

No. UP-1626 160 Milliamperes 11.50
No. UP-1627 300 Milliamperes 15.75

GRID LEAKS (Radio Corporation)

No. UP-1719 For 5 Watt Tubes 1.10
No. UP-1718 For 50 Watt Tubes 1.65
No. UP-516 ½, 1, 1.5, 2 or 3 megohms ea. complete with mounting 1.25
Grid leaks only, each .... .75

HOT WIRE METERS

No. P-1 Roller-Smith 0-2.5 Amperes, flush mtg. Special value at 4.75
No. UM-530 Radio Corp. 0-2.5 Amps .. 6.00
No. UM-533 Radio Corp. 0-5 Amps 6.25

JACKS (Radio type)

No. 61 Pacent open jack .... .70
No. 62 Pacent closed jack .... .85
No. 63 Pacent 2 circuit 1.00
No. 65 Pacent three spring Automatic filament control type 1.20
No. 66 Pacent five spring A. F. C. 1.50

LOUD SPEAKERS

No. R-3 Radio Magnavox, new type horn, very latest model 45.00
No. P-1 Vocaloud, station type 30.00
No. 400-W Federal Pleiophone 14.00

RECEIVING SETS (Crystal)

"Aeriola Jr.," Westinghouse, complete with Brandes "Superior" phones .. 25.00
"Radiola" DeForest, complete with Brandes "Superior" phones 25.00
Radio Service Type S-8 without phones, splendid value 7.50

MAGNETIC MODULATORS

No. UT-1684 ½ to 1½ Amperes $9.50
No. UT-1357 1½ to 3½ Amperes 12.50
No. UT-1637 3½ to 5 Amperes 17.00

RECTIFYING DEVICES

No. UV-216 Radio Corp. "Kenotron" 20 Watt type for UV-202 tubes 7.50
No. UV-217 Radio Corp. "Kenotron" 150 Watt type for UV-203 tubes 26.50
No. P-1 DeForest 20 Watt Rectifying tube for use with 5 watt tubes 7.00

RECTIFYING DEVICES (for "A" Batteries)

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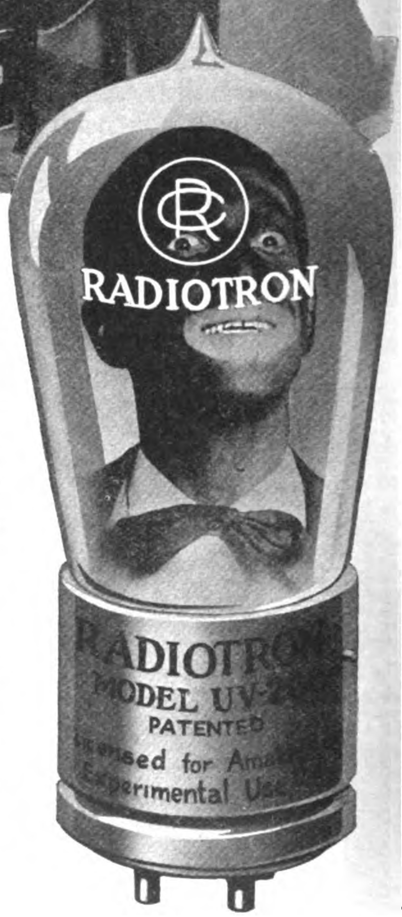
When AL. JOLSON sings and laughs



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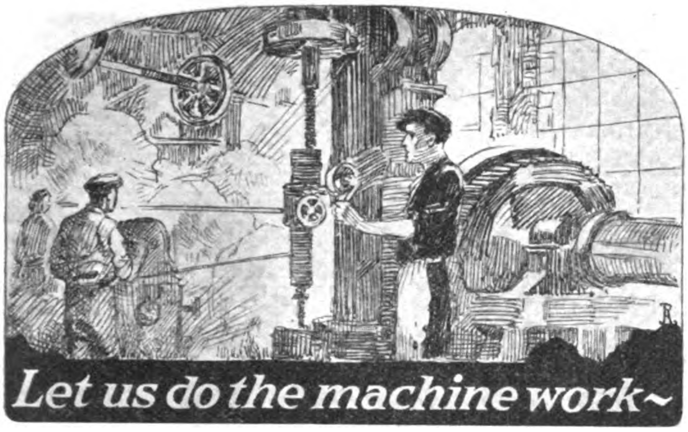

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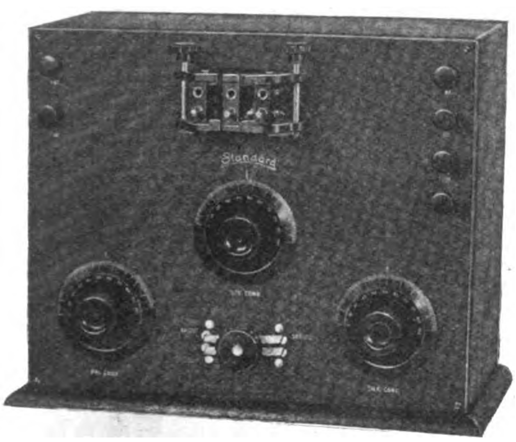

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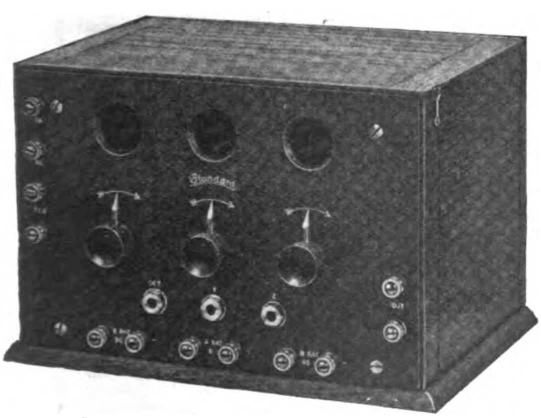

Detector and Two-Step Amplifier—Your choice of two types, Commercial or Amateur. The commercial type is assembled from the most costly, efficient units available. Radio Corporation UV-712 transformers and General Radio tube receptacles typify the quality thruout. The Amateur type is an exact duplicate, except that transformers and sockets of high efficiency, but lower cost, are used.

Prices, F. O. B. New York:

Commercial type, unwired...... $55.00
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Here is clear saving of $10.00 in either case, thru the "Standard" Plan.

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The first is essentially machine work. At the same time, because it *is* machine work, it is really the less expensive part of the entire assembly.

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April, 1922 **RADIO** Vol. 4 No. 4

Radiotorial Comment

PRELIMINARY recommendations from the Washington Radio Conference Committees allocate twenty bands of waves between 150 and 6000 meters, urge that control of radio communication be vested in the Department of Commerce, and suggest that the radio telephone be given the status of a public utility. The wavelength allocations are as follows:

Below 150 meters—Reserved.
150 to 200 meters—Amateurs, exclusive.
200 to 275 meters—Schools and amateurs.
275 to 285 meters—Police broadcasting.
810 meters—Special amateur telegraphy.
810 to 435 meters—Private and toll broadcasting.
500 to 525 meters—Aircraft telephony and telegraphy.
525 to 650 meters—Mobile radio telegraphy.
650 to 700 meters—Mobile radio telephony.
700 to 750 meters—Government and public broadcasting, 700 miles inland.
750 to 800 meters—Radio compass, exclusive.
850 to 950 meters—Aircraft telegraphy and telephony.
950 to 1050 meters—Radio beacons, exclusive.
1050 to 1500 meters—Government and public broadcasting.
1500 to 1550 meters—Aircraft telephony and telegraphy.
1550 to 1650 meters—Fixed stations, non-exclusive.
1850 to 2250 meters—Government broadcasting, non-exclusive.
2500 to 2660 meters—Mobile service, non-exclusive.
2850 to 8300 meters—Fixed service, radio telephony.
5000 to 6000 meters—Trans-oceanic radio telephone experiments.

From these it will be noted that ample privileges are to be extended to amateurs and to radiophone broadcasting. The committees' final report will be given about April first, after consideration of comments from various interests to whom this information has been transmitted. Thereafter the recommendations will probably be embodied in a bill to be submitted to Congress.

FOR three months have we reported the consistent work of 6ZAC of Hawaii. Without blare of trumpets and with the simplest receiving set he is hearing stations thousands of miles away. His work sets a record that has not yet been equalled in amateur circles. So it is with pleasure that many readers will learn that he will soon be on the air with his own transmitter and many a fine-eared operator, who thinks he can receive, will be given an opportunity to learn whether he can receive as well as he can send.

Because of the severe static conditions usually found in the Islands such a feat has hitherto been considered impossible. Several years ago navy officials using seven stages of amplification were unable to hear Pacific Coast stations during a pre-arranged test. With a loose coupler, detector and one stage of amplification, Mr. Dow is hearing spark stations in the fifth, sixth and seventh districts and C. W. stations in these as well as in the eighth and ninth districts. Among others, he reports NOF at Anacostia, B. C., a distance of 4800 miles along the great circle!

FROM the report of the Washington Radio Conference, as printed elsewhere in these columns, it is evident that some little time will elapse before the present etheric chaos can be corrected by law. The report is interesting in that it succinctly presents the viewpoints of the many conflicting interests involved and points the way to an equitable allocation of wave lengths.

But until the final recommendations of the committee are made law by Congress some plan of "live and help live" should be worked out in each part of the country. Voluntary restrictions by some plan, such as the Chicago plan or the Pacific plan, will prove helpful in each locality.

The essence of such voluntary restriction is co-operation, working together and playing together harmoniously for the good of the radio game. This is in accord with the fundamental principle of Americanism that in union there is strength and that the will of the majority is the only will to be considered safe relative to policies involving any body of individuals. Any plan adopted should be built to an ideal.

The ideal plan for amateur radio is one which will afford equitable privileges to the receptor station interested in radiophone broadcasts, the amateur operator interested in local work, and the dx hound who wants to annihilate miles with watts. This ideal now can be attained only by a gentlemen's agreement as to what in the opinion of the majority will provide the greatest good for the greatest number.

Such a plan would call for preliminary decisions by local groups and final decision by representatives from a large number of groups. This was the method used in the preparation of the Pacific Plan, which, while not yet perfect, is admirably adapted to provide the most favorable working conditions for all. Wherever enforced it is functioning satisfactorily.

But of far greater importance than the adoption of a plan is loyalty by all to whatever plan may be adopted by the majority. In general, we are loyal to that thing which protects our own interest. But the protection can be continued only as long as loyalty continues. No plan will work if a dx man disputes the traffic officer's order to discontinue the use of high power local work, if an operator refuses to put out NA or to recognize IM, or if some ambitious amateur puts his spark on the air during the concert period.

A gentleman's agreement is an agreement between gentlemen and needs no bond. Our traffic officers are our servants, telling us how to conform to our own rules for our own good and sacrificing their time for the welfare of all. They exercise an authority backed up by the power of the radio inspector. Their orders should be obeyed.

Should we find a Bolshevik in our midst, let us deal gently with him. He is ignorant and is to be taught rather than fought. He misunderstands and his misunderstanding should be removed by education. But if he still refuses to conform voluntarily, we still have the power to compel him to consider the privileges of other people as superior to his own.

Report of the Washington Radio Conference

By Max Loewenthal, Official Delegate from the Pacific Radio Trade Association

This report summarizes the testimony given before the Committee by representatives of radio manufacturers, trade associations, amateur associations, electric power companies, telephone companies, ship operators, newspapers and others interested in the regulation of radio communication.

THIS epoch-making conference, destined to evolve conclusions of immeasurable benefit to the radio industry, not only in view of the magnitude and scope of the problems under discussion and the importance of the recommendations which will result from these deliberations, but also in view of the prominence of the members of the commission and those attending the conference, as voluntary witnesses and advisers, was opened in the conference room of the Department of Commerce, Washington, D. C., on Monday, February 27th by Secretary of Commerce Herbert Hoover.

The official commission appointed by Secretary Hoover at the suggestion of President Harding consisted of the following members:

Dr. S. W. Stratton, chairman (director of Bureau of Standards, Department of Commerce).

Major General George O. Squier, War Department.

Capt. Samuel W. Bryant, U. S. N., Navy Department.

Mr. J. C. Edgerton, supt., Radio Service, Postoffice Department.

Mr. W. A. Wheeler, Bureau of Markets and Crop Estimates, Department of Agriculture.

Representative Wallace H. White, Jr., of Maine.

Mr. R. B. Howell, of Omaha, Nebraska.

Dr. Alfred N. Goldsmith, secretary, Institute of Radio Engineers, New York, N. Y.

Mr. Hiram Percy Maxim, president, American Radio Relay League, Hartford, Cann.

Prof. L. A. Hazeltine, Stevens Institute of Technology, Hoboken, N. J.

Mr. D. B. Carson, Commissioner of Navigation, Department of Commerce.

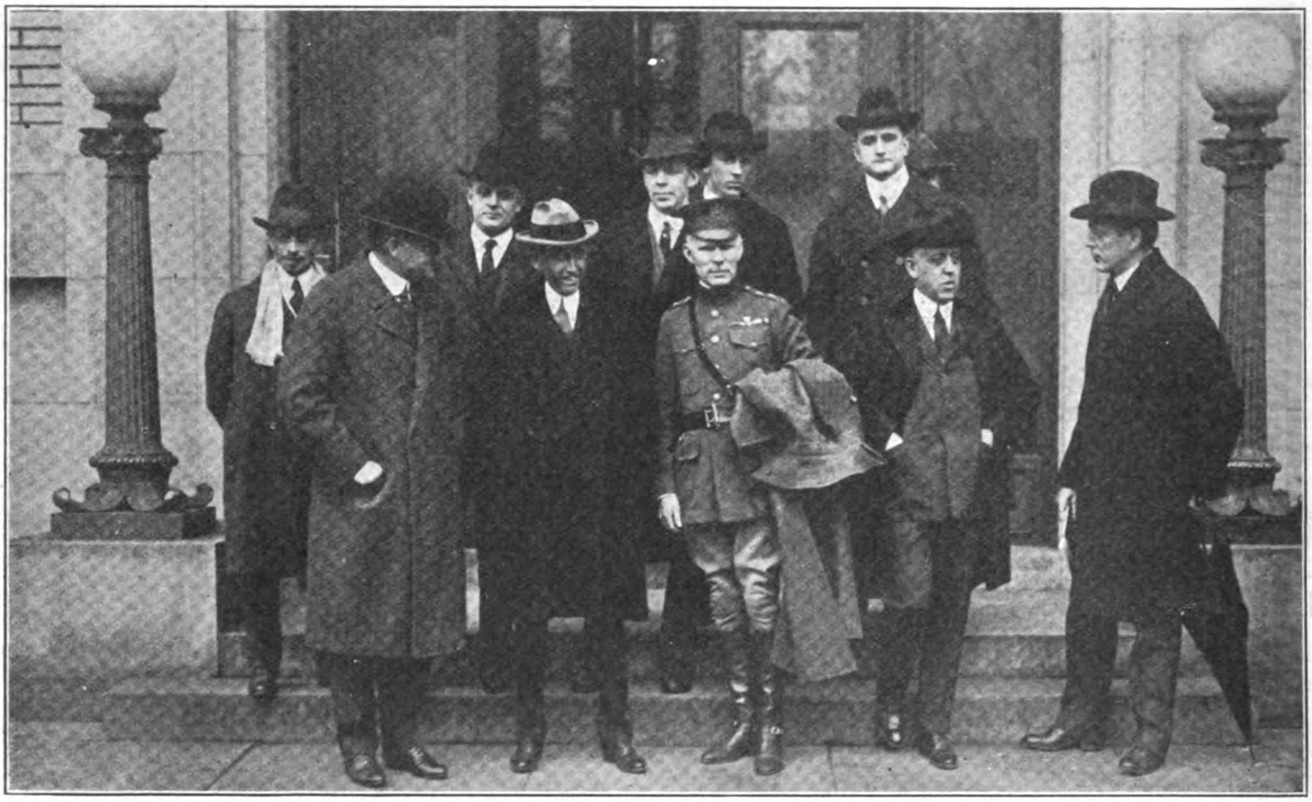
Prof. C. M. Jansky, Jr., University of Minnesota.

Senator Frank B. Kellogg, of Minnesota.

Mr. Edwin H. Armstrong, Columbia University, New York, N. Y.

There were present during the two-day conference representatives of various public service corporations, manufacturing companies, radio telephone users, commercial and amateur, from coast to coast, to the number of about 125, as well as representatives from the various government bureaus, the army and navy, Boy Scout and trade associations, many representatives of the press and commercial bodies, in order to present their views concerning the situation brought about by recent strides in broadcasting and the need for allocating the ether waves so as to permit the greatest use of wireless telephony for commercial purposes and amateur development.

Secretary Hoover, who might be called "the personal representative of the American small boy," in view of the interest he has shown in the past and repeatedly evidenced during the course of the convention, opened the proceedings with an address which was heartily received by those in attendance. Mr. Hoover's interest in the situation was further evidenced by his continuous presence during all of the proceedings over which he presided and during which he asked many pertinent questions.



Leaders in Washington Radio Conference. Left to right, front row, Secretary of Commerce Herbert Hoover, Postmaster General Will Hays, Gen. George O. Squier, Congressman W. H. White, of Maine; former Congressman Shirley. Back row, Dr. Louis Cohen, consulting engineer for War Department; Prof. C. M. Jansky Jr., Edwin H. Armstrong, Columbia University; Harry F. Breckel, Dr. Alfred Goldsmith, New York City.

Opening Address by Secretary Hoover

It is the purpose of this conference to inquire into the critical situation that has now arisen through the astonishing development of the wireless telephone; to advise the Department of Commerce as to the application of its present powers of regulation, and further to formulate such recommendations to Congress as to the legislation necessary. This is one of the few instances where the country is unanimous in its desire for more regulation.

We have witnessed in the last four or five months one of the most astounding things that has come under my observation of American life. This department estimates that today over 600,000 (one estimate being 1,000,000) persons possess wireless telephone receiving sets, whereas there were less than 50,000 such sets a year ago. We

Continued on page 44

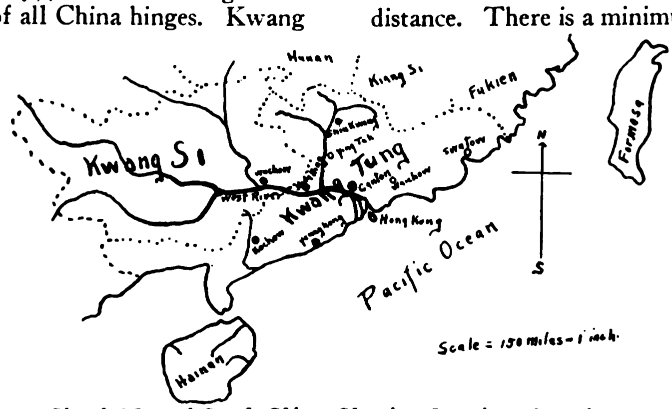
中國無線電工程

By Charles R. Grubbs

THE characters above, reading from left to right, are "Chung Kwok, Mo Tsein Tien Koong Chuen," and taken literally mean "middle kingdom without wires electrical work engine(ering)," or "Radio Construction in China." Radio is a new art in China and, like all other innovations in that country, there are no words with which to exactly describe the subject. So existing words are used descriptively to meet the emergency. Usually they are very apt in the description, as the above caption testifies. A motorboat is a "fire boat," and a railway train is a "fire carriage," while an automobile is a "fire carriage to go anywhere."

A few words as to the geographical and political status of South China will explain why radio construction was undertaken there.

The valley of the Si Kiang, or West River, extends through two provinces of South China, Kwang Tung and Kwang Si (east country and west country), where is being made history upon which the progress of all China hinges. Kwang Tung, with the rich delta lands of the West River and the fertile valley of the North River, has the two principal cities, Hong Kong and Canton. In the little territory scarcely larger than the state of Kentucky twenty-nine million people live. Agriculturally inclined and commercially aggressive, the people of this province are peace loving, studious, philosophical and thrifty. Most of the Chinese living in foreign lands and studying in foreign universities are from Kwang Tung; and therefore if foreign ideas and inventions are accepted into China they usually enter by way of Kwang Tung. It was to be expected that radio, the newest and most useful of arts, would get its first real start in the southern part of China.



Sketch Map of South China, Showing Location of Stations

In marked contrast to Kwang Tung is the mountainous province of Kwang Si; the land, while rich in undeveloped mineral resources, is poor agriculturally, and hundreds of years of fighting with neighboring provinces has reduced the population from 15,000,000 to less than 7,000,000 people. These were the militarists of China.

An unusually successful raid in 1917 gained control for the Kwang Si troops of the whole of Kwang Tung province, and for three years they ruled with the hands of vandals. High taxes were collected on anything and everything; gambling concessions were sold; if they couldn't get the money any other way they took it. As quickly as possible all money was moved from Kwang Tung to Kwang Si. Railroads were to be built and equipped, highways to be laid out, and communication was to be fostered in Kwang Si, all at the expense of the richer province of Kwang Tung.

A radio station was to be erected at Wuchow, one large enough for communication directly with Pekin, 1200 miles distant. They estimated about 10 kw. It is not very clear just how this estimate was arrived at, but the money was appropriated and an American-educated Chinese was sent to the United States to purchase this station, together with other machinery.

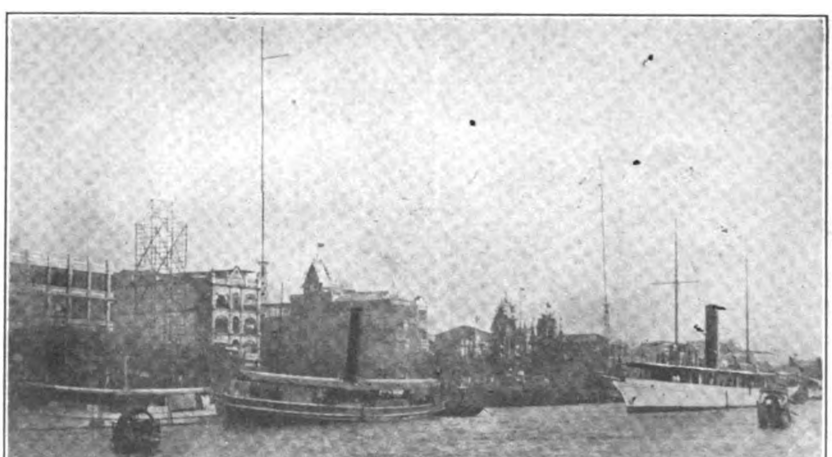
Upon arrival in the states, an American radio engineer advised this representative that 10 kw. would not be sufficient and stated that nothing less than a 25 kw. arc should be used. Due to the large ferrous deposits in the country, and the exceptionally heavy type of atmospherics encountered, it is the opinion of the writer that at certain times of the year a 100 kw. arc would have difficulty in consistently covering this distance. There is a minimum of static in the winter months.

It was then decided to use this appropriation, which was not enough to buy a 25 kw. arc, in the purchase of a number of small radio sets. De Forest radiophones and receivers, with 110 volt Genco light farm sets for a source of power, were selected.

Messrs. Slocum and Halleck, radio engineers of San Francisco, were sent on to China to prepare for the erection of these sets. Before this apparatus could arrive in China the Kwang Tung people, under the leadership of Sun Yat Sen, Chen Chiung-ming, and others, had revolted, the Kwang Si militarists were driven out, leaving Slocum and Halleck nothing to do but to return to the states, and the radio shipment on its arrival was seized by the people who had really paid for it.

Some few months later the writer was called upon by the Chinese in control to furnish them with advice and other services incidental to the erection of these stations.

FROM San Francisco to Hong Kong was the usual uneventful trip, listening to the old reliables, KPH, KET, NPL, NPM, the amateurs trying to strangle each other, "that will be all for now" from the California Theater. "We'll have another" from the sergeant, the Japanese stations and others. Off the Japanese coast we heard the tube sets which were being tested out, but of course were not able to understand what was said; it sounded like "Ho-o Rin Ahh" and "Ichi, Ehr, Sahn, Seu," repeated over and over.


Station CN at Canton. Built by German Engineers in 1907

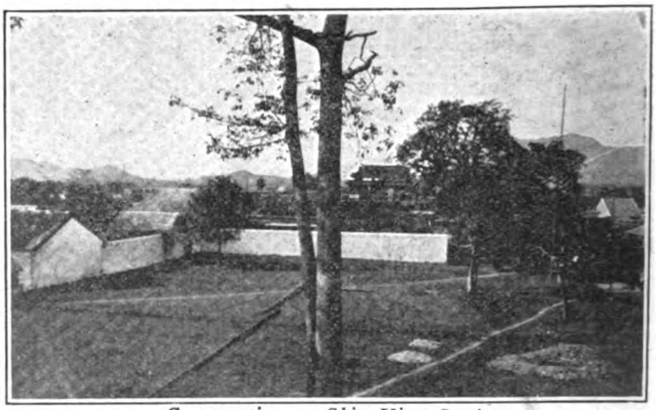
Although the Japanese and also the Chinese are required to know the international code, together with the use of English, the code which they use for their own language would appeal to the chap who has a hard time to memorize the code. It only has ten characters and is a number code, each of the words being represented by four of these characters. For instance the numeral 5438 could represent the longest word in their language or the shortest as the case might be. Many of the ship operators are puzzled when they hear this code as it seems to be made up of letters, numbers, and Morse. Continental N is 1, D is 2, B is 3, - . . . . is 4, and so on with the Morse L for zero. A code book is furnished to each operator with the Chinese characters and its corresponding code number listed.

Upon arrival at Canton, a conference was called by the officials in order that the best and most advantageous locations could be selected for the stations, that a complete communication network of the entire province would result. We had many of these conferences during the course of the work and they were mostly alike in that each took up the greater part of a day with tea, ceremony, and difficulty of exact understanding. It was decided that ten stations would be put up immediately and simultaneously even though a large portion of the construction material still had to be purchased. It is no easy thing to buy construction material of any description in China and it is especially difficult when it is desired in quantity and of a specialized nature.

The six 1 kw. stations proposed are shown on the map; in addition there were to be two ship stations of ½ kw., and two 100 watt stations in the vicinity of Canton.

About sixteen spark stations were already in operation at various points on land and small river boats in and around Canton. These had been installed fifteen years previously by German engineers and even though they each carried a Chinese "chop" they had all the earmarks of Slaby-Arco and Telefunken sets.

The largest of these stations at Canton, CN, had a sending radius of less than 60 miles. An idea of the size of the antenna for this station may be had by studying the waterfront view shown herewith. The masts are 220 ft. high and 680 ft. apart. There is a four-wire grid suspended between these masts, each wire seven strands of No. 14 copper, which makes a very heavy antenna. All four wires are brought to the lead-in insulator from the east end of the grid. Then from this point through the oscillation transformer to the ground.



Construction on Shiu Hing Station

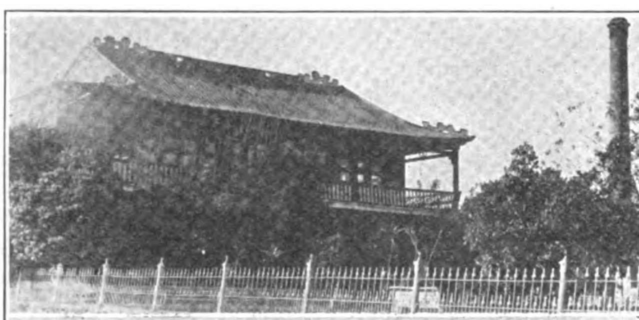
The ground consists of two heavy copper wires laid out radially into the river. The oscillation transformer is made up of 25 turns of No. 4 solid copper on a cylindrical wooden frame. Taps were taken off this for the closed circuit, which consisted of a large glass plate condenser and a spark coil or open core transformer, the primary of which was fed directly off the 100 volt, 50 cycle lighting main. This transformer, 24 in. long and 8 in. in diameter, was completely encased in hard rubber to keep out the moisture.

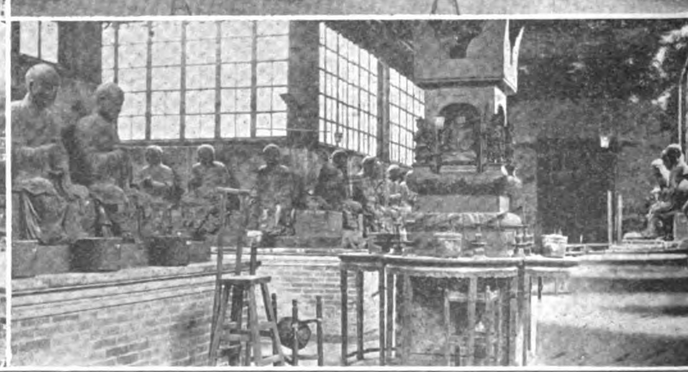
Originally there had been a straight spark gap, but someone had fitted a rotary gap on a fan motor. At that the overall efficiency did not go very high as is indicated by the fact that with an input of 1 kw. they were able to put into the antenna less than two amperes. With the size of that antenna the surprising thing is that they were able to do as well as that. The emitted wave was so broad that there were no "humps."

The receiver was 2 ft. high with a long, multipoint lever switch which opened all the circuits at once. Fixed coupling inductances, locally made condensers, variable, and a single low ohmage phone made up the rest of the set.

We connected to this antenna an audion receiver, one-step, Baldwin phones, and the Chinese operators were afraid to use it because it hurt their ears.

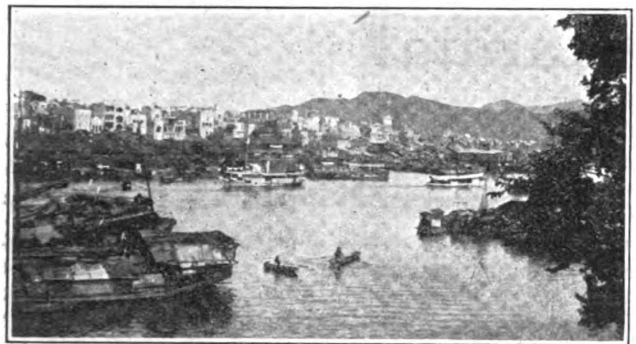
ONE of the first things which had to be done was to make a complete test of all the apparatus in the shipment. For some unexplainable reason this radio material had not been crated or prepared for export shipment





Radio Station at Shek Chong
View of Pearl River, Canton

Hotel Reservations, Shiu Chow
Temple of 500 Genii, Canton



Wu Chow Harbor

and as it had been handled four times in transit, considerable damage had resulted.

To make matters more complicated, the white ants had eaten into the cases and the oak cabinets were little more than shells. White ants or "ahn hi" as they are called, are the "wouf-hongs" of China. The Chinese will seriously tell you that the little insects will cheerfully eat anything that they come to, including lead and gold and silver.

Needless to say we did not try the experiment, but rigged up a cyanide room and made short work of them. The ship's fumigating method was entirely new to the natives, for they knew of no way to rid themselves of the pests other than fire and kerosene; the former of course could not be considered while the latter is not effective.

Many of the Chinese believe that the white ants are caused by the moisture in the air, and will affirm that there is no other possible way in which the ants can get a start. At times one is tempted to believe them. The high humidity is capable of bringing on all sorts of calamities to electrical machinery. It was next to impossible to keep the magnetos in operation on the aeroplanes, while the damage caused by the moisture was disastrous to the coils, transformers, and condensers of the radio sets.

The woodwork had also suffered from the moisture. It did not seem to affect the length of the board, but the width was increased nearly a half inch in each foot. In the winter months this same board will shrink back to normal, so that it does no good to make the board to size. The solution is teak wood cabinets, which are not so susceptible to moisture.

The entire shipment had been there for five months or more subject to this moisture, and the high voltage generators were in no condition to deliver the 1500 volts required. Each piece that would require this treatment was baked at 180°F in an oven, rigged up temporarily, before being tested.

One of the Genco light sets and a set of storage batteries was set up, men were taught to run it and the testing was started. The results were discouraging, but we managed to sort out enough pieces to carry on, thinking to repair the rest at a later date. Three men were afterwards kept busy for a period of two months in repairing storage battery plates alone and a lot of the apparatus could not be salvaged at all.

The first three stations were put up in Canton, a 1 kw. at CN's old site, and the other two 100 watt stations at a distance of three and twelve miles respectively.

We were now ready to commence the work on some of the outlying stations. Shiu Hing, 60 miles up the West River, being the next on our plan, arrangements were made for a "lighter" or large cargo boat and the lighting generator, transmitter, power panel, receiver, motor generator set, and other material was loaded on by coolies. The masts were to be towed astern.

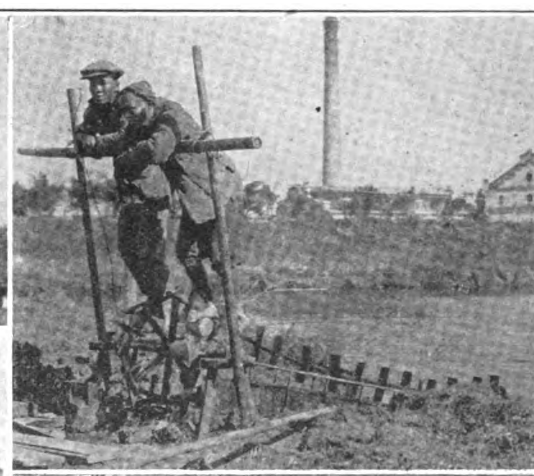
Three days later (time is no object in China) we were able to pull the diplomatic strings and cut the necessary red tape to get a steamboat to tow us up the river.

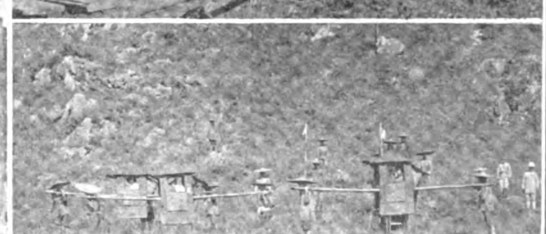
THE trip up the West River is beautiful at any time of the year; through a rich delta country, the greenest of green rice fields, well tilled, with never the sign of a weed, quaint "dobe" houses with straw thatched roofs, picturesque river temples, sampans (boats) and lily ponds. Nothing is raised in China to which is not attached a food value and lilies are no exception; the lotus lily has an edible seed similar to pease but richer, and the root is something like the potato. They call it the poor man's potato.

About forty miles of this and we left the sluggish waters of the delta region and came into the more swiftly running part of the river where the mountains start. The Shiu Hing gorges, where the river is forced to pass between two mountains by an ancient landslide, was passed and soon after the boat was anchored along the river bank at Shiu Hing.

The rain had suddenly decided to come down in torrents

Continued on page 58





Chinese Steam Shovel
On the Way to Market

Celestial Centrifugal Pump
Rapid Locomotion in China

The C. W. Manual

Fourth Installment

By J. B. Dow, Ensign U. S. N.

The Design and Construction of a 10 Watt C. W. Transmitter, I. C. W. Transmitter and Phone Set Using Direct Current

In conformity with the policy adopted in the preceding chapter of stating the conditions affecting the design and construction of apparatus under consideration, the following statements are made with reference to the subject matter:

1. A Hartley oscillating circuit wherein two 5 watt tubes are employed as oscillators, will be used in conjunction with the Heising system of modulation employing two similar tubes as modulators.
2. With a small antenna, the apparatus must function at frequencies corresponding to wavelengths between 200 and 375 meters.
3. The various integral pieces of apparatus, except the radiating system, sources of power supply and attendant filter and rectifier systems must be so mounted as to comprise a complete unit.

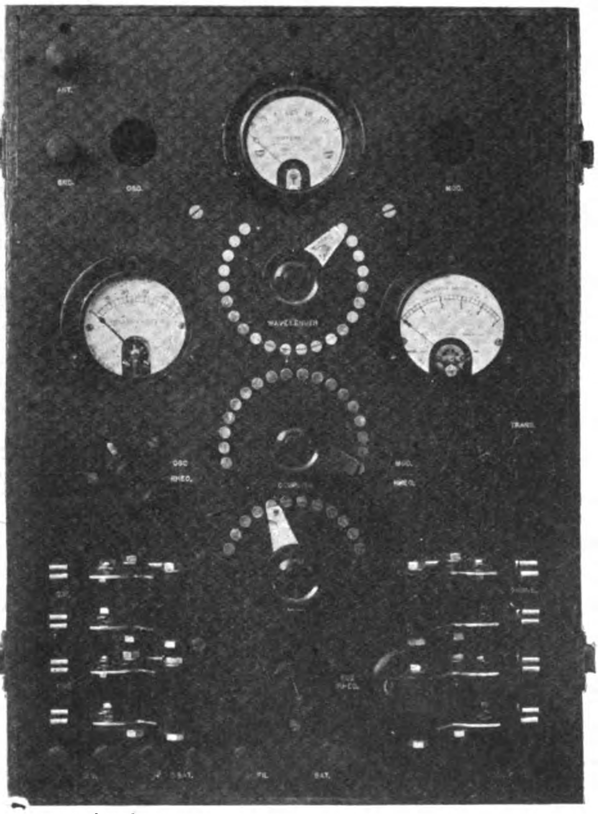


Fig. 30. Front View of 10-Watt Phone Set.

4. An efficient self contained switching arrangement must be provided in order that the operator may transmit signals of any of the following characteristics at will: viz, C. W., I. C. W., and phone.
5. Efficiency in operation combined with ruggedness in construction will be considered as of paramount importance.

Figs. 30, 31, and 32 show three views of the completed apparatus. Fig. 33 is a schematic diagram of the circuit. It will be observed by reference to the figures that much of the apparatus was obtained from the market; for example, the indicating instruments, filament rheostats, receptacles, modulation transformer, choke coils, and switches. The constructor will do well in following this practice, since, in most cases, it will be the more economical. However, full constructional details will be found elsewhere in the manual for much of the above mentioned apparatus.

In the construction of this unit, recourse will be given first to apparatus comprising the basic electrical parts of the circuit—since the arrangement of these parts in the circuit depends to a great extent upon the constructor's adherence to the specifications given. In most cases, considerable tolerance is allowed.

The details of the condenser inserted in the circuit between the plate and coupling tap on the variable inductance are shown in Fig. 34. As will be seen by reference to this figure, the condenser is merely an ordinary mica dielectric device having a capacity of approximately 0.01 micro-farad. It is mounted as in Fig. 32 upon the inside surface of the backboard under the oscillator tube sub-panel.

The radio-frequency choke coil shown in the same figure consists of a 250 turn honeycomb mounted upon the bracket which is detailed in Fig. 35.

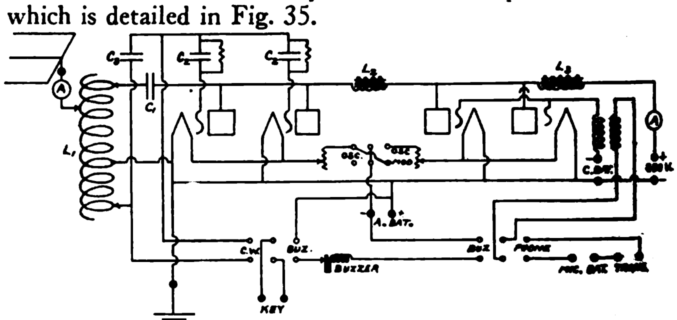


Fig. 33. Diagram of 10-Watt Phone Set.

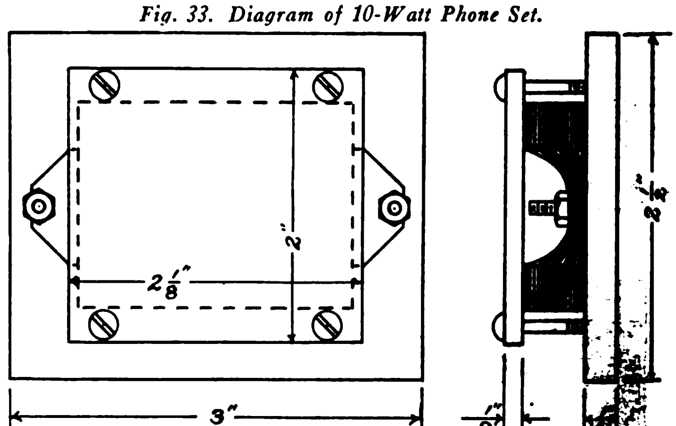


Fig. 34. Details of Condenser in Circuit Between Plate and Coupling Tap. Capacity, 0.01 mf., 50 pieces copper foil 1.75 x 1.25 in. between 51 pieces 5 mil ruby mica 2 x 1.5 in.

The mounting for the modulation transformer and radio-frequency choke coil is shown in Fig. 31. Complete details for the construction of the modulation transformer are given in Fig. 26. If the reader desires to construct an audio frequency choke to take the place of the one shown in Fig. 31, he may do so by following the details of Fig. 29 (see March RADIO).

The attention of the reader will now be turned to the grid circuit in Fig. 33. It will be observed that this is a branched circuit consisting of three small capacities and two large resistances. The individual grid condensers should have a capacity of approximately 0.0005 micro-farad, and should be shunted by a suitable grid leak resistance. For Western Electric Co. oxide-coated filament tubes, this resistance should have a value of about 10,000 ohms. Some manufacturers recommend that with their tubes, the capacity-grid-leak-resistance system comprise a resistance of 5000 ohms in conjunction with a capacity of 0.002 micro-farad.

Three sheets of copper foil 2 by 3 inches separated with thin mica may be used with the grid leak shown in Fig. 27 for each of the oscillator tubes of Fig. 33.

The third condenser in this system is one of similar construction. By manipulating the upper left hand switch of Fig. 30, a small telegraph key is shunted across this condenser for the transmission of C. W. signals. When thrown to the opposite side, this switch inserts the key in the buzzer circuit for the transmission of I. C. W. signals. In this latter position, the two disengaged switch points must be short-circuited to cut the key condenser out of circuit. It may be well to point out here that the resistance of the key condenser, as measured by means of a megger, should be infinity. If this resistance is of any finite value, in all probability the circuit will oscillate with the key in the released position. A leaky key will often cause the same trouble. This condenser, as well as the grid condensers and leaks, are mounted atop the upper horizontal panel of Fig. 32.

Two 2½ ohm rheostats and one 7 ohm rheostat serve to control the modulator and oscillator filaments and the buzzer, respectively. An added refinement, though an unnecesssary one if good tubes are used, would be the introduction of a separate rheostat for each filament.

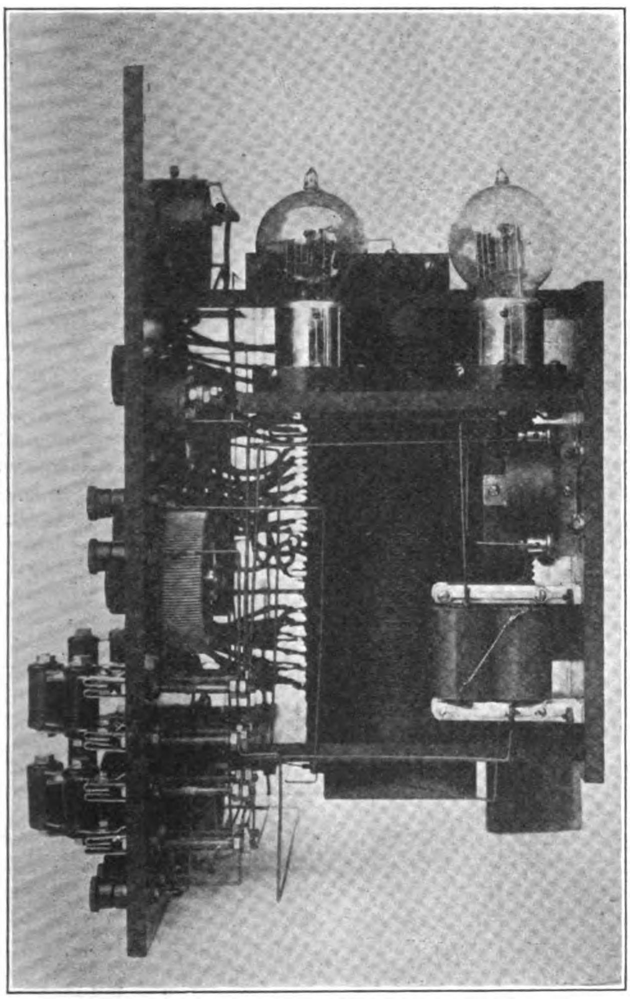


Fig. 31. Right Profile of 10-Watt Set, Showing Location of Modulation Transformer and Audio-Frequency Choke Coil. Note location of Key Condenser Under Lower Sub-panel.

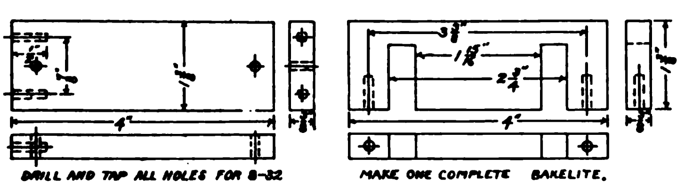


Fig. 35. Dimensions of Bracket for Mounting Honeycomb Coil.

The variable inductance, which is supported between the upper and lower sub-panels of Fig. 31, consists of a Bakelite tube (see Fig. 36 for details) 9 in. long and 5 in. in diameter. It is threaded for 8 in. of its length, leaving a ½ in. margin on each end and wound with 48 turns of 10 by No. 30 enamel insulated wire twisted three cord. A slightly better design of Litz for use with alternating currents of the frequencies corresponding to wavelengths between 200 and 375 meters, could be developed with No. 38 enameled wire. The increased difficulties resulting from the use of such small wire, particularly in regard to making the taps, soldering, etc., would not warrant its use, however. Taps should be provided as indicated in the accompanying table. In making connections to this type of conductor, considerable time and care is required.

The small brass lugs shown in Fig. 36 should be soldered to the Litz in the following manner as the respective turns are wound upon the tube: Clamp a small electric soldering iron between the jaws of a bench vise to steady same. The iron should be previously tinned in order to hold a small globule of solder on the flat part of the point. Immerse the

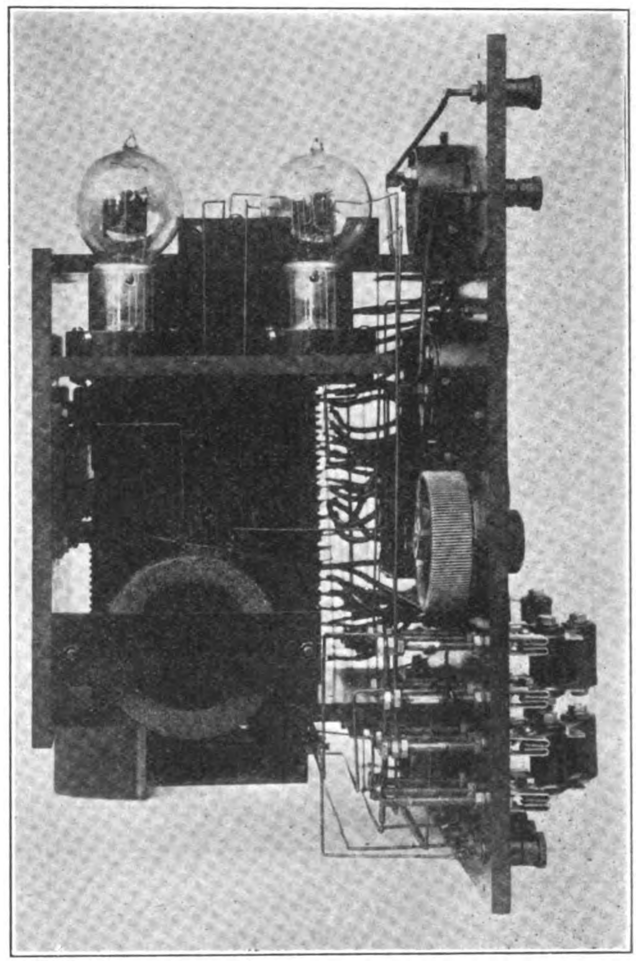


Fig. 32. Left Profile of 10-Watt Set, Showing Location of Radio-Frequency Choke Coil and Plate Series Condenser.

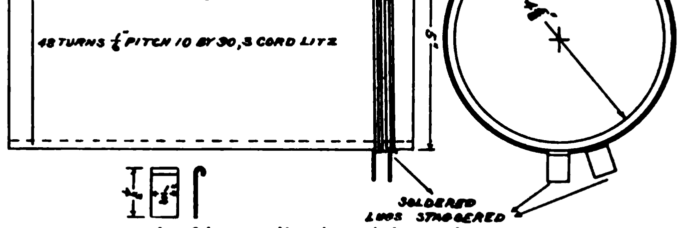


Fig. 36. Details of Variable Inductance.

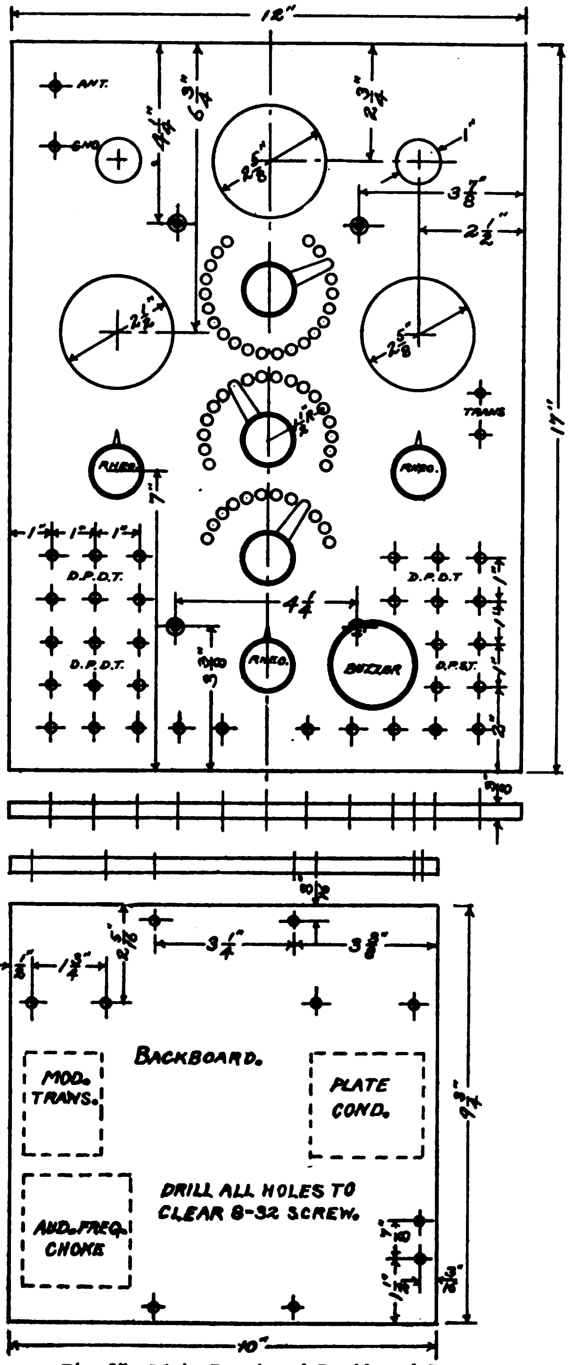


Fig. 37. Main Panel and Backboard Layout.

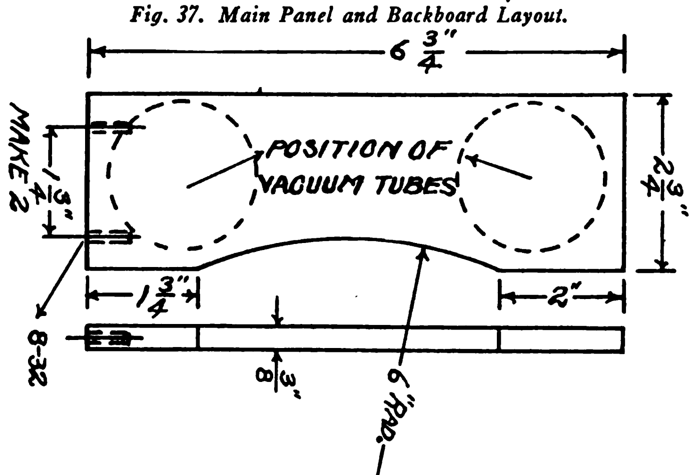


Fig. 38a. Layout of Sub-panel

conductor in this hot solder at the point to be tapped, adding solder if necessary. Holding the wire in this position, scrape carefully with a sharp knife. The enamel, now softened and

GRID TAPS (A)	TURNS (B)	LUGS (C)	COUPLING TAPS (D)	WAVELENGTH TAPS (E)
	1	—		22
	2			
	3	—		21
	4			
	5	—		20
	6			
	7	—		19
	8			
	9	—		18
	10			
	11	—		17
	12	—	18	
	13	—	17	16
	14	—	16	
	15	—	15	15
	16	—	14	14
	17	—	13	13
	18	—	12	12
	19	—	11	11
	20	—	10	10
	21	—	9	9
	22	—	8	8
	23	—	7	7
	24	—	6	6
	25	—	5	5
	26	—	4	4
	27	—	3	3
	28	—	2	2
	29	—	1	1
	30	—	MID POINT	
	31			
	32			
	33			
	34			
	35			
1	36	—		
2	37	—		
3	38	—		
4	39	—		
5	40	—		
6	41	—		
7	42	—		
8	43	—		
9	44	—		
10	45	—		
11	46	—		
	47			
12	48	—		

"WAVELENGTH" SWITCH		"COUPLING" SWITCH	"GRID" SWITCH
22			
21			
20			
19			
18		18	
17		17	
16		16	
15	—	15	
14	—	14	
13	—	13	
12	—	12	12
11	—	11	11
10	—	10	10
9	—	9	9
8	—	8	8
7	—	7	7
6	—	6	6
5	—	5	5
4	—	4	4
3	—	3	3
2	—	2	2
1	—	1	1

Table Showing Grid Taps and Switch Connections. In Table to Left Column B Indicates the 48 Turns of Litz, C Shows Position of Lugs, A, D and E, Connections of Various Switch Points. The "Coupling" and "Wavelength" Switches Have 15 Common Connections as

partially charred by the heat, will float to the surface of the globule and can be removed with ease. Using a small piece of solid wire solder as an instrument, apply a small amount of good anti-corrosive soldering paste to the heated section of the conductor, and, if same is properly cleaned as suggested above, the whole should become a solid mass at this

Continued on page 59

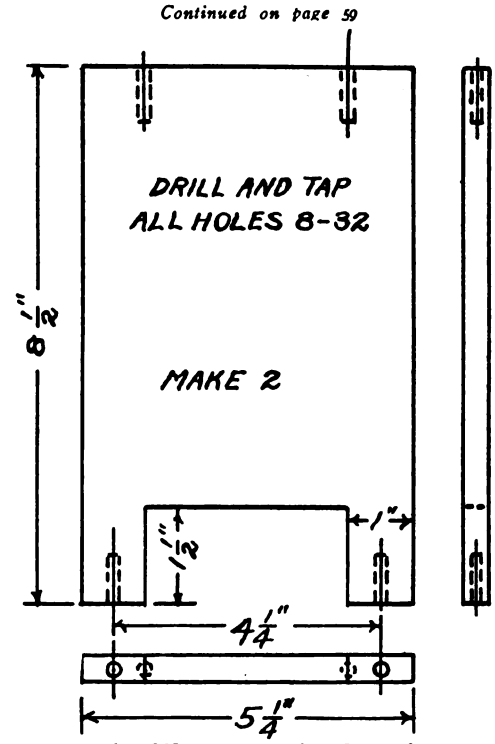


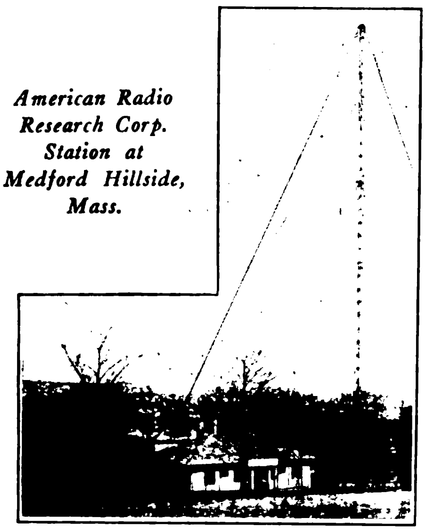
Fig. 38b. Layout of Sub-panel

Radio Broadcasting Stations of the United States

From this list anyone may tune his receiving set to receive the news, concerts, lectures and sermons that are "on the air" throughout the country. Corrections, changes and additions will be published hereafter. Unless otherwise noted, broadcasting is on 360 meters.

First District

WGI—American Radio & Research Corporation, Medford Hillside, Mass. 8 p. m. daily; sermon and sacred music Sunday. Babson business report, Liberty Bond quotations and popular music Monday; bedtime story for children Tuesday and Thursday; radio talks Friday; popular music and lecture every night.



American Radio Research Corp. Station at Medford Hillside, Mass.

WGB—C. D. Tuska Co., Hartford, Conn. 425 meters; concerts on Tuesday, Thursday and Saturday evenings.

WBZ—Westinghouse Electric & Mfg. Co., Springfield, Mass. Music and news 8:00 p. m. Monday, Wednesday and Friday; church service Sunday, 7:00 p. m.

Second District

WNO—Wireless Telephone Co. of Hudson County, 997 Bergen Ave., Jersey City, N. J.

WDT—Ship Owners' Radio Service, 80 Washington St., New York City.

WDY—Radio Corporation of America, Roselle Park, N. J. Closed; to be replaced by large station located in New York City.

WJZ—Westinghouse Elec. & Mfg. Co., 95 Orange St., Newark, N. J. Daily except Sunday; music every hour from 11 a. m. to 6 p. m. on the hour; weather, 11:00 a. m., 12:00 m., 5:00 and 10:01 p. m.; shipping news, 2:05 p. m. (except Saturday); agricultural reports, 12:00 m. and 6:00 p. m.; Children's Hour, Tuesday at 7:00 p. m.; Arlington time daily at 9:52 p. m.; music on Tuesday, Thursday, Saturday and Sunday, 8:20 p. m. until 10:00 p. m.; Radio Chapel, Sunday 3:00 p. m.

WGY—General Electric Co., 1 River Road, Schenectady, N. Y.

Union College—Schenectady, N. Y. Music at irregular intervals.

Fourth District

4CD—Carter Electric Co., Atlanta, Ga. Sunday, Tuesday and Thursday, 7.30 to 8:00 p. m.; music and news services.

Fifth District

WGH—Montgomery Light & Power Co., 111 Dexter Ave., Montgomery, Ala. Daily 11:05 a. m. and 5:05 p. m., weather forecasts; Sunday, 8:30-9:30, address or sermon and sacred music; Tuesday, Thursday and Saturday, 8:30-9:30 p. m., educational matters, farm bulletins, crop statistics, stock quotations and concert.

WRR—Police and Fire Signal Department, 2012 Main St., Dallas, Texas. 7:00 p. m., daily police bulletin, weather and sports; 8:30-9:00, music; Sunday, 11:00 a. m. and 7:30 p. m., church service.

Radio Equipment Co., Dallas, Texas.

University of Texas, Austin, Texas. Schedule to be announced later. "Texas Radio Market News Service."

Roswell Gas & Electric Co., Roswell, New Mexico.

Sixth District

KZY—Atlantic-Pacific Radio Supplies Co., Rock Ridge, Oakland, Calif. Daily, except Sunday, 3:30-4:30 p. m., concert; 6:45-7:00 p. m., press; Sunday, 11:00 a. m. to 12:15 p. m., sermon and sacred music; 3:00 to 4:00 p. m., concert; Wednesday, 7:30-8:15 p. m., concert; Saturday, 8:15-9:00 p. m., concert.

KDN—Leo J. Meyberg Co., Fairmont Hotel, San Francisco. Daily, except Sunday, 4:30-5:30, markets, press and concert; 7:00-7:15, financial and weather; Sunday, 10:00-11:00 a. m., concert; Monday, 8:30-9:00, concert; Thursday, 7:30-8:30, concert.

KZC—Western Radio Electric Co., Kinema Theatre, Los Angeles, Calif. Daily, except Sunday, 5:00-5:30 p. m., press; Tuesday, Wednesday and Friday, music.

KZM—Western Wireless School, Hotel Oakland, Oakland, Calif. Daily except Sunday, 7:15-7:30 p. m., sports and foreign news; Tuesday, 7:30-8:15 p. m., concert, Friday, 8:15-9:00 p. m., concert.

KLP—Colin B. Kennedy Co., Los Altos, Calif. Sunday, 4:00-5:00 p. m., concert; Monday, 7:30-8:30 p. m., Industrial News and concert; Thursday, 8:30-9:00 p. m., concert.

KGC—Electric Lighting Supply Co., 5118 Harold Way, Hollywood, Calif. Monday and Friday, 7:30-8:30, concert.

KYJ—Leo J. Meyberg Co., Hamburger's Department Store, Los Angeles, Calif. Daily, except Sunday, 4:00-5:00 p. m., Monday, Thursday and Saturday, 8:00-9:00 p. m., concert, weather, market and general news.

KWG — Portable Wireless Telephone Co., Stockton, Calif. Daily, except Sunday, 4:00-5:00 p. m., press and markets; Sunday, 2:00-3:00 p. m., concert; Tuesday and Friday, 8:00-9:00 p. m., concert.

KJQ—C. O. Gould, 615 E. Main St., Stockton, Calif. Wednesday, 7:00-8:00 p. m., concert.

KVQ—J. C. Hobrecht, Sacramento Bee, Sacramento, Calif. Daily, except Sunday, 5:30-6:30 p. m., press and concert; Wednesday and Saturday, 8:00-9:00, concert.

KJJ—The Radio Shop, Sunnyvale, Calif. Tuesday, 8:15-9:00 p. m., concert; Friday, 7:30-8:15 p. m.

KQW—Herrold Laboratories, 425 So. First St., San Jose, Calif. Sunday, 5:00-6:00 p. m., concert; Wednesday, 8:15-9:00 p. m., concert.

6XAM—Warner Bros., Oakland, Calif. Sunday, Tuesday and Friday, 12:15-1:00 p. m., concert; Saturday, 7:30-8:15 p. m., concert.

AGI—Signal Corps, Presidio, San Francisco. Sunday, 7:00-9:00 p.m., concert and instruction.

KFU—Precision Shop, Gridley, Calif. Sunday, 3:00-4:00 p. m., concert; Monday and Thursday, 8:00-9:00 p. m., concert.

Maxwell Electric Co., Hotel Claremont, Berkeley, Calif. Sunday, 1:00-2:00 p.m. and 6:00-7:00 p.m., concert.

DDV—Noble Electric Works, Monterey, Calif. No schedule yet assigned.

KUO—Examiner, San Francisco. No schedule yet assigned.

Continued on page 56

Construction and Operation of a Crystal-Detector Radio Receiving Equipment

(Prepared by the U. S. Bureau of Standards, at the request of the States Relations Service of the U. S. Department of Agriculture for the use of boys and girls radio clubs)

THIS article tells how to construct the entire receiving station, including antenna as well as a crystal-detector receiving set. This station will enable one to hear the messages sent from medium-power transmitting stations within an area about the size of a large city, and to hear high-power stations within 50 miles, provided the waves used by those stations have wave frequencies between 500 and 1500 kilocycles per second (i. e., wave lengths between 600 and 200 meters). Much greater distances are often covered, especially at night. If a person constructs the coil and other parts as indicated, the total cost of this set can be kept down to about $6.00. If, however, a specially efficient outfit is desired, the cost may be about $15.00.

ESSENTIAL PARTS OF RECEIVING STATION

There are five essential parts: the antenna, lightning switch, ground connections, receiving set, and phone. The received signals come into the receiving set through the antenna and ground connection. In the receiving set they are converted into an electric current which produces the sound in the "phone." The phone is either one or a pair of telephone receivers worn on the head of the listener.

The purpose of the lightning switch is to protect the receiving set from damage by lightning. It is used to connect the antenna directly to ground when the receiving station is not being used. When the antenna and the connection to the ground are properly made and the lightning switch is closed, an antenna acts as a lightning rod and is a protection rather than a source of danger to the building.

The principal part of the station is the "receiving set." In the set described herein it is subdivided into two parts, the "tuner" and the "detector," and in more complicated sets still other elements are added.

THE ANTENNA, LIGHTNING SWITCH, AND GROUND CONNECTIONS

The antenna is simply a wire suspended between two elevated points. Wherever there are two buildings, or a house and a tree, or two trees with one of them very close to the house, it relieves one of the need of erecting one or both antenna supports. The antenna should not be less than 30 feet above the ground and its length should be about 75 ft. (See Fig. 1.) While this figure indicates a horizontal antenna, it is not important that it be strictly horizontal. It is in fact desirable to have the far end as high as possible. The "lead-in" wire or drop-wire from the antenna itself should run as directly as possible to the lightning switch. If the position of the adjoining buildings or trees is such that the distance between them is greater than about 85 ft., the antenna can still be held to a 75 ft. distance between the insulators by increasing the length of the piece of rope (D) to which the far end of the antenna is attached. The rope (H) tieing the antenna insulator to the house should not be lengthened to overcome this difficulty, because by so doing the antenna "lead-in" or drop-wire (J) would be lengthened.

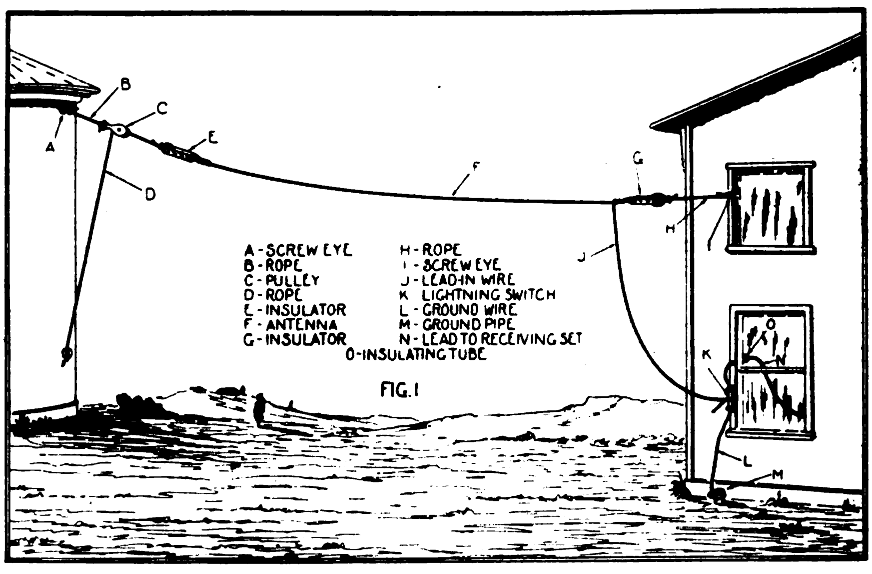


FIG. 1

Details of Parts.—The parts will be mentioned here by reference to the letters appearing in Figs. 1 and 2.

A and I are screw eyes sufficiently strong to anchor the antenna at the ends.

B and H are pieces of rope ⅜ or ½ inch in diameter, just long enough to allow the antenna to swing clear of the two supports.

D is a piece of ⅜ or ½ inch rope sufficiently long to make the distance between E and G about 75 ft.

C is a single-block pulley which may be used if readily available.

E and G are two insulators which may be constructed of any dry hard wood of sufficient strength to withstand the strain of the antenna; blocks about 1½x2x10 in. will serve. The holes should be drilled as shown in Fig. 1 sufficiently far from the ends to give proper strength. If wood is used the insulators should be boiled in paraffin for about 1 hour. If porcelain wiring cleats are available they may be substituted instead of the wood insulators. If any unglazed porcelain is used as insulators, it should be boiled in paraffin the same as the wood. Regular antenna insulators are advertised on the market, but the two improvised types just mentioned will be satisfactory for an amateur receiving antenna.

F is the antenna about 75 ft. between the insulators E and G. The wire may be No. 14 or 16 copper wire either bare or insulated. The end of the antenna farthest from the receiving set may be secured to the insulator (E) by any satisfactory method, being careful not to kink the wire. Draw the other end of the antenna wire through the other insulator (G) to a point where the two insulators are separated by about 75 ft., twist the *insulator* (G) so as to form an anchor as shown in Fig. 1. The remainder of the antenna wire (J) which now constitutes the "lead-in" or drop-wire should be just long enough to reach the lightning switch.

K is the lightning switch. For the purpose of a small antenna this switch may be the ordinary porcelain-base, 30 ampere, single-pole double-throw battery switch. These switches as ordinarily available, have a porcelain base about 1 by 4 in. The "lead-in" wire (J) is attached to this switch at the middle point. The switch blade should always be thrown to the lower clip when the receiving set is not actually being used and to the upper clip when it is desired to receive signals.

L is the ground wire for the lightning switch; it may be a piece of the same size wire as used in the antenna, of sufficient length to reach from the lower clip of the lightning switch (K) to the clamp on the ground rod (M).

M is a piece of iron pipe or rod driven 3 to 6 ft. into the ground, preferably where the ground is moist, and extending a sufficient distance above the ground in order that the ground clamp may be fastened to it. Scrape the rust or paint from the pipe before driving in the ground.

N is a wire leading from the upper clip of the lightning switch through the porcelain tube (O) to the receiving set binding post marked "antenna."

O is a porcelain tube of sufficient length to reach through the window casing or wall. This tube should be mounted in the casing or wall so that it slopes down toward the outside of the building. This is done to keep the rain from following the tube through the wall to the interior.

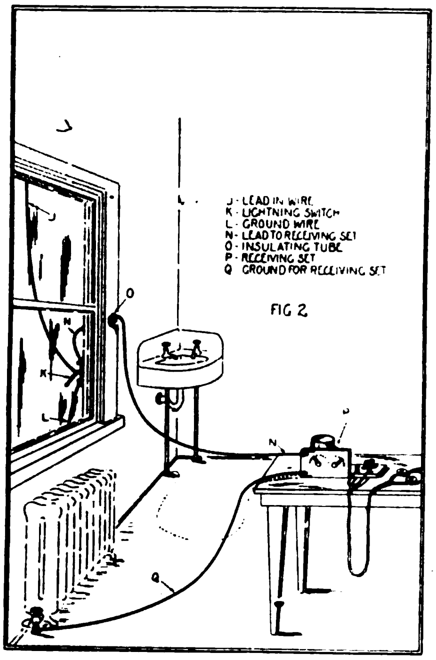


Fig. 2 shows the radio receiving set installed in some part of the house.

P is the receiving set which is described in detail below.

N is the wire leading from the "antenna" binding post of the receiving set through the porcelain tube to the upper clip of the lightning switch. This wire, as well as the wire shown by Q, should be insulated and preferably flexible. A piece of ordinary lamp cord might be unbraided and serve for these two leads.

Q is a piece of flexible wire leading from the receiving set binding post marked "ground" to a water pipe, heating system or some other metallic conductor to ground, except M, Fig. 1. If there are no water pipes nor radiators in the room in which the receiving set is located, the wire should be run out of doors and connected to a special "ground" below the window, which shall not be the same as the "ground" for the lightning switch. It is essential that for the best operation of the receiving set this "ground" be of the very best type. If the soil near the house is dry it is necessary to drive one or more pipes or rods sufficiently deep to encounter moist earth and connect the ground wire to the pipes or rods. This distance will ordinarily not exceed 6 ft. Where clay soil is encountered this distance may be reduced to 3 ft., while in sandy soil it may be increased to 10 ft. If some other metallic conductor, such as the casing of a drilled well, is not far away from the window, it will be a satisfactory "ground."

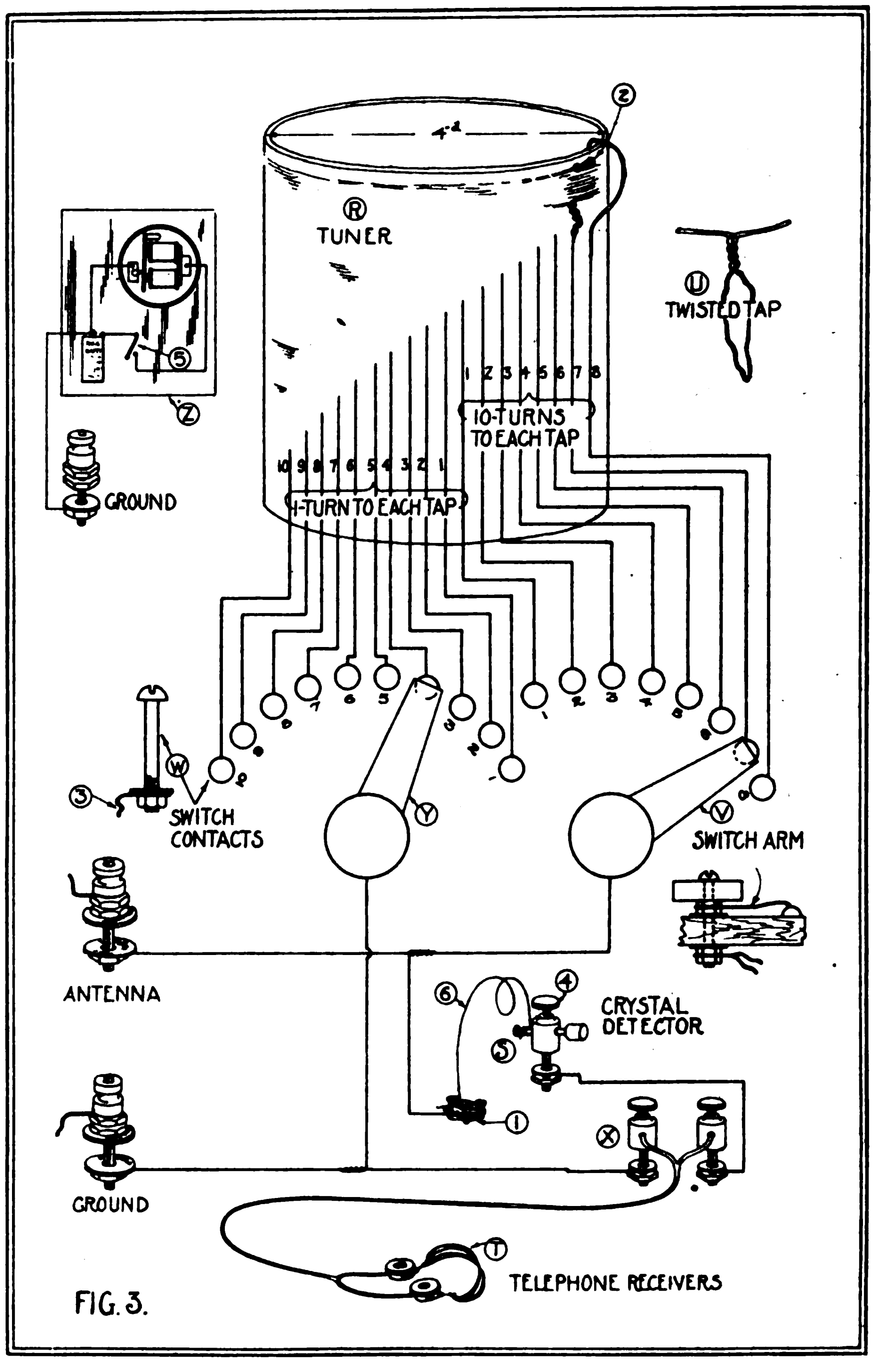
TUNER, DETECTOR AND PHONE

The detector and phone will have to be purchased. The tuner and certain accessories can be made at home.

Tuner (R, Fig. 3)—This is a piece of cardboard or other non-metallic tubing with turns of copper wire wound around it. The cardboard tubing may be an oatmeal box. Its construction is described in detail below.

Crystal Detector (S, Fig. 3)—The construction of a crystal detector may be of very simple design and quite satisfactory. The crystal, as it is ordinarily purchased, may be unmounted or mounted in a little block of metal. For mechanical reasons the mounted type may be more satisfactory, but that is of no great consequence. It is very important, however, that a very good tested crystal be used. It is probable also that a galena crystal will be more satisfactory to the beginner.

The crystal detector may be made up of a tested crystal, three wood screws, short piece of copper wire, a nail, set-screw type of binding post, and a wood knob or cork. The tested crystal is held in position on the wood base by three brass wood-screws as shown at 1, Fig. 3. A bare copper wire may be wrapped



tightly around the three brass screws for contact. The assembling of the rest of the crystal detector is quite clearly shown in Fig. 3.

Phone (T, Fig. 3)—It is desirable to use a pair of telephone receivers connected by a head band, usually called a double telephone headset. The telephone receivers may be any of the standard commercial makes having a resistance of between 2000 and 3000 ohms. The double telephone receivers will cost more than all the other parts of the station combined, but it is desirable to get them, especially if one plans to improve his receiving set later. If one does not care to invest in a set of double telephone receivers, a single telephone receiver with a head band may be used; it gives results somewhat less satisfactory.

Accessories—Under the heading of accessory equipment may be listed binding posts, switch arms, switch contacts, test-buzzer, dry battery, and boards on which to mount the complete apparatus. The binding posts, switch arms and switch contacts may all be purchased from dealers who handle such goods or they may be quite readily improvised at home. There is nothing peculiar about the pieces of wood on which the equipment is mounted. They may be obtained from a dry packing-box and covered with paraffin to keep out moisture.

Details of Construction

The following is a detailed description of the method of winding the coil, construction of the wood panels, and mounting and wiring the apparatus:

Tuner—See R, Fig. 3. Having supplied oneself with a piece of cardboard tubing 4 in. in diameter and about ½ pound of No. 24 (or No. 26) double cotton covered copper wire, one is ready to start the winding of the tuner. Punch two holes in the tube about ½ in. from one end as shown at 2 on Fig. 3. Weave the wire through these holes in such a way that the end of the wire will be quite firmly anchored, leaving about 12 inches of the wire free for connections. Start with the remainder of the wire to wrap the several turns in a single layer about the tube, tightly and closely together. After 10 complete turns have been wound on the tube hold those turns snugly while a tap is being taken off. This tap is made by making a 6 in. loop of the wire and twisting it together at such a place that it will be slightly staggered from the first tap. This method of taking off taps is shown quite clearly at U, Fig. 3. Proceed in this manner until 7 twisted taps have been taken off at every 10 turns. After these first 70 turns have been wound on the tube then take off a 6 in. twisted tap for every succeeding single turn until 10 additional turns have been wound on the tube. After winding the last turn of wire anchor the end by weaving it through two holes punched in the tube much as was done at the start, leaving about 12 in. of wire free for connecting. It is to be understood that each of the 18 taps is slightly staggered from the one just above, so that the several taps will not be bunched along one line on the cardboard tube. See Fig. 3. It would be advisable, after winding the tuner as just described, to dip the tuner in hot paraffin. This will help to exclude moisture.

Upright Panel and Base—Having completed the tuner to this point, set it aside and construct the upright panel shown in Fig. 4. This panel may be a piece of wood approximately ½ in. thick. The position of the several holes for the binding posts, switch arms and switch contacts may first be laid out and drilled.

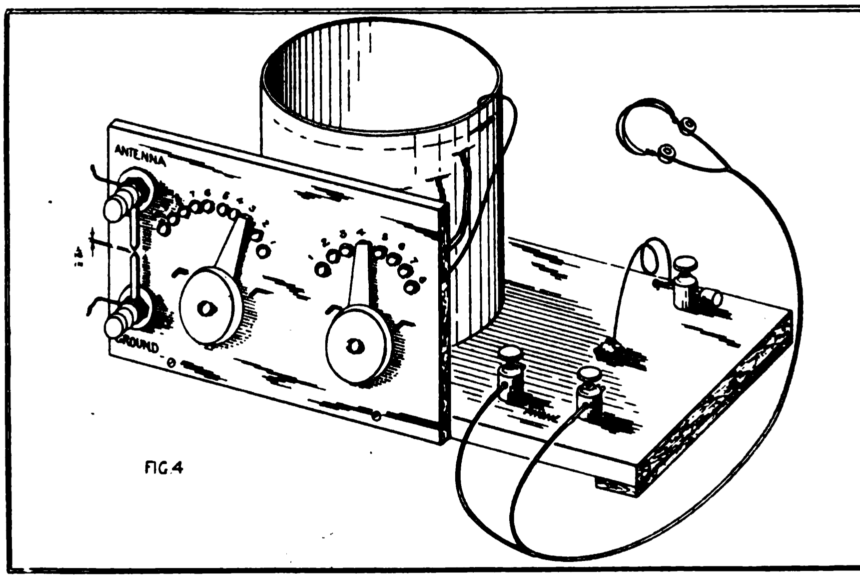


FIG. 4

The "antenna" and "ground" binding posts may be ordinary ⅛ in. brass bolts of sufficient length and supplied with three nuts and two washers. The first nut binds the bolt to the panel, the second nut holds one of the short pieces of stiff wire, while the third nut holds the antenna or ground wire as the case may be. The switch arm with knob shown at V, Fig. 3, may be purchased in the assembled form or it may be constructed from a thin slice cut from a broom handle and a bolt of sufficient length equipped with four nuts and two washers together with a narrow strip of thin brass somewhat as shown. The switch contacts (W, Fig. 3) may be of the regular type furnished for this purpose or they may be brass bolts equipped with one nut and one washer each or they may even be nails driven through the panel with an individual tap fastened under the head or soldered to the projection of the nail through the panel. The switch contacts should be just close enough that the switch arm will not drop between the contacts, but also far enough apart that the switch arm can be set so as to touch only one contact at a time.

The telephone binding post should preferably be of the set screw type as shown at X, Fig. 3.

Instructions for Wiring

Having constructed the several parts just mentioned and mounted them on the wood base, one is ready to connect the several taps to the switch contacts and attach the other necessary wires. Scrape the cotton insulation from the loop ends of the sixteen twisted taps as well as from the ends of the two single taps coming from the first and last turns. Fasten the bare ends of these wires to the proper switch contacts as shown by the corresponding numbers in Fig. 3. One should be careful not to cut or break any of the looped taps. It would be preferable to fasten the connecting wires to the switch contacts by binding them between the washer and the nut as shown at 3, Fig. 3. A wire is run from the back of the binding post marked "ground" (Fig. 3) to the back of the left-hand switch-arm bolt (Y), thence to underneath the left-hand binding post marked "phones." A wire is then run from underneath the right-hand binding post marked "phones" to underneath the binding post (4, Fig. 3), which forms a part of the crystal detector. A piece of No. 24 bare copper wire about 2½ in. long, one end of which is twisted tightly around the nail (the nail passing through binding post 4), the other end of which rests gently by its own weight on the crystal (1). The bare copper wire which was wrapped tightly around the three brass wood-screws holding the crystal in place is lead to and fastened at the rear of the right-hand switch arm bolt (v), thence to the upper left-hand binding post marked "antenna." As much as possible of this wiring is shown in Fig. 3.

Directions for Operating

After all the parts of this crystal-detector radio receiving set have been constructed and assembled the first essential

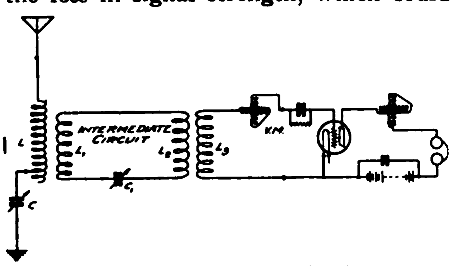
Continued on page 62

THE INTERMEDIATE CIRCUIT

By HUGH R. SPRADO

THE present crowded condition of the ether on short wavelengths, especially on 200 meters and on the radiophone concert wave, has forced the writer to make numerous experiments in the attempt to eliminate, or at least greatly decrease, the interference encountered.

In order that others may benefit through the results of these experiments, this as well as other papers have been written. One of the first successful circuits discovered, or rather, unearthed from ancient history, was the intermediate tuning circuit. This circuit was used in the early days of radio by the British Marconi Company in their magnetic detector receivers, but was finally discarded because of its inefficiency when used with magnetic or crystal detectors; the trouble lying in the fact that the increased selectivity offered, was offset by the loss in signal strength, which could



The Intermediate Circuit

not be afforded in those early days of low power transmitters and insensitive detectors. However, the vacuum tube detector and its N stage amplifier has brought back the possibility of this circuit.

The circuit consists essentially of an antenna tuning circuit composed of the primary of a variocoupler L in series with a tuning condenser C; an intermediate circuit of extremely low resistance composing secondary L_1, second primary L_2 and variable condenser C_1 in series; and a standard regenerative receiver secondary L_3 and grid variometer.

The selectivity of the circuit depends primarily upon the intermediate circuit L_1, C_1, L_2. The main requisite in this intermediate circuit is low resistance, and without this essential it is of little advantage. The secondary L_1 and primary L_2 should be wound with small copper tubing having as thin a wall as is possible to obtain. Should it be impossible to obtain copper tubing, No. 10 copper wire can be substituted. The variable condenser should have a maximum capacity not exceeding .0005 mf. and must have low resistance. Coto-Coil, or General Radio Company's type No. 182 condensers are recommended. The dimensions of the coils are dependent upon the wavelength range desired.

To adjust the circuit for an incoming signal, the antenna circuit is first tuned to approximately the wavelength of the transmitting station and with the coupling between antenna and intermediate circuit, and intermediate circuit and secondary fairly close, the intermediate circuit is adjusted to resonance with the antenna. The secondary or tube circuit is now adjusted for maximum signal strength. When all these adjustments have been made, loosen the coupling between the various circuits slowly, returning for resonance for each change in coupling. The coupling should be made as loose as is consistent with good signal strength. It will now be found that a fractional part of a degree on the intermediate condenser will completely erase the signal, and interference from stations only a few meters off of the working wave will be greatly decreased.

It is extremely important that no energy from the antenna circuit be coupled directly into the tube circuit. This is possible if the two coupling coils are in close proximity unless thoroughly shielded. It is advisable to separate the two couplers several feet and arrange the coils so they are at right angles. To test for any direct coupling effects, tune all circuits to resonance with some station that is transmitting a loud signal. Keeping all adjustments as made, open the intermediate circuit completely by removing some connecting wire. If the signal is still heard, energy is being transferred directly to the tube circuit and good selectivity cannot be secured. It will be necessary to further increase the distance between the couplers or rearrange their position until no signal is heard in the telephones. This test should be made with full amplification.

When all adjustments of coils have been made as outlined, the circuit will give great selectivity and, in many instances, louder and clearer signals than the single coupled receiver. Due to its extreme selectivity, the operator may have some difficulty in finding a certain station, but his efforts will be well repaid by the freedom from interference.

This intermediate circuit can also be calibrated and used as a receiving wave meter for checking the wavelengths of transmitting stations. A very accurate wavelength check can be made if the coupling is kept sufficiently loose to prevent any reaction between circuits. Accuracies within one-half of one per cent are possible on weak signals and one-tenth of one per cent on strong signals.

In conclusion, the writer wisher to imbed one fact: *The intermediate circuit must be of extremely low resistance to be effective.*

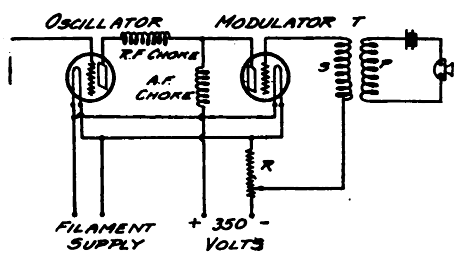
ELIMINATING THE GRID BATTERY

By HUGH R. SPRADO

IN all radiophone transmitter circuits using the Heising constant current system of modulating the oscillator tube output, a negative grid potential is required on the grid of the modulator tube. This grid potential, or grid biasing as it is called, is the most important adjustment on a radiophone transmitter and, when overlooked, is the cause of most of the distortion in transmitting speech.

Practically every schematic drawing of a Heising modulator shows a battery of dry cells in the modulator grid circuit to maintain the necessary negative potential. As a result, the experimenter uses dry cells; which in time become inoperative and noisy, causing all sorts of queer noises to be transmitted.

Fig. 1 shows a circuit by means of which the battery of dry cells can be dispensed with and a far more constant and automatic grid potential maintained. For simplicity, only the modulator tube connections are shown in the figure. P and S are the primary and secondary respectively of the modulation transformer.



Circuit for Eliminating the Grid Battery.

R is a variable resistance of sufficient capacity to carry the combined oscillator and modulator plate currents without excessive heating. This resistance is connected in series with the negative high voltage lead to the tube filaments and carries the total plate current of the oscillator and modulator tubes.

Any current passing through this resistance will cause a certain potential drop across its terminals, and it is this potential drop that we will use as a negative bias for the modulator grid.

Assuming that we are using two 5 watt Radiotrons, one as an oscillator and one as a modulator and also assuming that the proper grid potential for these tubes is negative twenty volts, we will find by Ohms Law that, with a combined plate current to both tubes of 100 milliamperes, the potential drop across a resistance of 200 ohms will be 20 volts.

Where

$I = .1$ ampere

$E = 20$ volts

$$R = \frac{E}{I} = \frac{20}{.1} = 200 \text{ ohms}$$

As this resistance is in series with the negative lead to the filament, the grid of the modulator will consequently be

Continued on page 74

Scratchi Starts Business Careering

By David P. Gibbons

To Editor "RADIO" (which amplifies its percolation in high-stepping fashion):

DEAREST SIR:

You will be quite glad, maybe so, to be inform that my Cousin Scratchi have obtained for himself new radio position and are again very joyously in synchrony with all mealtimes. He have now become gracious dispenser of knobs, dials and binding posts for wireless retailer who require only experts of supreme type. He extend to me permit to visit him and inspect the high-value stockup in showoff cases. I do so and while my cousin are giving lucid lecture to lady with little boy on oppositeness of vacuum bulb from rayolite crystals, I regard among the glassy shelves for some up-to-the-moment send and receive equippings, but fail to expose any such. Instead of these I gaze in upon some E. I. Co.'s model one slip coil tuners, and also many ancient audion detecting panels which are large and awkward as operator's trunk. When Scratchi discover that lady and little boy are even dumber than appearance, he supply hasty excusing and tell them come along again any time—not matter when, and he then explode to me how he propound to become great plute in radio gameplay.

"Are not some brains necessity to become that way?" I ask to find out.

"Those which I possess are very sufficient for purpose," he make rapid giveback to me. "Since I attain to touch up large groups of radio-buying public through generous square inch messages in truthful part of 'RADIO'."

"Mightbe then you have obtained learned degree from corresponding university for high paying adwriting experts?" I accuse him.

"Assuredly not," response of Cousin Scratchi, "as new system which I devolve are mostly composed of prize contesting and donating free souvenir objects for each cash sum which customer forward. For instant, with every A. P. A. tube, which are most sensible known to radiartist, I shall inclose one Lessgo Tuner, which last month at Ketchifcan, Alaska, make ten old sea dogs bark out 'Gosh ding your shandigaffs! Wot next!! Wot next!!!' Also with each Half-Ready B battery I shall wrap up one Gall Radio Delay Machine, which do everything which operator should do and have no intelligence either."

"How then," I say, "can you acquire difficult cash money when making such costly giveaways?"

"Because I shall also have for selling other equippings to go along with these, such as half dozen vary condensers, resisting coils, storing cells, without which donations are silent as Sphinx," he explanate. "Yes, silenter than two Sphinxes," he add in afterthink.

"What style of contest have you in head?" I wonder at him.

"With aid of Hon. Man, who know something of these, I shall derange new one each issue," quote Scratchi. "First one will be contest in snappy sending and snippy receiving and will be confined excludedly to old timer operators. Old timers are those who first learn of ships when Von Tirpletz and Hon. Hearst are sinking entire Pig's Island put-out daily on front page. In order to save country old timer made confidence talk with Embarcadero ship-candling person who supply him 1st class uniform and 1st class license for small down payment, and he then take part in many warmish engagements in San Pedro and Coos Bay sectors. He also accept slight bonus while doing so, which are much wiser than bearing around many tons of communicating wire at front with Signalling Core and seeking bonus two years after lucky comeback, among loud shouts of 'Stick up! Bums!!' and so on from reformed profiteers. Special prize for this test shall be beautiful hammered glass cuspidor of two trip capacity."

"When will this be yanked off?" I depose.

"Soon as all old timers are on beach once again," he quack, "and next prize struggle after this will be grand free-for-everybody QRM contest which shall be open to all, whether amateurs, professionals or admiraline operators. This event will be pulled over on Mile Rock Lighthouse at one minute to noon whistle and object are to compose wireless bloc against time and weather signals, and make foolish listeners still more foolish. Prize in this contest will be one-way tickets to Russia on first maru passing out, for the ten members with most solid domes."

"Are experts from glorious navy invite to partake in these premium winnings?" I rogate.

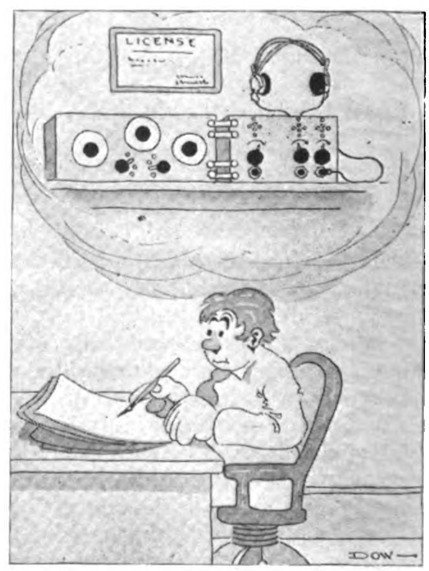
"Cannot allow such," moan my cousin, "since NPX, NPE and NPW now are world champions in long period sleeping contest, and can win all such prizes without moving fingers."

"Do business need much of this pepping?" I interfere.

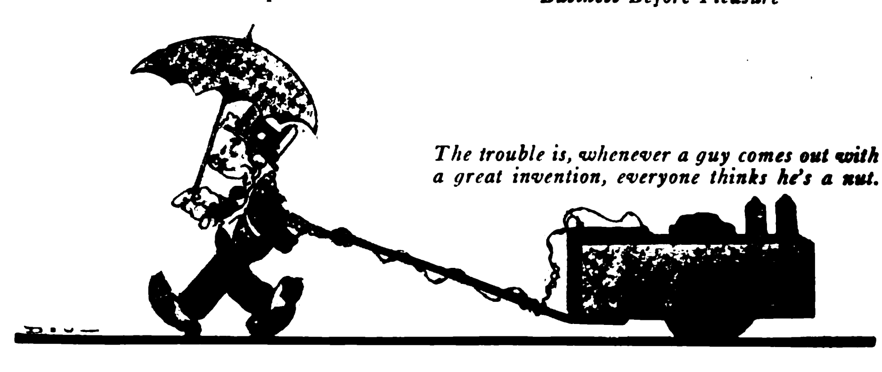
"Mine do," he make spreckely answer, "and in few months I shall retire to classy bungalow in Burlingame like all successful hootchleggers."

You see then Mr. Editor that my Cousin believe that radiogame are now beyond well known corner where business have been turning around for several past months, and hoping you are the same, I remain,

Your valued reader,
HILOLI NOGO.



Business Before Pleasure



The trouble is, whenever a guy comes out with a great invention, everyone thinks he's a nut.

Ralph Kline, Noted Character Impersonator, Exhibits Successively, Scepticism, Surprise, Realization, Interference, and Finally Complete Radio Satisfaction. Pictures Used by Courtesy San Francisco Bulletin.

THE RADIO FACE

Have you a "wireless face?"

There has been the "speed face," the "motor face" and the "airplane face." Now comes the "face" that is acquired from listening to a wireless telephone concert. It is the face of radio satisfaction, with the smile that refuses to come off. It is the face of contentment.

The "wireless face" is the face of the future. When every home shall have a wireless telephone in it, and broadcasted concerts are as common as debts, the general expression will be one of continued pleasure. If you would be down to date, install a wireless set, sit down before your mirror, and watch your "wireless face" grow.

THE WAIL OF A WIRELESS BUG'S WIFE

By BERNICE M. HARRISON

SAY, girls, if you think you've a grudge against life, just list to this wail from a wireless bug's wife.

I clean up my house, now real spic and span, then comes—a cyclone? No, just my man. Whang! goes a bottle on my clean kitchen floor. Some acid flies out and runs through the door. It rambles along 'neath the pretty new rug, while I stand and bless (?) my radio bug.

He looks so abused that I have to let up, and to hug me, he drops some lead on a cup. To cheer me he tells of a wonderful plan, "to cut out short circuits in any ash pan."

When he's out late at nights, "at other bugs' homes," he tells me he's been "to sift out some ohms."

He's forever at changing his station around. We sleep on antennae and cook on the ground. For breakfast we always, to please that big kid, have pancakes because they're baked on a grid. Our milk must always go through a condenser, or sometimes his language would hardly pass censor.

But then—I half think his mind's not quite right, for tell me, I pray, why should he bake a light? He's talking so much about "controlling jack." When I ask who that is, he just turns his back. Then sometimes he talks of "tuning a wave." It worries me sick to hear that bug rave. He talks of "mounting" on some kind of "plug," and "charging a battery," and something to "lug." The use of such slang, I just can't approve. He's got to reform, or someone will move. He's been "binding posts," and he says, "switching points," but I can't believe he's been "soldering his joints."

He has a new chum, whom he calls "Mike A." Now that may be who is leading my dear boy astray. "Resistance" he's talking from morning till night, and of "choking" someone till I'm fainting from fright.

There's wires in the parlor and strung through the doors. There's boxes and tables and things on the floors. The coal's on the lawn, for the shed's full of trash. It's enough to make any wife do something rash.

Oh girls! If you think you'd like married life, consider the wail of a wireless bug's wife.

THE D.X. BRINGER-IN

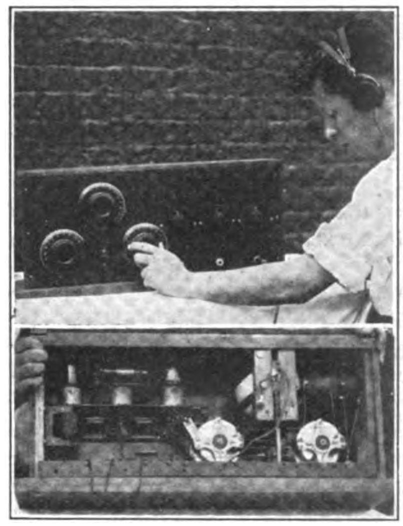
An All-Wave Receiver

By STUART A. HENDRICK, 2BJG

HEREWITH are pictures and diagrams of a receiver that will regenerate, oscillate and detect up to 30,000 meters, bringing in arcs from all over the world on detector tube alone. It has no dead-end losses as the long wave part is disconnected from the rest of the circuit while not in use. Signals will not fade after removing hand from knob. No shielding is necessary. No switches or contacts are necessary over the entire range. It is easily tuned, having but one wavelength control, one vernier and a regenerative control.

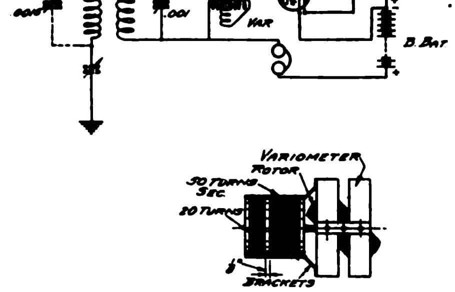
The picture of the rear of the set shows a variometer and a coil on the side of it. This coil contains the fixed primary and secondary windings. It is 3 in. in diameter and 4 in. long. The secondary nearest the variometer has 50 turns of No. 18 wire, D. C. C., and the primary has 20 turns of No. 18 D. C. C. wire 1/8 in. away from the secondary wound upon the same tube. This coil is the secret of the sharp tuning and regeneration.

Two variable condensers are used to tune these coils, a .001 mfd. across the secondary, and a .0015 mfd. either in shunt or series with the primary. The secondary condenser tunes extremely sharp and the primary condenser is used as the vernier. The variometer controls the regeneration.



Front and Rear View of Set

This makes a fine short wave set, which is the equal of any on the market today, and does away with the hard tuning of the ordinary two-variometer set. The wavelength may be calibrated directly upon the secondary condenser scale.



Circuit Diagram

To get the long waves, the set should be loaded with honeycomb or similar coils in the primary, secondary and plate circuits at the place marked X in the circuit diagram. These can be movable or fixed, but the correct polarity will have to be found by experimentation. Plugs and jacks or key-switches may be used to insert these loading coils in the circuit. The grid condenser is rather critical, and should be made by clamping two copper strips 1x1/4 in. on each side of a piece of .003 (3 mil.) mica.

A Radio Primer

By H. A. Eveleth

The Ether

THERE seems to be a general impression among people who are not acquainted with the principles of wireless communication that the air is the medium by which wireless signals are transmitted. They hear the received signals as sound and naturally assume that the receiving instrument has the faculty for picking up sound waves sent out from the transmitting station. This is, of course, not so.

The medium of transmission of wireless signals is the so-called ether, a "something" which is believed to exist throughout all space. Scientists cannot describe it with certainty nor give definite proof of its existence, but they assume that it must exist in order to account for the phenomena of light, heat and certain electrical effects. For instance, we receive light and heat from the sun, a distance of some 93,000,000 miles. Now those light and heat rays must be carried by a medium just as your voice is carried by the air. Several hundred miles above the surface of the earth there is no air. Therefore light and heat waves from the sun must be carried by some other medium, which is called the ether. Observations show that the ether must exist between the molecules of all matter, in fact the earth rushing through it at a velocity of thousands of miles an hour causes no displacement of the ether, in other words the ether passes through the earth like air through a sieve; further, that it is of an extremely elastic nature, so much so that a disturbance of the ether at any point immediately spreads out in all directions just as the sound waves spread out when a gun is fired.

Air waves travel about 1100 feet per second while ether waves have a velocity of about 186,000 miles per second. This terrific velocity, which according to the Einstein theory is the greatest that can be attained in the universe, can be quite accurately measured. Light, heat and wireless waves are all forms of ether waves. You can create sound waves by making a "noise." You can create water waves by tossing a stone into water. The function of the wireless transmitter is to create ether waves and the function of the wireless receiver is to detect those ether waves and change them to sound waves which can be heard and understood.

Wave Motion

IF you toss a stone into a pond of water a series of waves spread out in all directions over its surface. If it is a small stone it will generate a series of small waves quite near together, while a larger stone will set up bigger waves which are not so close together. The distance between two successive crests of two waves is called the wavelength. In the case of these water waves it may be a few inches or it may be several feet. The larger wave is what you might call a higher wave and it is said to have more amplitude than the smaller wave. It has more energy and can do more work, such as lifting a piece of drift wood, because it was generated by a larger stone.

A series of waves in the ether, or wave-train as it is called, is created whenever a flow of electricity takes place. The particles of which electricity is composed, called electrons (the exact nature of which is not known) have a "grip" on the ether, so to speak, and cause a stress or strain to be set up in the ether whenever a movement of electricity takes place. By reason of its great elasticity this disturbance in the ether spreads in all directions in the form of ether waves, with the velocity of light, 186,000 miles per second. The smallest ether disturbance, even that caused by the flow of current when ringing a bell, sets up ether waves which travel to an indefinite distance. Our problem is to improve our receiving apparatus rather than our transmitting apparatus. Ether waves can be sent around the earth with an expenditure of little energy. The problem is to perfect our apparatus so that it will detect waves of extremely small amplitude. At present our trans-oceanic stations have to employ hundreds of kilowatt of power because the receiving apparatus will not detect the signals if less power is used.

Wavelength

THE law says that amateur stations shall not transmit on a wavelength greater than 200 meters. Just what does wavelength mean?

Going back to our water analogy we said that the wavelength is the horizontal distance between two successive wave crests. So in the case of ether waves a wavelength of 200 meters would mean that the horizontal distance between two successive crests is 200 meters. A meter is a little over 39 inches.

We said that ether waves have a velocity of 186,000 miles per second. This is equal to about 300,000,000 meters per second. Remember this is not theory; it can be shown by experiment. Since the velocity of ether waves is practically the same under all conditions if we know the wavelength we can tell how many waves there are per second, or what the rate of vibration is, in other words, the frequency. For instance, a wavelength of 300 meters would represent a frequency of one million cycles per second because 300 million divided by 300 gives one million. The present practical limits of wavelength range for radio communication are 150 meters to 20,000 meters, which represents a vibration range of from two million to 15,000 per second which would be inaudible. The average human ear cannot "hear" sound waves below forty nor above 10,000 vibrations per second. So it is apparent that "radio-frequencies," as they are called, are inaudible. Hence our receiving apparatus must reduce the radio-frequencies to audio-frequencies, so they can be heard, and this is the function of the detector in the receiving apparatus. The detector rectifies the high frequency radio current to an audio pulsating direct current which can be heard in the receivers.

All light and heat waves are ether waves of extremely short wavelength and high frequency. Your eyes detect ether light waves and your nerves ether heat waves. The different frequencies of ether light waves determine the different colors. Heat waves consist of 20 trillions to 300 trillions of vibrations per second; light waves 430 trillions to 740 trillions per second and ultra-violet and X-rays 870 trillions to 1500 trillions per second.

Absorption, Reflection, Refraction and Diffraction of Electric Waves

CONSIDERABLE energy is absorbed from ether waves as they travel over the country. Irregular country, that is, rough and hilly with forests, absorbs more energy than level country. Foliage absorbs energy from the advancing wave, hence a station located in heavily wooded territory can transmit farther during the winter months than during the summer months. Bear in mind that trees are more or less conductive and tend to absorb energy just as aerials do, in fact trees have been used as aerials for receiving messages by connecting a wire to spikes driven into the tree trunks. Buildings absorb energy; in fact any object extending into the air and grounded tends to rob the ether waves of energy. The better conductor the object is the more energy it absorbs.

All soils absorb energy to a certain extent. The greatest distances of communication can be accomplished over salt water. The absorption over some soils is 30 times as great as over salt water.

Much greater distances can be covered at night than during the day. This is thought to be due to ionization of the higher atmosphere by ultra-violet light from the sun, which makes the air conducting and hence absorbs energy.

Continued on page 55

How to Finish Your Cabinet

By **B. H. Linden, Assistant Radio Inspector**

TOO much stress cannot be laid on the importance of a properly finished cabinet in the neat appearance of a radio station. Most amateurs do not realize this, or otherwise their stations would bear witness to this fact. Is it because the pocket book is too slim and the lack of knowledge is such that the amateur becomes satisfied with almost anything for a covering of a set that justly deserves better? If so, then this article will not go amiss.

When one contemplates the construction of a building, the foundation is of the utmost importance and so it is with the finishing of a piece of wood. First see that all planer marks are removed and that a flat, smooth surface is obtained by the usual method of scraping and sandpapering; always use a block when sandpapering, as this insures a flat surface, doing away with the possibility of having mounds and hollows which would show up in a highly finished cabinet. It is surprising how polishing the surface of an object brings out the defects that exist which otherwise might hardly be noticeable.

There are various kinds of stains that may be employed for a satisfactory coloring. Among them are alcohol, oil, turpentine and water stains. The alcohol and water stains have a tendency to raise the grain of the wood so as to make finishing more difficult, but on the other hand their use results in a clean, bright looking completed work. Johnson's wood stains are recommended, as the writer has obtained some very excellent results with their use. Otherwise, powdered aniline with alcohol may be used. As aniline is a coal tar product, any solvent derived from coal tar, such as benzol, can be used. Aniline and water make a very good water stain. Umber in its raw state, calcined or burnt can be used with either water or oil. It is the same with ochre. As umber and ochre are of ferruginous clays and can be found in various forms and colors, they make a very permanent stain when used with boiled linseed oil and turpentine, also allowing a variety of colors when mixed.

If it is desired to give gum wood a rich golden finish, simply mix sufficient turpentine with boiled linseed oil so as to make it flow easily and apply to the natural wood with a brush. As gum is a fine grained wood, the oil, in addition to its staining qualities, acts as a splendid filler, drying very hard.

Turpentine and lampblack make a reasonable as well as excellent stain for oak and pine. This combination should be applied with a brush and rubbed off before dry. The mixture should be rather thick, about the consistency of priming paint. Various shades may be had by the addition of ochre and umber.

In building up a body to work upon, shellac may be used entirely, three coats of shellac and a flooding coat of varnish, or just varnish alone. If the work must be completed in a short time, the first method should be employed as shellac drys so quickly; it being possible to finish a cabinet in one day. When varnish is used, three days at least, should be allowed. Remember the importance of shellacing and, especially, varnishing in a warm and dust-proof place, also that the brush to be used should be free from dust particles. Extreme care should be exercised in sandpapering or steelwooling between each application of either varnish or shellac.

After the drying of the final coat, when pores of the wood should be entirely filled, everything should be ready for the last steps to be taken for obtaining the lustre and polish which is so much desired. There are two means whereby this end can be accomplished; one is by the use of rottenstone and the other by means of French polishing. The former is by far the easier, but sometimes the latter is preferred.

When rottenstone is to be the polishing medium, then a felt pad, one-quarter inch thick, should be mounted on a hand block and used to do the rubbing with. Rottenstone and water applied freely with plenty of "elbow grease" will obtain the desired results. Obviously, washing and then dry polishing with a clean cloth is necessary after rottenstoning. A dull gloss finish may be obtained by using oil with rottenstone instead of water.

French polishing is a great deal more tedious. A rubbing pad must be made of a woolen core and a linen covering. This pad is partially saturated with alcohol and a small amount of shellac, while a very few drops of raw linseed oil are sprinkled on the piece to be finished so as to prevent sticking. Now, with a continuous circular movement with the pad on the object to be polished, the body of shellac or varnish can be loosened and moved around gradually so as to obtain a very smooth surface, after which the pad is allowed to dry out by lengthy rubbing when a high polish will be obtained.

In order to French polish properly, some practice on material not needed will be necessary, as the first attempt usually turns out to be a failure. If one learns the art of French polishing, scratches, watermarks, weather checks, etc., can be removed from furniture and the original lustre and finish brought back by just using the above mentioned pad, with alcohol and raw linseed oil, on the old body, without any further application. Similarily, the original lustre may be brought back on automobile bodies when the varnish is still intact.

TEXAS RADIO MARKET NEWS SERVICE

Plans to install agricultural market news for Texas daily by radiophone have been completed after a conference between officials of the State Department of Agriculture, State Department of Markets and Warehouse, the University of Texas and the Federal Bureau of Markets and Crop Estimates, Washington, D. C. The necessity for a general diffusion of reliable information fresh from the loom is evidenced by a growing public desire from all trades and professions, manifested in the great number of constant inquiries and requests received daily by state officials for information.

The plan is to obtain daily market reports from the central markets of the country through the Kansas City office of the United States Bureau of Markets and Crop Estimates and from other sections of the country through other agencies. The data will be collected by the State Department of Agriculture, compiled by the State Markets and Warehouse Department, and disseminated by the University of Texas. The news will be broadcasted through the University high power radio station each day to the various radio receiving stations throughout the state promptly at a given time, which time will be announced later.

It is thought that this service will be of greatest value to farmers, farmers' organizations, distributors of farm products and commercial organizations, but any individual, association or organizations may also receive it free of cost by installing a simple radio receiving apparatus which can be had at a small cost.

Texas has many radio clubs, and literally hundreds of radio receiving stations fully equipped to receive radiophone messages. It is probable that the Chambers of Commerce in each town or city will wish to make their organization the radio news center for the community by posting bulletins and relaying the news by telephone to interested parties. It is contemplated, if possible, to release the news from Austin at a time which would seem most convenient for the press.

Geo. Endress, who represented the University of Texas in the conference, will have charge of the university radio station, and J. Austen Hunter has been designated as a joint representative of the

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Resistance in Radio Circuits

By Charles K. Fulghum

IT IS the purpose of this article to explain to the reader the "hows" and "whys" of resistance in circuits oscillating at radio frequencies. The effect of resistance on the various elements of such circuits will be dealt with in such a way that the amateur may grasp the importance of its proper distribution in such circuits.

The loss of electrical energy due to the electronic structure of a conductor carrying an electrical current, and depending on the proportions and qualities of that conductor, may be expressed in terms of resistance. Since resistance in any circuit represents power loss it is desirable to minimize it. This is especially true of radio circuits where resistance not alone represents power loss but may seriously interfere with the proper functioning of that particular circuit.

Direct currents flowing in a conductor are evenly distributed through it, but we find that alternating currents of radio frequencies have a tendency to flow on the surface of the conductor. This "skin effect" increases with the frequency and at very high frequencies the current flows entirely on the surface of the conductor. The resistance of conductors carrying such currents depends largely on the surface condition of the conductor. The form that the conductor takes has been found, also, to greatly alter the resistance. This high frequency resistance has been calculated for certain forms of conductors and the ratio of d.c. resistance to a.c. resistance at various frequencies has been determined.

Copper tubing has been found to offer the least resistance to currents of radio frequencies and its use in radio circuits has met with wide favor. Copper strip is also used, but the edge effect presents a drawback to its use in certain forms of apparatus, especially the oscillation transformer.

Stranded wires of a variety of forms have been designed to lower the high frequency resistance. The use of such wire is particularly recommended in the construction of inductances of high values.

For a minimum of resistance to high frequency currents of large values, a conductor composed of parallel strands widely separated, has been proposed. Such antenna, correctly constructed and designed, offer a minimum of ohmic resistance and a maximum of radiation surface.

Considering the radio circuit and resistance in general, it may be said that aside from the power losses entailed by the resistance in the circuit, it also has the effect of increasing the damping of the oscillations taking place in that circuit and of lowering the "sharpness of resonance." Increasing the resistance in such a circuit will cause it to tune "broad," all other constants remaining the same. Since selectivity is a most desirable feature in the receiving unit, it would be well to look to the minimization of the resistance in that part of your apparatus. In wave meter work the problem of resistance should be seriously considered. As the resistance will vary with the frequency, it is well to calibrate the instrument at a number of frequencies, especially if it is to be used as a decremeter. This resistance measurement is made by the U. S. Bureau of Standards.

Since the antenna may be considered as a simple radio circuit, it is apparent that if we want sharp tuning and a "persistent" antenna, we should keep the ohmic resistance of the system as low as possible.

While considering antennae systems an explanation of the term "radiation resistance" would not be out of place. Since radiation represents power loss we may express this loss in terms of resistance. Thus "radiation resistance" is merely an expression of power loss by radiation. It varies inversely as the square of the wavelength, and is proportional to the square of the current flowing at the anti-node of the antenna.

The effect of resistance on the various components of the oscillating circuit is very marked. This is especially true of the capacity elements of such circuits. Serious losses may take place in radio circuits due to poor condensers, or condensers with imperfect connections.

A perfect condenser when introduced in to the radio circuit will not add to the resistance of that circuit. Such a condition is not realized in practice, however. In a resistance the current and voltage are in phase with each other, but in a condenser the current is 90° out of phase with the voltage.

A condenser placed in a circuit that is in oscillation acts as a conductor by virtue of its capacity, but if we put a condenser that is imperfect, i. e., one that introduces resistance into the circuit, in such a circuit we will cause serious power losses. These losses depend upon the resistance caused by the condenser and upon the frequency of the oscillations occurring in the circuit.

Should we use a condenser with an imperfect dielectric or one with leakage between the plates, we would find that these losses grow less as the frequency is increased. A condenser with a resistance in series, however, causes power loss which increases with the frequency. This resistance may be caused by imperfect connections or by poor contact between the plates. The resistance of the plates is usually small and its effect may be considered negligible.

The effect of resistance upon the inductance in the circuit is not as serious a consideration as its effect on the capacity. In general, the resistance should be kept as low as possible. In designing inductances, especially if they are to be used in wave meter work, the amateur should use wire that will not unduly increase the resistance of the circuit in which it is used and the inductance itself should be designed with a minimum of resistance in view. There are proper proportions for inductances which will keep the resistance at radio frequencies at a minimum. These data may be found in various texts on the design of radio apparatus and the reader can gain much aid from the publications of the Bureau of Standards.

In thermionic tube circuits the grid leak often plays an important part. The grid leak may be defined as a non-inductive resistance element shunted across the grid condenser. It functions as a leakage path for the negative charge which accumulates on the grid. Were it not for this resistance, the charge would become so great as to paralyze the action of the tube. In power tubes of high rating this charge may represent a current of fairly high amperage. The necessity of employing resistances that will adequately handle this current is apparent.

It may puzzle some readers why the specification "non-inductive" is made. Altho the current that flows in this circuit is really d.c., it is rapidly fluctuating, and possesses the characteristics of an a.c. Were a resistance used that was inductive, i. e., a coil of wire of the required resistance, it would act as a choke and prevent the proper action of the tube. Shunted across the condenser it would act too, as a frequency trap.

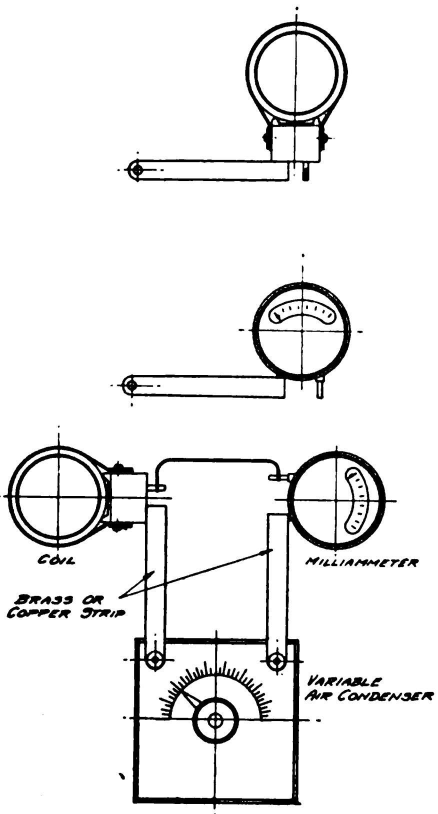
In receiving units using vacuum tubes, the resistance of the receivers used is an important item. Some amateurs think that it is upon the resistance that the sensitiveness of the receiver depends, but this is not true. Using vacuum tubes it is necessary that the impedance of the receiver equals that of the tube used. The same is true of inter-valve transformers and of telephone transformers if they are used. The sensitiveness of the receiver is dependent, however, upon the number of ampere turns producing a maximum magnetic flux in the poles and diaphragm.

It is hoped that the above outline will give the reader something to think about and that he will, after reading this make a serious study of the connections in that "pile of junk" (father's words), that he so proudly designates as a "real regenerator."

Construction of a Wavemeter for Tuning C. W. Transmitters

By George F. Patrick

A WAVEMETER for amateur work having a range of from 150 to 450 meters may be put together at a low cost by any club or individual. A calibrated variable air condenser, an inductance of known value, and a thermo mil-ammeter or current squared meter are required. The coil may be home-made if desired, although it may be purchased for less than $2.00 from one of the radio supply houses. The condenser and mil-ammeter may be purchased at a cost of $20 or less for both.



Meter Assembly, Below, with Details of Coil and Meter Mounting, Above.

The coil should be of rigid construction so that its turns and shape will not be disturbed in handling, as this would cause a slight change in its inductance value. It should preferably be of Litz wire and of honeycomb, duo-lateral, or lattice winding in order to keep the distributed capacity at a minimum. This is not necessary, however, as any kind of wire or winding will do where approximation is sufficient and very accurate results are not sought. An inductance value of 57 micro-henries in such a coil when used with an air condenser of .001 micro-farad capacity at full scale will give a range of 150 to 450 meters wavelength.

The better way is to order such a coil of 57 micro-henries inductance from one of the manufacturers who put out coil units for use on receiver panels, with instructions to measure its inductance accurately and mark the value plainly on the coil. Its slight expense is preferable to buying material, making a form, calculating the size and number of turns, winding, and then most important of all, calibrating a coil.

Variable air condensers of .001 microfarad capacity may be purchased for from $5 to $10, depending on the mounting. It pays to buy the better class for wave meter use, as those having a skeleton mounting leave the plates exposed and liable to be bent or disarranged through handling, which would disturb the calibration. In ordering, stipulate that an accurate calibration curve must accompany the condenser unless there are means at hand for calibration. As a rule such means are lacking in the amateur station.

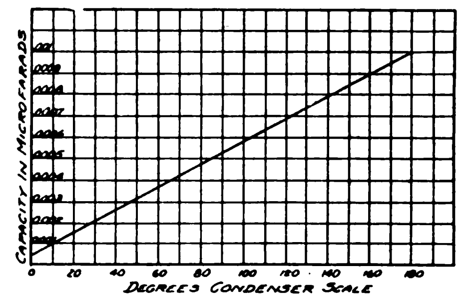
A mil-ammeter with full scale reading of 100 mils is suitable and such may be purchased for about $10. Two strips of brass or copper 1/8 in. thick by 1 in. wide and 6 in. long, with one end of each strip drilled to fit over the two binding posts of the condenser and the ends drilled to take one connection post of the coil and the mil-ammeter respectively, complete the wave meter. The mil-ammeter and coil are connected by a straight piece of low resistance wire just long enough to reach both connections. The coil and meter mountings and the assembly are shown herewith.

The wavelength values may now be computed and the curve constructed using the values furnished with the coil and condenser and the formula

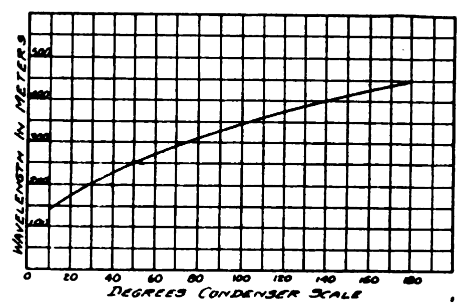
$$WL = 59.6 \sqrt{LC};$$

wavelength being expressed in meters, capacity (C) in micro-farads and inductance (L) in centimeters. If the inductance of the coil is given in micro-henries multiply this value by one thousand to convert into centimeters.

If the company furnishing the condenser does not furnish a calibration curve, but only maximum and minimum values of the condenser it will be necessary to construct a curve. This however, amounts only to marking the points of maximum and minimum capacity on a sheet of co-ordinate paper and drawing a straight line between the two points, the curve approximating a straight line. From this curve we read the condenser capacity at 10, 20, 30, 40, 60, 80, 100, 130 and 170 degrees of the condenser scale. In the curve shown herewith for example, these values would be .000097, .00015, .0002, .000255, .00036, .00047, .000575 .000735, and .00095 mf. respectively. Figuring the wavelength for these values, using the value of 57,000 cm. for our coil and the above formula we obtain wavelengths of 140, 174, 201, 227, 270, 308, 341, 386, and 439 respectively. Plotting these values against condenser scale degrees on a sheet of co-ordinate paper we obtain the wavelength curve. If desirable a paper scale may be

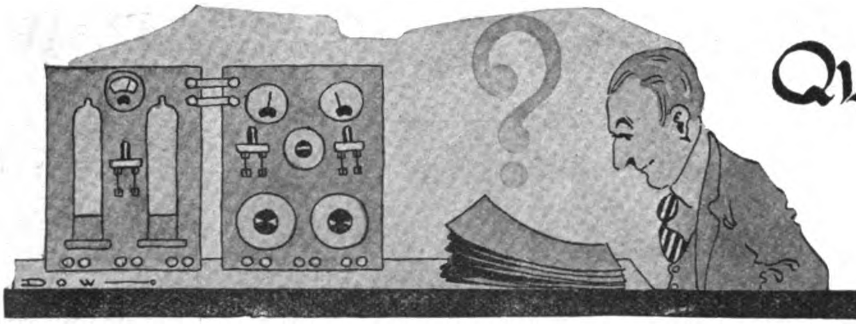


Calibration Curve of Condenser



Wavelength Curve

pasted on the condenser top and the wavelengths marked opposite every five degrees of the scale. This will allow direct reading instead of having to refer to the curve. If another calibration wave meter is available the better way is to calibrate the new instrument from it, using it as a driver by means of a buzzer and marking the resonant point on the meter being calibrated as indicated by a crystal and telephones connected across the condenser. Two coils, one of 30 micro-henries and one of 60 micro-henries, with calibration curves for each would be better than one of 57 micro-henries and would give better results. It must be understood that there will be inaccuracies more or less pronounced in such a wave meter. The only way in which these can be avoided is by very careful design and construction and laboratory calibration. Such a meter however will prove useful around a station and the cost is not prohibitive.



Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor

Question: I am sending a circuit for an I. C. W. transmitter, using a spark coil for the plate supply. This works well on one 5 watt tube. Would a British spark coil, 3 or 4 inch size, furnish sufficient power to supply a 50 watt power tube in this circuit?

W. A. B., Soneham, Mass.

Answer: I doubt very much if the spark coil you have would furnish the power necessary for a 50 watt tube. You can make your transmitter more flexible by making the following changes shown in Fig. 1.

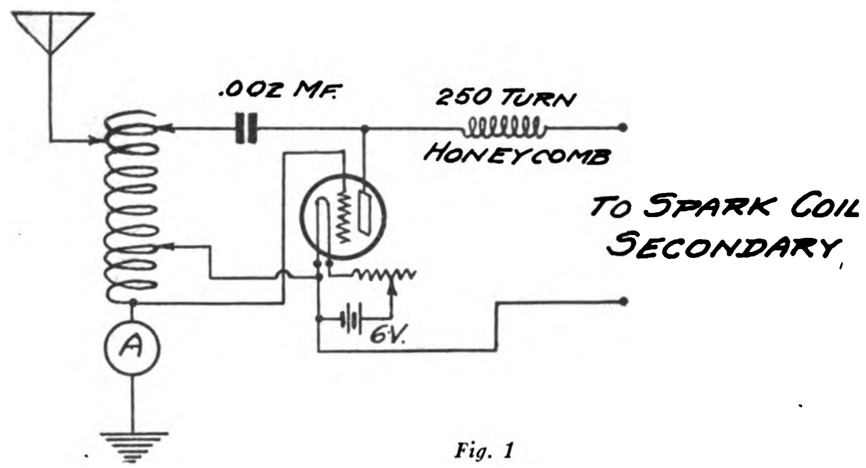


Fig. 1

Question: Kindly furnish me with the name of a book covering the manufacture or construction of relays for wireless control.

B. M. M., Spokane, Wash.

Answer: With the exception of occasional articles written for the various radio publications, by experimenters interested in such work, there are no books on the subject. If you are interested in the purchase of a relay, however, I would suggest that you write to J. E. Jones, Box 22, Palo Alto, Calif., who is distributor for the Hall Recording Relay.

Question: Please tell me which antenna would be most suitable for receiving 360-meter concerts; one wire 150 feet long, or four wires 75 feet long, the former being the easiest for me to construct.

E. W. F., Dixon, Calif.

Answer: If the antenna is to be used for receiving only, by all means use the single wire 150 feet long, as such an aerial, together with the lead-in and ground leads, would have a fundamental wavelength just about right for the 360 meter music.

Question: Please publish a diagram of a two-step audio frequency amplifier to include automatic filament control, using Remler cam switches instead of jacks, and same "A" and "B" batteries. Please give me a circuit for a 4-jar electrolytic rectifier for charging batteries.

P. E. R.

Answer: Fig. 1 on page 29 of the March number of RADIO answers all of your questions except the Remler cam switch. If you use automatic filament control jacks you cannot also use cam switches. Which do you prefer? The circuit for the 4-jar rectifier is shown in Fig. 2.

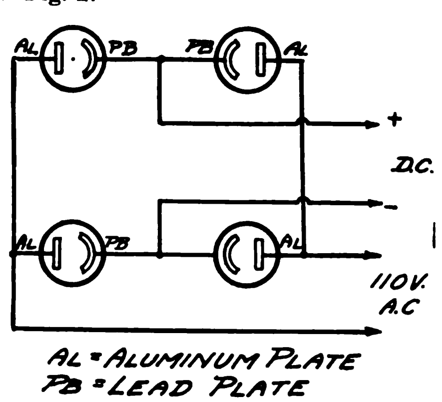


Fig. 2

Question: In the Armstrong super-heterodyne circuit shown in February Radio, what coils will have to be changed in order to increase the wave length of the set? Should the heterodyne oscillator coils be variable?

I. A. N., Lockport, N. Y.

Answer: The antenna tuned circuit coils, and the Heterodyne Oscillator coils

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HOW TO DESIGN A C.W. ANTENNA FOR 200 METERS

By GERALD M. BEST

A FEW days ago I heard two C.W. enthusiasts comparing notes with each other via the air route, one being sharp on 200 meters and the other somewhere around 230 meters. The one with the higher wavelength was complaining of his inability to make his C.W. set oscillate on 200 meters and he was asking the other for advice as to what changes he should make in his inductances, series condenser, and other apparatus, in order to get down to the legal wavelength. There is every reason to believe that the seat of the trouble lay not in his apparatus, but in his antenna system, which probably had a fundamental wavelength so far above 200 meters as to render work on that wave impossible.

This seems to be the experience of many beginners in C.W. They construct a large antenna, perhaps 150 ft. long and 50 ft. high, and when they begin transmitting, to their dismay they discover that the lowest wavelength at which the transmitter will function is well above 200 meters and no adjustments will persuade the set to oscillate on or below the legal wave.

It is for those amateurs who are in such a difficulty, that I review briefly the reasons why a small antenna is better for C.W. work than a large one.

We have had a regular epidemic of freak antennae of late, ranging from wired cage types to bed springs and screen doors. Thanks to Ensign Dow's discourse on "Why the Cage Antenna?" in the March number of RADIO, it will not be necessary at this time to give any particular reasons why the cage types are no better, if as good, as the flat tops. Neither will I quarrel with the advocates of the "fan" antenna. The latter takes up a lot of room, which few of us have to spare, and is expensive to construct. Hence, I will assume that one of the flat top types, such as the "T", inverted "L" or slanting "L" of four wires, will be the one most commonly used in C.W. transmission.

There are two principal reasons why it is highly desirable when using C.W. to have an antenna system with a fundamental wavelength well below 200 meters. One is to thus avoid the use of a series condenser, which not only re-

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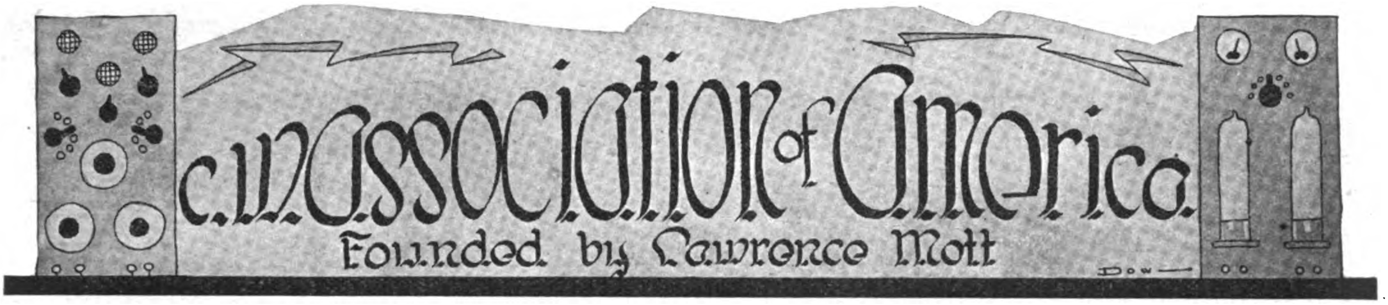


RADIO 3FS

By C. J. BENZING

Following is description of station 3FS, at 2425 S. Twelfth St., Philadelphia, Pa.:

Transmitter when heard by 6XAD and 7FQ was only 10 watts with radiation of 2 amps, using rectified a.c. and 550 volts. The rectifier consisted of 12 jars (6 on a side). Rectifier consists of ½ inch strips aluminum and lead plates 1/16 inch thickness, and saturated borax solution. Have since increased power to 15 watts with 16 jars and plate voltage of 700. Radiation, 2.6 amps. Using Colpits circuit with high voltage across ground condenser. My receiver consists of home-made regenerator with 1 step of audio amplification. The antenna is of the inverted L type, 60 ft. high at free end, and 50 at lead-in end. 6 wires spaced 3 ft; ⅜" pipe for spreaders. Masts are iron pipe. The guy wires and masts are grounded, being connected in with regular ground, which consists of water gas and drain pipes. Antenna 45 ft. long.

Radio 3FS

Station 3FS C. W. transmitter has been in operation since August, 1921, and has been heard in every district.

ASSOCIATE EDITOR'S NOTE: It will be remembered that I made especial mention of Mr. Benzing's wonderful work—on 2 five watt tubes—in March RADIO. But it is only fair for me to add that this photograph of his transmitter and receiving apparatus is as astounding to me, as it well must be to all who understand C. W. work! I repeat my statement of last month, to the effect that I have had great pleasure in working 3FS on many occasions—as our logs will show. He is always QRK at Avalon, Catalina Island, Calif., and when QRM and QRN permit I work him with as much ease as a local on the neighboring mainland!

6XAD will not be on the air regularly between April 1 and Oct. 1 due to increasing QRN, and because of his duties as game warden during the fishing season at Catalina Island.

I would point out that in 3FS we have no huge outlay of money invested in *intricate, farcial and useless apparata!* We see no 250 watt tubes lying side-by-side, like a lot of pot-bellied, drunken soldiers! We see no maze of wiring—cob-web fashion — *everywhere!* 3FS brags of no marvelous antenna and ground systems! The photograph shows no 4-5-6-7-8 steps of amplification!

No! In this photograph we are shown such a set as practically ANY amateur can afford. Modest, very neat, and marvelously efficient, I present to our readers that which, to my mind—and I have worked many Eastern C. W. stations—is as MODEL, inexpensive C. W. set of apparatus as I believe exists in the U. S.! And I would point out to them that are interested, and who might become interested in C. W. transmission, that Mr. Benzing is in the heart of a great city, with all the attendant radio difficulties of imperfect grounds, inadequate space for aerial, losses from nearby metals, etc. YET his signals reach unto 6XAD with unvarying clarity and precision!

Compare these two results:

1. From the shores of the Atlantic Ocean to Scotland — ALL OVER WATER—on 990 *admitted* watts.

2. From the center of a great city—across the entire United States on TEN watts!

Further remarks are superfluous! (Saving to remark that 3FS received 6XAD on but TWO-steps of amplification.)

THE FALLACY OF MUCH AMPLIFICATION

By LAWRENCE MOTT

IN the last issue I briefly took up the matter of having been able to reach great distances from my station—6XAD, on Catalina Island, California—with but four five-watt tubes, on a wavelength of 220 meters. Since that time there have been numerous DX stations worked by me, and reporting me, on this small set, whose calls I give further along.

The objective of this article is to once and for all time disprove the alleged theory to the effect that many stages of amplification are imperative for DX reception. For the last month I have been working 3AQR (Hershey, Pa.), 8BUM and 8BSS (Syracuse, N. Y.), 8AWP (Syracuse, N. Y.), and 3ALN (Washington, D. C.) with great regularity—delivering messages to these stations on four five-watt tubes!

So much for this.

I propose now, to briefly quote from the hundreds of cards that I have—in order to show the kind of apparata that my signals have been received on—all over the United States and Canada. These facts will amply speak for themselves.

1BLN (Westfield, Mass.) on detector only.
2F (Brooklyn, N. Y.) on detector and 2-step.
3ALN (Washington, D. C.) on detector only.
3BHY (Philadelphia, Pa.) on detector only.
3CA (Roanoke, Virginia) on 2-step.
3CG (Newton, New Jersey) on 2-step.
3HJ (Harverford, Pa.) on 1-step.
3BF (Roanoke, Virginia) on 1-step.
3JJ (Washington, D. C.) on detector only.
3JI (Toronto, Canada) on home-made spider-web. No ampli.
3FS (Philadelphia, Pa.) on 1-step.
3NB (Canadian, Sarina, Ontario) on 1-step.
3JK (Canadian, Toronto) on spider-web and 1-step.
4CB (Canadian, Morse, Sask.) on 2-step.
4CO (Decatur, Georgia) on detector only.
5OP (Houston, Texas) on 1-step.
5HK (Oklahoma City, Okla.) on 2-step.
5ZA (Roswell, New Mexico) on 2-step.
7FI (Pullman, Washington) on 2-step.
7GO (Salem, Oregon) with aerial and ground CUT OUT and 1-step.
7RN (Cashmere, Washington) 1-step.
8JL (Cleveland, Ohio), on 1-step.
8AGK (Lancaster, N. Y.) on 2-step.
8AMK (Rochester, N. Y.) on 2-step.
8BRL (Crafton, Pa.) on 1-step.
8BMX (Buffalo, N. Y.) pickle tube only.
8BDG (Cleveland, Ohio) detector only.
8EW (Crafton, Pa.) detector only.
8JQ (Washington, Pa.) 1-step.
8AMM (Webster, N. Y.) on 2-step.
8BK (Cleveland, Ohio) 1-step.
8GY (Euclid, Ohio) on 1-step.
8AXI (Syracuse, N. Y.) on 2-step.
8IZ (Milan, Ohio) on 1-step.
8KW (Buffalo, N. Y.) detector (pickle-tube) only.
8ZAC (Barnesville, Ohio) detector only.
8BXX (Norwalk, Ohio) detector only.
8WO (Buffalo, N. Y.) "pickle tube."
9DTM (Denver, Colo.) 1-step.
9DVA (Denver, Colo.) 2-step.
9AOG (Lawrence, Kansas) 2-step.
9JQ (St. Louis, Mo.) on 1-step.
9RC (Chicago, Ill.) on 2-step.
9BAD (Ellendale, N. Dakota) detector only.
9NX (Wichita, Kansas) 1-step.
9AIF (Sioux Falls, S. Dakota) 2-step.
9LW (Wahpeton, N. Dakota) 2-step.
9AJA (Chicago, Ill.) 1-step.
9ZN (Chicago, Ill.) "all over room on 2-step."
9ASN (St. Paul, Minn.) on 2-step.
9AIG (Sioux Falls, S. Dakota) on 2-step.
9XAQ (Boulder, Colo.) on 1-step.
9DZE (Wichita, Kansas) detector only.

And so it goes, through a LONG list of other stations! It will be remarked that in NO case is more than 2-steps

Continued on page 60

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

H. D. Arnold, Pat. No. 1,403,475; Jan. 17, 1922. Vacuum tube circuits.

A tandem connection of amplifier tubes is described, in which the output circuit of the first tube includes an impedance such as 25 and 28 in series with the plate battery 27. The input circuit of the second tube is connected across this impedance through a condenser 26 which prevents the direct current from battery 27 from flowing in this circuit. The input circuit is also bridged by the resistance 29, so that a direct electrical connection may be had between the grid and filament of this input circuit.

O. B. Blackwell, Pat. No. 1,403,835; Jan. 17, 1922. Frequency control system.

This patent describes a scheme for controlling, from a single distant station, the frequencies used by groups of transmitting and receiving stations. The master control station transmits a definite fundamental frequency energy to all of the stations. Each of these stations, however, is equipped with proper devices to modify the frequency and to amplify the energy to the desired values. This may be accomplished by proper modulators, filters, etc.

I. Langmuir, Reissue No. 15,278; Jan. 31, 1922. Electron discharge apparatus.

An evacuated 3-electrode tube is described, in which the grid is wound as a flat helix on a frame support, this helix enclosing the heated filament forming the cathode. The anode is also formed of fine wire stretched in zig-zag formation on hooks 12 supported on a forked member 13. It is claimed that this construction lends rigidity and reliability to the device.

R. M. Allen, Pat. No. 1,401,121; Dec. 27, 1921. Mounting for vacuum tubes.

In order to prevent injurious vibrations from disturbing the relative spacing of the electrodes in a vacuum tube, it is mounted on a resilient member 12, such as sponge rubber.

H. S. Read, Pat. No. 1,403,566; Jan. 17, 1922. Vacuum tube repeater circuits.

A tandem vacuum tube arrangement is described, consisting of the two tubes 2 and 3. The arrangement seeks to wipe out any inherent fluctuations in the direct current source 13 which is included in the output circuits of both tubes 2 and 3. Such fluctuations even if relatively small are objectionable since they, too, are amplified and distort the signal. To regulate this current a regulator tube 22 is used, inserted in the battery circuit of tube 2, its impedance being made dependent upon the current flow through this circuit. This is accomplished by causing the potential difference between the filament 20 and grid 25 to be dependent upon the drop across the resistance 19 which is in series in the battery circuit. If the current through battery 13 tends to vary, the potential drop across 19 varies, and regulates the potential of grid 25 to minimize this variation. The regulator tube 22 also prevents variations in the space current between electrodes 4 and 6.

J. R. Carson, Pat. No. 1,403,841; Jan. 17, 1922. Frequency control system.

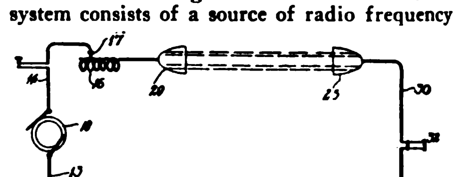
A system is described in which a master control station radiates energy at several frequencies to intercommunicating stations. These in turn manipulate the frequencies by special apparatus at each station to provide their own definite transmitting frequencies and modulating frequencies. At the master control station there is generated a modulating frequency too low for radio transmission, such as 10,000 cycles, and used merely for obtaining variants from the radio frequencies generated there. By the aid of this system, definite ranges of frequencies may be assigned to intercommunicating stations.

H. J. Round and G. M. Wright, Pat. No. 1,403,640; Jan. 17, 1922. Wireless telegraphy.

A system of aerials ABC and ADE for direction finding is described. Each loop includes a coil JK or GH with which a third exploring coil L is in close mutual induction. The whole system can then be tuned by proper variation in the condenser M connected to the exploring coil L, since the aerials are aperiodic closed loops. It is thus unnecessary to choose very accurately the dimensions of the aerials, which would otherwise be the case if open aerials were used. Close tuning is an essential for direction finding in this system, and the present invention provides an easy way to accomplish this result.

F. S. McCullough, Pat. No. 1,403,700; Jan. 17, 1922. Apparatus for directing transmission of electromagnetic waves.

The transmitting circuit of this directive system consists of a source of radio frequency



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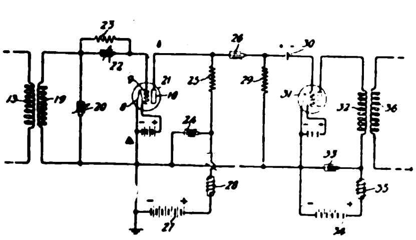
oscillations 10, an inductance 16 and the special paraboloid shaped capacity 20, which gives the system its directive properties. This member is formed of flat ribbon to provide a skeletonized surface. The receiving system also includes an identically formed member 25.

Radio broadcasting of congressional speeches at Washington is provided for in a resolution introduced by Representative Brennan of Washington. Brennan explained that in introducing the resolution he had in mind the placing of radio communication under close observation of Congress at a time when bills are being introduced looking to its development and control and to the encouraging of experimentation and study by amateurs.



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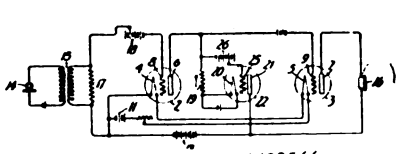

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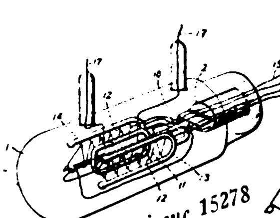

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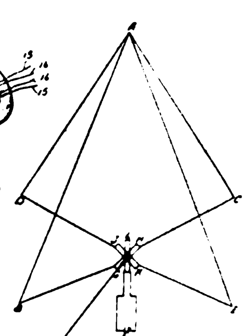

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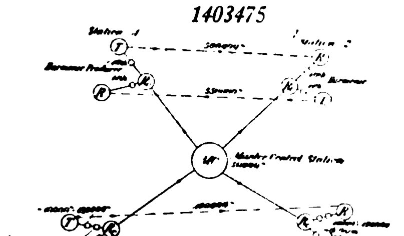

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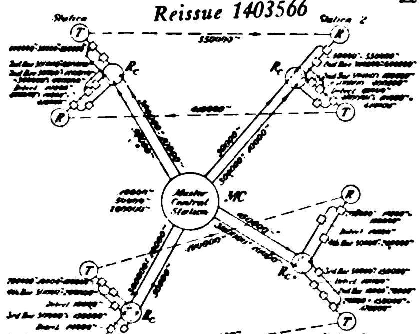

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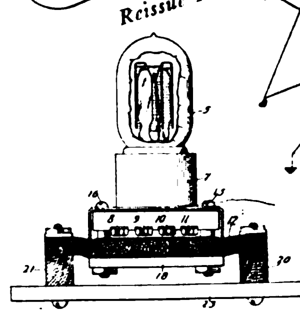


1401121

With THE U-S-Radio Inspector

CONDUCTED BY MAJOR J. F. DILLON

A MONTHLY DEPARTMENT OF INFORMATION FOR OUR READERS

Questions and Answers

Question: I have recently changed my ac. C. W. set to a phone, using pure dc. on the plates, but I want to use C. W. telegraph, also. Will I have to return my license for correction?
H. J. N., Oakland.

Answer: No. If you are already licensed for C. W. there is no limit on the use of C. W., I. C. W., or telephone, provided, of course, that it is operated according to law.

Question: How may an amateur prepare for a commercial license?
K. N. K., Kansas.

Answer: Attendance at a good radio school is the simplest and quickest way. Amateur experience only counts 5 per cent, while a total experience credit of 20 per cent is allowed by the regulations. School experience, provided the applicant has attended a resident school for at least three months, will count 10 per cent. An amateur remote from such schools may obtain a reasonable mark, but in general, it will require much closer attention to detail, and more thoro personal study than if the candidate has attended school. There are many good text books on the market which will prepare a student for the examination, and in addition the "Radio Laws and Regulations of the U. S." should be carefully studied. This may be procured from the "Superintendent of Documents, Government Printing Office, Washington, D. C." for 15c. (Stamps *not* accepted.)

Question: I recently failed for an amateur operator's license. May I apply for a commercial license before the three months have elapsed? H. D., Berkeley.

Answer: No. You must wait three months. There is no alternative.

Question: What is the lowest class and grade of operator's license that a person may hold to act as operator of a broadcasting station? J. G. F., Sacramento.

Answer: At least a Commercial Second Class, Third Grade License will be required. Anyone holding a higher grade of license may, naturally, serve.

Question: Can the holder of a Commercial First Class License have his license renewed without examination, if his entire service has been in a broadcasting station? Same.

Answer: No. The holder would only be eligible for a Commercial SECOND Class License. The grade would be determined by the man's service, and his ability as an operator—i. e., his ability to copy 25 words per minute.

Question: May amateurs use apparatus infringing on certain patents?
H. G., Seattle.

Answer: The Department of Commerce has no jurisdiction over the patent rights of any person, or persons, and does not take cognizance of any such particulars. This is a matter for the owners of the patents to take up, it is believed, altho no definite information is at hand regarding the exact details of the patent laws.

Question: Can a person not an American citizen get a U. S. amateur or commercial license? A. C., Los Angeles.

Answer: There is no law against such a person getting a license as an operator, but he cannot be granted a station license.

Question: If the above answer is "no," can he obtain a license if he has lived here two years, intends to continue here and his parents have taken out their first papers?

Answer: Station licenses can be granted only after final papers have been taken out.

Question: Why is it advantageous to have the poles of a telephone receiver permanently magnetized?

Answer: The answer, if given complete, requires quite a lengthy explanation. The magnitude of the attraction and repulsion between the magnetic core and the diaphragm depends, not only upon the strength of the field created by the varying current through the coils, but upon the strength of the permanent magnetic field as well. The force of attraction between the poles and the diaphragm varies inversely as the square of the distance separating them and directly as the square of the magnetic force acting upon them.

Let us take for an example the case of a simple electric magnet in a receiver in which the alternate positive and negative current impulses create a magnetic field of X and -X, respectively. The corresponding difference in field strength according to the above would be the difference in their squares. If we let X equal 10, the squares become 100 and 100, and the difference therefore is 200. Let us assume that a force varying 200 units displaces the diaphragm 1 mm. We will now replace the soft iron core of the magnet with one permanently magnetized, having a field strength of say 20, and then apply the same current as before. Now the field strength due to the positive current impulse will be added to the steady field, i. e., 20 plus 10, or 30, and when the negative impulse acts upon it the strength will be reduced by a like amount—20 — 10, or ten, and the corresponding squares will be 100 and 900 respectively, and the difference will be 800, and since a variation of 200 displaced the diaphragm 1 mm in the case of the simple electro-magnet, the displacement due to the action of the permanent magnet will be four times as great, and the amplitude of the current produced in the receivers will be increased in the same proportion.

The fact should be kept in mind that if the permanent magnetic field strength is increased until the diaphragm becomes saturated, that the effect of any current variation in the coils of the magnet will be almost negligible, and in that case the permanent magnet becomes a disadvantage. It will be thus seen that there is a distinct relation between the thickness of the diaphragms and the strength of the magnetic field. Neither the core nor the diaphragm should be nearly magnetically saturated if the optimum results are to be obtained.

J. F. DILLON,
Radio Inspector.

Question: How far can I transmit on a 5 watt tube? H. L. K., S. F., Cal.

Answer: This is entirely a matter of guesswork. A 5 watt tube set might work several hundred miles, under favorable conditions, and then again it might work only 50 miles, or so. It depends on so many factors, that no estimate can be given. Why not try and see?

COMMON OPERATING FAULTS

By D. B. McGOWN,
Assistant Radio Inspector

How many operators, either amateur or commercial, *know* the contents of the rules and regulations books? Not many, I warrant, know all the rules, and set forms for the various operations, such as calling, answering, send, counting the check, etc. Of course I admit that generally speaking many of these people get along well enough, and usually manage to get their business off in some sort of a fashion.

It is usually possible to tell the first time an operator calls whether or not he is a "lid," to use the common term. A man may call strictly according to regulations, and still come in this class, and, in some cases, he may break every rule of the game—at times—and still not be as much of a "ham" as the first man. However, in most instances, the man who, by following the rules as laid down, shows that he is a gentleman, and he is the man who will in the long run gain the respect of his fellows, even tho he starts out as a green-horn. Take, for instance, the fellow who calls long windedly. In the first place he is violating the law, but aside from that he generally is making himself a nuisance to all within hearing—which is usually a large number—and then he often doesn't get any better service, if as good. Then there are the "high power birds" who open up anywhere and call with all the power their set will put out. These are just a few instances where men show themselves up more truly than they realize by what they do, and not how they do it.

The use of excessive power and the long calling and testing habits are several of the worst that operators can get into. The use of excessive power is usually either through carelessness, or a general "don't care" attitude. What is the sense in starting up and calling a nearby station which is known to be within easy range, using everything the set will put out to do it? It not only wastes energy and puts the receiving operator in an unpleasant frame of mind, often expressed by his operating, but does far more serious damage in the way of interference. Many stations are able to transmit far beyond their normal receiving range, and when they are using high power for local or nearby work, they only are making trouble for someone else—and always running the chance of interfering with a distress call that they can't hear.

The long callers are nearly as bad. If a station can't get your call, or can't hear you call him without repetition after repetition in the call, what chance is there that he will be able to receive the business you have for him? Usually the two stations will fool around for a long time and block traffic generally, and then after all find that the receiving station can't get the business, he will report QSU, or something of the kind. This is sometimes done to prevent relaying, apparently with the idea that it is very wonderful to work long distances, etc., but usually better service can be obtained if the business is relayed thru a nearer station, and again, less power can be used than when working the extreme long ranges.

The testers are absolutely the worst class of offenders that exist. I refer to two classes

Continued on page 72

MILWAUKEE AMATEURS' RADIO CLUB

By L. S. BAIRD, *Past President*

The Milwaukee Amateurs' Radio Club was founded in January, 1917, by L. S. Baird, A. C. Kletzsch Jr., J. B. Hitz, and Alonzo Pawling. In its pre-war existence it could have been characterized as the junior amateur radio organization of the city. This existence being one of but a few months, all the early members were drawn from but a limited section of the city.

Previous to the founding of the Milwaukee Amateurs' Radio Club two of the local high schools had organized radio clubs, and one or two other attempts were made to found local wireless clubs, but with one exception none endured long. This exception was the Milwaukee Radio Association, which at the time of the founding of the Milwaukee Amateurs' Radio Club constituted the senior radio association of Milwaukee. This association did not survive the war and period of government ban on amateur radio activities. Its post-war membership was absorbed by the Milwaukee Amateurs' Radio Club. Among these members were Robert Miregler, C. F. Bates, L. J. Prahl, and L. A. Degner. The Milwaukee Boy Scout Radio Club was founded at about the same time, but existed for only a short period while its members were receiving instruction in elementary radio from a member of the faculty of the School of Engineering. Some of its members joined the Milwaukee Amateurs' Radio Club.

In the spring of 1919 and shortly after the government ban on amateur radio activities was removed, a meeting of the Milwaukee Amateurs' Radio Club was held and plans were made for the coming club season of 1919-1920. A careful survey of the city was made and a list of all amateurs was compiled. This list was the nucleus of the complete record of all amateurs in the city that the club now keeps. The trustees' room of the Milwaukee Public Museum, which has a seating capacity of about one hundred, was secured as a meeting place.

At the first meetings in the fall of 1919 a new constitution was adopted and officers elected and installed. The officers were: L. S. Baird, president; C. N. Crapo, vice-president; R. A. Teschan, secretary; T. V. Weston, treasurer; and R. A. Pelishek, business manager. Others prominent in the direction were C. S. Polacheck, C. M. Prinslow, A. C. Kletzsch Jr., and A. B. Lord.

The club became affiliated with the American Radio Relay League, Inc., and L. A. Degner, a member, was appointed city manager. Many other events, both business and social, took place this year.

The club opened the season of 1920-1921 with L. S. Baird, chairman of the board of directors; C. N. Crapo, president; A. B. Lord, vice-president; Louis Heyman, secretary; and E. W. Ruppenthal, treasurer and business manager. Mr. Crapo succeeded Mr. Degner as city manager for the American Radio Relay League, Inc. Meetings were held this season in a lecture room in the Old Insurance Bldg., obtained thru the courtesy of the School of Engineering of Milwaukee. The Milwaukee membership of the now defunct Wisconsin Radio League, which had been founded by M. B. Grogan and R. F. Laidlaw, was absorbed by the club. Mr. Grogan became the Milwaukee Amateurs' Radio Club's publicity manager. Before the organization of the Milwaukee Radio Executive Council, the Club became affiliated with the Chicago Executive Council (Radio). The "Chicago Plan" for control of radio traffic was adopted and enforced first by the club and then by the Milwaukee Council. It was thru the efforts of the leaders of the club that the Milwaukee Radio Executive Council was formed. This club and several others are represented in the council. The season was closed by a successful social and dance held in the dining room of the St. James Episcopal Church.

The season of 1921-1922 was opened with the following officers: L. S. Baird, past president; C. N. Crapo, chairman of the board of direction; D. J. Gellerupt, president; H. F. Wareing, vice-president; L. W. Klingbiel, secretary; and E. W. Ruppenthal, treasurer and business manager.

The club meets weekly at 8 on Monday evenings, except the third Monday of each month, in the trustees' room of the Milwaukee Public Museum. Visitors and prospective members are welcome at all meetings. At meetings when outside speakers are not present, members present papers and informal discussions take place.

This year the club has embarked on an extensive lecture program. An attempt has been made to secure from the ranks of employes of Milwaukee's electrical industries a number of men who could lecture on some subject that has points in common with radio communication. Some of the lectures that have been given and some that remain to be given are: December 8, 1921, "The National Electrical Code and Its Application to Radio Signaling Apparatus," by A. C. Schultz, electrical inspector, Wisconsin Inspection Bureau; January 23, 1922, "Serving the Radio Amateur," by W. S. Wilder, Sc. B., E. E., Electrical Testing Division, The Milwaukee Electric Railway and Light Co.; February 13, 1922, "The Theory of the Electron Tube," by R. C. Siegel, Sc. B., The University of Wisconsin, 1921; February 27, 1922, "Some Possibilities in the Development of Electron Discharge Apparatus," by Arthur Simon, member I. R. E., electrical engineer, Cutler-Hammer Mfg. Co.; March 13, 1922, "Storage Batteries," by J. P. Schroeter, electrical engineer, formerly consulting engineer, American School of Correspondence, Chicago, Ill. All radio men and other interested persons are invited to attend.

The club has several committees thru which much of its work is accomplished. Membership in one or more of these committees entitles the radio amateur to become actively engaged in the solution of the problems of local radio organization. There is a committee on interference and relay which has for its duty to co-operate with the A. R. R. L. city manager in the solving of problems of local radio traffic. Some other committees, the work of which is obvious from their names, are the committee on papers and publications, program committee, publicity committee, and the committee on research and development. The work of the last named committee is shortly to be transferred to a radio laboratory founded by several radio club members.

Membership appeals alike to the "DX" man, the radio experimenter, the beginner, and to those who have only a set for the reception of radio broadcasts. There are three classes of membership, viz.: member, associate, and junior. Dues for the first two classes are fifty cents a month and for juniors, twenty-five cents. An initiation fee of one dollar is charged. The direction of the club is especially desirous of having for members all local members of the A. R. R. L., making the club a real local section of the League.

There are several other radio clubs in Milwaukee and its suburbs, three of which are affiliated with this club thru the Milwaukee Radio Executive Council. They are as follows: Wauwatosa Radio Club, meeting on Monday evenings in the Wauwatosa High School; West Allis Radio Club, meeting on Friday evenings in the West Allis Public Library; South Side Radio Club of Milwaukee, meeting on Wednesday evenings in the South Side Branch of the Public Library. Although the Milwaukee Amateurs' Radio Club has a centrally located meeting hall and embraces a city-wide membership, its direction realizes the expediency of having additional radio clubs in the suburbs and various sections of the city. The Milwaukee metropolitan district is large enough and boasts a sufficient number of amateurs to make it a multi-club one. The direction of this club does not view these contemporary clubs as competitors, but as organizations striving with this club to make Milwaukee's radio organization a success.

Milwaukee's radio traffic organization and traffic conditions will be discussed in another article under the heading of the Milwaukee Radio Executive Council.

The executive office to which all club correspondence should be addressed is 601 Enterprise Building, Second and Sycamore Streets, Milwaukee, Wisconsin.

"IN THE EASTERN STATES"

By WILLIAM S. HALSTEAD, 2LH

1ARY of Burlington, Vt., is very QSA on both C.W. and spark. 1ARY was the second best station to get across to Godley.

1BIR of Exeter, N. H., is doing some fine work on his 10 watt C.W. set. He has worked as far south as Philadelphia on phone, which is very good work considering the power used and the distance, 700 miles.

1BCG has left the air as suddenly as he went on. Rumor has it that he will be on soon again tho. Look out for your fones, you 6th district owls!

1AFV ought to work Japan soon by the way in which he makes the "cans" rattle in the east.

The C.W. craze seems to be at its height in the first district. Practically all the d. x. stations have changed to C.W. or are using C.W. in conjunction with their spark sets.

2BK is still splitting our diaphragms. His spark has been heard in Scotland, England, California, etc. Wonder where next?

2AID now has a 5 watt C.W. set. His old spark has hit the trail to Long Island. 2AID is putting over an ampere into the aerial with wonderful results for a 5 watt set. He seems to reach out nearly as good as on his spark.

2DK has also changed to C.W. with very good results. He is using a 50 watt tube.

Down in Brooklyn the latest is: "Sparks may come, and sparks may go, but NAH goes on forever."

2UA has been off the air for over a month. He expects to get going again very soon, but he is trying to get a good pole first.

2AWF is putting the capital city of the Empire state on the map. For the benefit of those who don't know where the capital is, might say that it is Albany.

2XI of Schenectady is "knocking" all the tubes around Albany and Troy.

2OM is still handling messages by the carload and making his "O" shorter every time. Wonder what 2SM will say? Hi.

Everybody has gone "nuts" over radio in the vicinity of New York City. WJZ and WDY are the reasons.

8ML is making all kinds of records with his 10 watt set. His latest is to 6ALP in Long Beach, Calif.

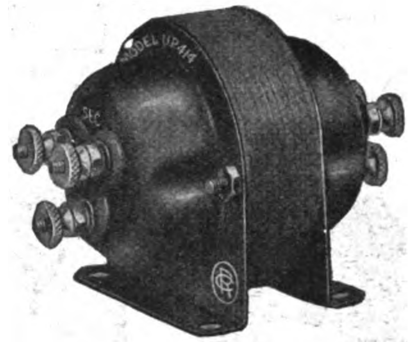
8LX has also been doing some real distance work thru to California.

4GL and 3ZO come in thru the second and first districts like locals. 4GL is more like an express, tho. And when he goes—Oh Boy! Talk about Omnigraphs racing!

3ZA is helping put the messages thru the third district.

4IB is one of the real relay stations with an OW at the key. And she can rattle the key, too! 4GL will soon have a new rival in the 40 per league.

UP—1368 Power Transformer
325 Watts..........$25.00



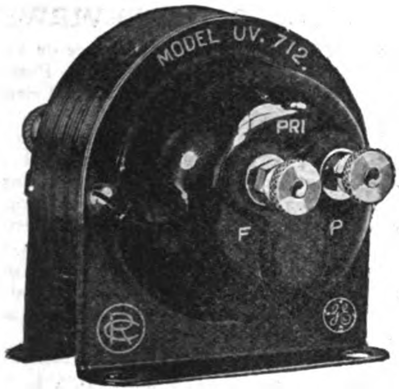
UP—414 Microphone Transformer.................$7.25

General Electric

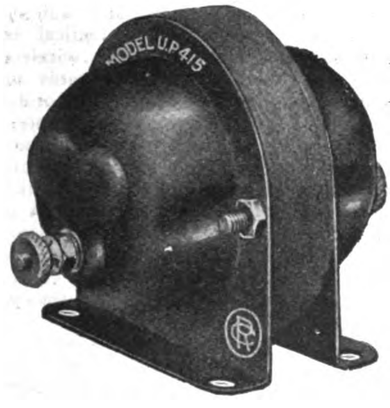
Transformers and Reactors

FOR

C.W. Transmission and Reception



UV—712 Amplifying Transformer.............$ 7.00



UP—415 Plate Circuit Reactor............ $5.75

The Radio Corporation line of transformers (manufactured by the General Electric Co.) offers a unit for every need in assembling a C. W. Transmitting or Receiving Set. A few of the items constituting this line are shown here.

We are Western Jobbers for the following high grade lines of Radio Equipment and carry in San Francisco the largest, carefully selected stock of quality apparatus in the West.

- Radio Corporation of America (Westinghouse and General Electric Apparatus)
- General Radio Co.
- Adams-Morgan Co. (Paragon Apparatus)
- Remler Radio Mfg. Co.
- Federal Tel. and Tel. Co.
- Signal Electric Mfg. Co.
- Western Electric Phones
- Burgess Battery Co.
- Magnavox Co.
- Wm. J. Murdock Co.
- Baldwin Telephones
- Wireless Press Books
- Weston Instruments

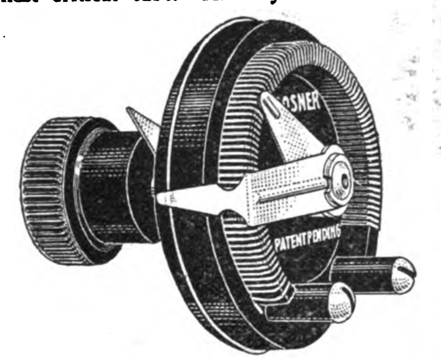
The Radio Corporation's C. W. Manual and Catalogue contains a great deal of useful information, especially for those interested in C. W. Transmission. It will be sent upon receipt of 25 cents.

Bulletins describing the Kennedy line of high quality Radio Receivers will be sent free upon request.

THE COLIN B. KENNEDY COMPANY
INCORPORATED
RIALTO BUILDING SAN FRANCISCO

KLOSNER VERNIER RHEOSTAT

A useful form of vernier rheostat has recently been put on the market by the Klosner Improved Apparatus Co. of New York City. It is equipped with a single knob for both rough and fine adjustments, and is claimed to give quick and positive results with the most critical tube. As may be noted from



Klosner Vernier Rheostat

the picture it has a condensite base and knob and phosphor bronze contact springs, all metal parts being nickel plated. It has a diameter of 2⅜ in., and should prove highly valuable for the control of filament current to detector and amplifier tubes in the receiving set.

NEW RADIO CATALOGS

A handsome catalog of radio equipment has been issued by the Karlowa Radio Co. of Rock Island, Ill. In this 48-page 9x12 book many interesting and useful types of radio apparatus are illustrated and described, including the Hall recording relay, complete receiving sets, spark and tube sending sets, and parts of all kinds. In addition to complete hook-ups, there are many miscellaneous items of radio interest.

Catalog H from the De Forest Radio Telephone & Telegraph Co. of New York City shows the complete line of De Forest radio equipment suitable for amateur and commercial use. A brief and simple treatment is given of the theory of radio communication and of the vacuum tube.

Radio Catalog No. R-2, from Julius Andrae & Sons Co. of Milwaukee, is concerned with radio receiving and transmitting equipment for telephone and telegraph. In its 84 pages, 6x9, will be found pictures, descriptions and prices of complete sets and parts from most of the standard manufacturers of apparatus for sending and receiving. Especial attention is given to parts for C. W. transmitters.

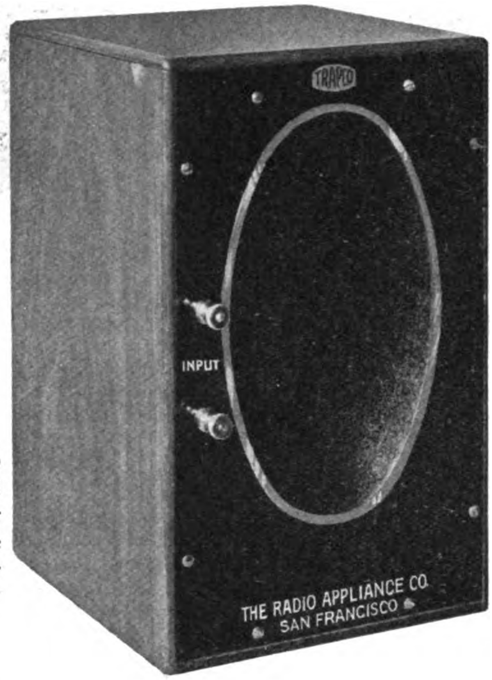
New bulletins from the Robinson Specialty Co. of Keyport, N. J., show the "Q R" vernier adjuster for attachment to any receiver so as to eliminate the effect of body capacity, and the "Q R" loud speaker for use without extra batteries on one-four stages of amplification.

The Surdam Rotary Spark Gap is detailed in a folder from the Star Machine Co., San Diego, Calif.

The Western Radio Electric Co. of Los Angeles has completed the installation of the Kinema-Brack Shops radiophone for broadcasting concerts from the Kinema Theater and news bulletins from the Los Angeles Examiner. The station was opened with a concert from the Victor Herbert orchestra. Receiving sets are being put in by all the West Coast Theaters, Inc., chain.

A NEW LOUD SPEAKER

A new and improved type of loud speaker for hearing radio concerts, news and speeches is announced by The Radio Appliance Company of San Francisco. This consists of a Baldwin phone and a scientifically designed tone chamber housed in a Kennedy No. 525 walnut cabinet 5x12½x8½ in.



It is believed that this will fill a long felt want for a handsome, compact unit, uniform in appearance with the rest of a receiving set. Because of the specially designed tone chamber the sounds are purer and more pleasing than is possible with the ordinary horn.

C. R. Kierulff of Los Angeles is supervising the installation of a 50 watt radio telephone broadcasting station for the Los Angeles Times. The equipment was designed by L. F. Fuller, chief engineer of the Colin B. Kennedy Co. of San Francisco. Dean Farran will be the operator in charge.

LETTERS TO THE EDITOR

Sir:—Will you pardon me if I presume to criticize one of your editorials in the March issue.

I think I know to whom you refer and if I am correct I agree with you that we should keep our eye on them and resent at least some of their efforts. There are certain interests that are trying to take unto themselves for selfish purposes more power than is their right.

However, your words may be construed in a number of ways, and under some constructions they are rather dangerous advice. You begin by condemning selfishness and end by seemingly advocating the most extreme kind of selfishness. No term could be more selfish than "personal liberty." This term has been much used of late years in another connection, but whether we are speaking of the use of alcoholic drinks or of wireless it is true that the rights of the individual stop where they interfere with the rights of others. *Wherever people come in contact with each other there can be no such thing as complete personal liberty.* The whole system of laws of the Republic depends on this principle. If one were to follow your advice literally he could "sit on the key" all day and stop all other radio work in the vicinity, but if we tried to stop him he could say, "You are interfering with my personal liberty."

A number of amateurs to whom I have shown your editorial think you mean the A. R. R. L. I sincerely hope they are wrong, for I think this organization deserves much praise for the work it is doing. There is no "personal domination" in it, for no amateur in the country is denied membership and all members have a voice in electing the directors. I admit it sometimes tries to impose certain regulations, such as certain listening periods, upon all of us whether members or not. Of course it has no legal right to do so. But you cannot find anything in any of these regulations that points to a selfish motive behind them; and they are always of such a nature that if we *all* take an interest in them and abide by them we will *all* be benefited by them. Here is certainly a case where we can afford to forget our "rights," and in so doing bring greater pleasure and profit to all amateurs, ourselves included.

Very truly yours,
H. K. DUNN,
Opr. at 8YR.
Asst. Prof. Physics.
Miami University, Oxford, Ohio.
Feb. 28, 1922.

RADIO BOOK REVIEWS

"WIRELESS IN THE HOME"—By Lee de Forest; 32 page pamphlet, 4¼x6¼ in. Published by De Forest Radio Telephone & Telegraph Co., New York City. Price 15 cents.

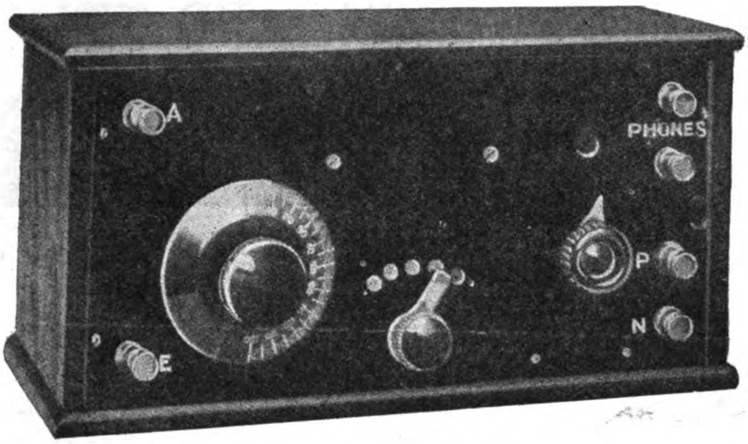
This is a popular account of radio as a hobby. It tells of the fascination of radio telegraphy and telephony. It explains the essentials of an amateur radio receiving station, including the aerial, tuning coil, detector, condenser, telephone and amplifier, in terms so simple that any one can read and understand it. Finally it gives a description of a crystal and a vacuum tube receiver and a two step amplifier.

"THE RADIO EXPERIMENTER'S HANDBOOK"—By M. B. Sleeper; 138 pages 4x6¼. Published by De Forest Radio Telephone & Telegraph Co., New York City. Price $1.

When a boy first becomes interested in radio he has many questions in mind for which he cannot find understandable answers in the more advanced texts. In this little book the author tries to tell you what you want to know. He omits all theoretical and mathematical discussion and confines his treatment to simple and practical matters. He first tells what makes the wireless work and then describes the apparatus used in simple damped wave transmitting and receiving sets, giving diagrams of connections and telling how to set up and operate the equipment which has been bought. A brief account is given of how the audion works, what is an undamped wave, and how it may be transmitted, received, and amplified. The book is concluded by a chapter on radio rules and regulations. While of little value to the advanced worker, the entire book will be helpful to the beginner.

Theater managers of New York are contemplating the use of wireless telephony to replace orchestras. Vaudeville theaters and musical shows could not avail themselves of melodies from the air, and will continue to pay from $75 up for their leaders, and a minimum of $52 weekly for their musicians. But theaters with dramatic offerings and the picture houses could save a tidy sum by the installation of wireless receiving stations.

A sending set and an audion for his receiver is the first thing that Vallimar Gilbert, an adopted boy, of San Francisco, wanted to get when notified that he was the heir unexpectedly to $180,000 from the estate of Jay Moncrief of New York. He prefers "the kind you put up yourself."



The Harko Senior V. T. Radio Receiver $21.00 Guaranteed

This HARKO SENIOR RADIO RECEIVER has been developed to supply the demand for a low priced, efficient receiving outfit, having a range of from 150 to 600 meters, thus bringing in on the average amateur antenna-amateur stations, radio telephones and commercial stations, operating up to and including 600 meters.

This instrument is a combination tuner and audion detector. It consists of a tapped inductance, a Crosley Variable Condenser, a Crosley Model "a" Rheostat, a Crosley V. T. Socket, a Crosley Grid Condenser and Leak. The hook up is special—of our own design.

These parts are mounted on a panel of formica. The surface is ground; the binding posts marked and the whole thing mounted in a mahogany finished cabinet. Cords with clips extend through the back of the cabinet to be attached to the "B" batteries.

From our Minneapolis station we have picked up Chicago, Detroit, and Cleveland. On rare occasions we have heard Pittsburg.

This set is very efficient and the price is remarkably LOW.

Price complete as described without TUBE, "B" BATTERY, "A" BATTERY or PHONES

Only

$21.00

Absolutely guaranteed or your money back

We can furnish a Crosley Two-Step Amplifier to work with this Senior Radio Receiver for the low price of $25.00.

The United Radio Schools

Radio Engineers

500 Delaware Street S. E. Minneapolis, Minnesota

SPECIAL NOTE: We are prepared to furnish "Principles of Radio Telegraphy, in loose leaf form, prepared for self instruction by Prof. C. M. Jansky of the University of Minnesota, for $7.50—just what the amateur needs to "bone up" on radio

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY 8CP, HOLLAND, MICH.

(2arb), 2arm, 2bfu, (2bm), 2bk, 2el, (2fp), (2ju), 2om, 2pu, 3ajd, 3bk, (3fb), 4cg, 4cx, 4dh, 4bq, 4gn, 5by, 5er, (5fo), 5hk, 5iq, 5is, 5pg, 5tu, 5za, 5zl, 8aap, 8acf, (8aco), (8afa), (8afb), 8afg, (8aie), 8aiz, (8ajk), (8akq), 8akv, (8amz), 8ano, 8aog, 8ard, 8ars, 8atu, (8aum), (8auv), (8ave), (8avt), (8axn), 8axo, 8ayn, (8baz), (8bbu), (8bcy), 8bep, (8ben), 8bhv, (8blw), 8bum, (8btl), 8bwd, (8bxc), 8bxx, (8zaa), 8zac, 8ba, 8ch, (8eb), 8ef, 8ew, 8fi, 8ft, (8jp), (8jj), (8nz), 8oi, 8qq, (8sp), (8uc), (8yn), (8yy), (8xe), (8wd), 9aap, 9aaw, 9acb, (9acl), (9aef), 9aez, 9aff, (9agr), (9agn), 9aif, 9air, (9aiu), (9ajh), (9alp), (9alu), 9amk, 9amq, (9ano), (9aoh), (9aoj), 9apk, (9arz), (9asj), (9ask), (9auh), 9aul, 9avp, (9awz), 9ayh, 9aza, (9aze), (9bds), (9bij), (9daz), (9dbu), (9dgw), 9dhd, (9dhz), (9dkq), (9dkv), (9dlx), 9dld, 9dmm, 9dqq, (9dra), 9dsd, 9dso, 9dtn, 9dyu, 9dyw, 9dxm, 9dxw, 9dyy, 9dze, 9dzi, 9dzk, 9af, 9ar, 9au, 9bp, 9ak, 9bf, (9cp), (9fs), 9fu, (9gn), (9gx), 9hm, (9ib). 9iz, 9jn, 9jv, 9lf, 9mc, 9me, (9ms), 9mq, 9nq, 9oa, (9ox), (9ou), 9ur, (9pd), 9pi, 9pj, (9rc), (9to), 9ti, 9tl, (9uh), (9uu), (9vl), 9vv, 9wi, 9xi, 9yq, 9zn, (Can 3gn).

BY 6AIF, BAKERSFIELD, CAL.

Spark—5xu, (5za), 5zz, 6aah, (6aau), (6abw), 6abx, 6ack, 6ada, 6adl, (6aeh), 6afn, (6agf), 6agp, (6ah), 6ahp, 6ahv, 6aib, 6aio, 6ajr, 6ak, (6akl), (6alp), 6alv, 6amk, (6ang), 6aor, 6app, 6ark, (6as), 6ath, 6atq, (6atv), 6av, 6avb, 6avv, 6awh, 6awt, 6awx, 6baj, 6bak, 6baz, 6bcj, (6bgh), 6bm, 6cv, (6ea), 6eb, 6en, (6ex), 6fh, (6fk), (6ft), 6gf, 6gt, 6gx, 6ib, 6is, 6iv, (6kc), (6lc), 6ng, (6mh), (6od), 6oh, 6pj, (6po), 6pr, (6qr), 6sj, 6st, 6su, 6to, (6tu), (6tv), 6uo, 6vk, (6vx), (6wh), 6wr, 6wz, 6zaa, 6zal, (6zam), 6zd, 6zk, 6zu, (6zx), (6zz), 7bh, 7bj, 7bk, 7br, 7ck, 7fi, 7fq, 7gj, 7hf, 7iw, 7lo, 7mf, 7mh, 7mp, (7my), 7tj, 7vo, 7ya, 7yg, 7yl, 7zj, 7zm, 7zt, 7zu, 7zv, 8zp, Canadian 9ax, Canadian 9bd, 9yae, 9yal.

C. W.—4ft, (5za), 6aat (fone-cw-icw), (6ale), (6alu), (6ak), 6akw, 6aoz, 6arc, 6asj, (6asv), 6atg, (6aul), 6avy, 6awt, 6ec, (6en), (6gr), (6jd), 6jj, (6ka), (6ky)-(icw), 6rr, (6xad), (6xaf), (6xh), (6za), 6zaf, 6zb, 6zt, 6zz, 7xf (cw-icw-fone), 8aml, 8zv, 9aja, (9amb), 9ayu, 9bji, 9dth, (9dtm), (9dva), 9nx, (9wd), (9xaq), Canadian 9bd, cl8.

BY 6AHQ, LA HABRA, CALIF.

(5if), 5of, 5xu, 5xj, 5za, 5zj, (6ah), 6ak, (6as), 6cv, 6cz, 6df, (6ep), (6ex), 6fh, 6fk, 6gr, 6gf, 6gx, 6hc, 6jc, (6kc), 6km, 6kx, 6oc, 6oh, 6pg, 6pj, (6po), 6qr, 6rs, (6tv), 6uo, (6tu), (6vk), 6vm, (6vh), 6vx, 6xa-cw, (6xh), 6za, 6zb, 6zk, 6zu, (6zx), 6zz, (6aah), 6aak, 6aau, (6abw), 6abx, 6ada, (6aeh), 6aei, 6aez, 6afp, 6afn, (6agf), 6aif, (6akl), 6ala, 6alv, 6ale, 6amk, (6ain), (6aor), 6arw, 6asj, (6ath), 6atq, 6atu, (6aur), 6avb, 6aul-cw, 6awh, (6awt-cw), 7bh, 7bj, 7hf, 7in, 7kk, 7fi, 7ly, 7me, 7mf, 7mp, 7ot, 7tv, 7tj, 7vo, 7xd, 7zg, 7zm, (7zt), 7zu, 7zv, 7ya, 7yg, 7cn, (7om), 9ax, 9dx, 9zv, 9avr.

HEARD AT 6AWT, 653 UNION ST., SAN FRANCISCO, CAL., JAN. 7 TO FEB. 28

Sparks—5ak Canadian, 5hk, 6ea, 6er, 6hh, (6kc), 6lc, (6mh), 6mz, 6od, 6oh, 6ol, 6qr, 6tc, 6zr, 6adl, 6aeh, 6afp, 6ahf, 6ahp, 6ahq, (6aib), (6aif), 6aio, 6ajh, (6alu), 6amn, 6avd, 6avr, 6awe, (6baj), 6zal, 7ax, (7bb), (7bc), 7bh, 7bj, (7bk), 7cc, 7cp, 7ed, 7fi, (7ge), 7gj, 7hf, 7iw, 7jw, (7kj), 7km, 7ly. (7mf), 7mp, 7my, 7nl, 7nn, 7om, (7tj), 7ya, 7yg, 7ys, 7zj, 7zm, 7zp, (7zt), 7zu, 7zv, 9ax Canadian, (9bd Canadian), cl8.

C. W.—(4cb Canadian), 5za, (6cu), 6ea, 6eb, (6ef), (6en), 6jd, (6gd), (6ka), (6ky-voice buzzer), (6rr), 6za, (6zf), 6zg, (6zz), 6aag, 6acb, (6aif), (6ale), (6aoz), (6xad), 7ce, 7nf, 7mw, 7we, 7xf, 8jl, (9bd Canadian), 9ps, 9wd, 9amb, 9bar, 9dva, 9zaf-voice, cl8. Anyone hearing 6awt pse 8 sl.

BY 6ZAC CLIFFORD J. DOW, WAILUKU, T. H., FROM JANUARY 1 TO FEB. 19

Sparks—5tq, 5xu, 5za, 5zz, 6aau, 6atv, 6eb, 6ebr, 6ex, 6hc, 6lc, 6xh, 6zk, 6zr, 6zx, 7bh, 7jd, 7ya, 7yg, 7zd, 7zj, 7zm, 7zt, 7zu, 9mc, 9yae.

C. W.—5za 6ant, (6pt ?), 6atg, 6aoz, 6ang, 6aif, 6ef, 6en, 6jd, 6xad, 6xaf, 6xw, 6zad, 6zaf, 6zb, 6aja, 7nf, 7tj, 7rn, 7xf, 8agz, 8bfx, 8uk, 9amb, 9aja, 9dwj, 9hw, 9wd, 9nxg, 9xab, 9zaf, kzy, cl8, kzcp, nof, nmw, sc3, xf1, Canadian 4cb, qsa.

Have had a qsl confirming xf1 reception. Langley Field, Hampton, Va., in charge of Sgt. Blair. Says using 450 watts of a 1 kw de Forest fone and Cw set. Would appreciate at least a card in acknowledgement of the reports I've tendered various stations whose address is known to me, and would be pleased to hear from those listed above who have not had direct word from me.

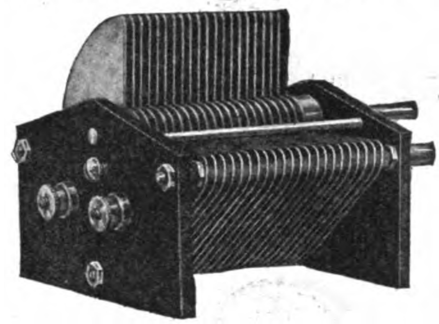
"Pen" Brand Variable Condenser with binding posts—

The "Pen" variable condenser is manufactured with two binding posts to which connection can easily and conveniently be made *without soldering.* Constructed with a special *adjusting screw* by means of which the plate adjustment can be tightened to prevent slipping. Accurately made, exceptionally high quality, remarkably low price, complete with the improvements described—

3 plate....$2.10	11 plate....$2.60
23 plate....$3.45	43 plate....$4.60

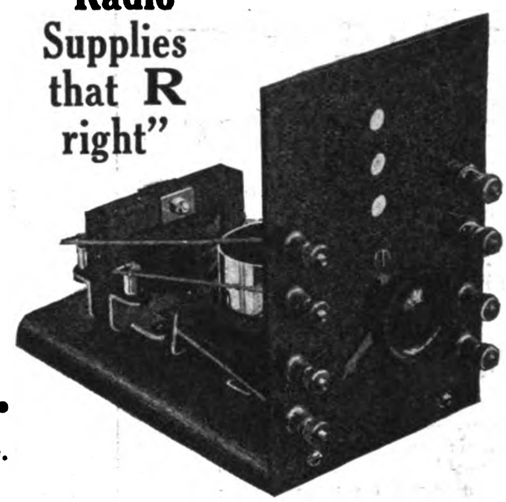
43 PLATE

$4.60



$12.50 CESCO 1-STAGE AMPLIFIER

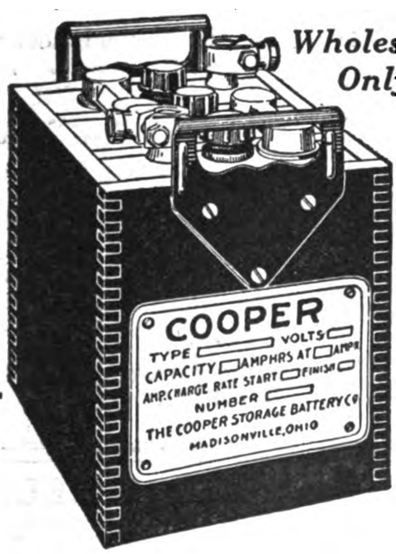
"Radio Supplies that R right"



Why pay more? Carefully made of standard parts and beautifully finished throughout—measures up to the usual high CESCO standards of service and efficiency. It will stand the gaff. And the low price represents a big saving to you—$12.50 as illustrated, postpaid to any address in the U. S. Order now to insure prompt delivery.

California Electric Supply Co.

643 MISSION ST. - SAN FRANCISCO - CAL.



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A Special Size for Every Radio Requirement

Every part in the Cooper Radio Battery, regardless of its importance, is constructed of the finest quality of material and is designed and tested to withstand the most severe service.

DEALERS AND MANUFACTURERS: Write for Complete Details. Let Us Figure on Your Requirements.

The Cooper-California Co.

PACIFIC COAST UNIT

1034 Geary Street **San Francisco, Cal.**

BY 6ZF EX 6ALE

2fp-ac-cw, 4by can. ?, 5iu, (5xj-cw), 5yq, (5za-cw), (6eb), (6en), (6ep), (6gk), (6gt), (6iv), (6jd-cw), (6lc), (6mh), (6po), (6qr), (6tu), (6vx), (6zb), (6zk), (6zx), (6aag), 6aat-cw, (6aau), (6abw), (6ack), (6afn), (6ahf), (6alu), (6alv), (6amn), 6zam, (6baj), (6bfe), (6bdk), (6bgh) phone, 6xaq-cw very qsa, (7ba), (7bk), 7ck, 7cs-cw, (7nw), (7nx), (7ly), (7mf), (7mp), 7nn, 7om, (7qt), 7tj, 7ya, 7yj, (7zm), 7zo, 7zt, 7zv, 7xb, 7zu, 8jl-cw, 8vj-cw, 8agz-cw, 8brl-cw, 9nx-cw, 9wd-cw, 9aja-cw, 9amb-cw, 9ays-cw, (9ayu-cw ?), 9bex-cw, 9bji-cw, 9dtm-cw, (9dva-cw), 9xaq-cw, (9bd can.).

BY 6AHS, E. SAN DIEGO, CALIF.
With crystal without amplification

5hk, 5if, 5mj, 5xj, 5xu, 5yq, 5za, 5zx, 6ak, 6as, 6av, 6bm, 6cp, 6cz, 6dd, 6dr, 6er, 6ew, 6ex, 6fh, 6fj, 6fn, 6ft, 6gf, 6gp, 6gt, 6gx, 6hf, 6ho, 6is, 6iv, 6je, 6jw, 6jy, 6km, 6ky, 6kz, 6lo, 6lu, 6mx, 6oc, 6oh, 6ol, 6pj, 6po, 6pp, 6pr, 6pw, 6qk, 6qy, 6re, 6rs, 6sa, 6sj, 6st, 6tu, 6tv, 6uo, 6up, 6uw, 6vm, 6vo, 6vx, 6vz, 5wv-icw, 6wz, 6xh, 6ze, 6zk, 6zu, 6zx, 6zz, 6zam, 6aah, 6aak, 6aau, 6abh, 6abp, 6abu, 6abx, 6acr, 6adf, 6aei, 6aew, 6aez, 6afy, 6afn, 6afp, 6agf, 6agp, 6ahh, 6ahq, 6ahp, 6ahv, 6aic, 6aif, 6aio, 6aix, 6ajv, 6ajx, 6akt, 6ala, 6ald, 6ale-cw, 6alk, 6amk, 6amq-cw, 6ang, 6ani, 6anp, 6ams, 6aor, 6ape, 6aph, 6app, 6apv, 6aqk, 6aqr, 6aqv, 6ard, 6are, 6ark, 6ase, 6ask, 6asv, 6atc, 6atf, 6ath, 6atu, 6auu, 6avb, 6avd, 6avr, 6avv, 6awh, 6awi, 6awt, 6awv, (6baf), 6bbr, 6bca, 6bcj, 6bga, 7bh, 7bj, 7br, 7ck, 7cw, 7in, 7jd, 7kb, 7lu, 7ly, 7mf, 7mo, 7mp, 7tj, 7ya, 7yg, 7yj, 7zj, 7zm, 7zt, 7zu, 9aeg, 9amb-cw, 9ayw, 9dze.

BY 6AKT, DAILY CITY, CALIF.
With one tube

5za, 6da, 6ek, 6en, (6fk), 6ft, (6gf), (6ic), 6is, 6kc, 6lc, 6lu, 6mh, (6qr), (6to), (6vz), 6aak, 6abw, 6acy, 6adl, (6afn), (6agf), (6ahq), (6aif), 6aio, 6aiu, 6ajh, 6akl, 6ale, 6aoa, 6ape, 6zb, (6zx), 6atq, (7mf), (7hf), 7tj, 7zu, 7jw, 7xa, 7zk, 7oh, 7ot, 7in, 7nz, 7ya, 7zt, 7zx, 7zu, 7gj, 7zo, 9bd.

BY TED FRENCHIE, LOS ANGELES, CAL.

5za, 5xu, 6ah, 6ak, 6as, 6acm, 6aif, 6aat, 6ale, 6agf, 6abx, 6asj, 6asp, 6alv, 6ark, 6ahf, 6apw, 6aah, 6aak, 6aau, 6aeh, 6afn, 6aid, 6ape, 6aph, 6cv, 6ex, 6gf, 6gr, 6gt, 6ic, 6ji, 6km, 6oc, 6za, 6ze, 6zk, 6zu, 6zx, 6zz, 6qr, 6xg-music, 6bft, wv6-music-fone, 7ag, 7bk, 7bj, 7ex, 7ed, 7in, 7jd, 7mf, 7tj, 7ya, 7yg, 7za, 7zj, 7zt, 7zu, 7iw, 7ks, 9abm, 9dva, 9bji.

BY 6ATN, FALLON, NEVADA

klt, 9zaf, dd5, agl, kwd, 6xag, kdw, kdf, 6xd, 5za, 6aat, 6vm, 7cf, cl8, 6ty, 6at, kzy, vaw, Roswell Electric Light Co., Roswell, N. M., Radio Equipment Co., Dallas, Texas, Hobrecht, Sacramento, Northwestern Radio Mfg. Co., Portland, Kinema Theater, Los Angeles, 6anj, 6ak.

BY 9BD, VANCOUVER, B. C.

C. W.—4cb Can., 4co wrkng 9ps, Feb. 26 12:40 a.m., (5bi) Can., (5bd) Can., (6ak), 5za, (6ale), (6awt), 6alu, 6eb, 6en, (6gy), (6jd), (6ka), 6amz, 6xw, 6xad, 6za, (6zf), 6zz, 6zaf, 6zak, 6zaq, klc concerts, kzy, 6vm, klg, 7aav, (7ce), 7ln, 7ma, 7mb, 7ha, (7qe), 7qt, 7rn chopper icw, 7vb, 7nf, kfc, 7xf, cl8, 7ge, 7yt, 7fq, 8bk ac-cw, Feb. 26 12:04 a.m. clg 9ps & 9bsg, 8agz Feb. 26, vy consistant & qsa 12 p.m. to 2 a.m., 9amb, 9ps, 9bsg, 9kp, 9yas, 9zaf, 9ays.

Spark—Canadian "5's" too numerous, (6as), (6ah), (6ark), 6abx, 6abw, 6acr, (6agf), 6ajr, (6afn), qra pse? 6atg, 6bb, (6ch), 6dm, (6ex), (6hc), 6hp, (6fh), (6gx), (6gr), (6ic), (6km), 6lc, (6po), 6qr, 6tc, (6tu), (6vx), (6wz), 6xh, 6zk, 6zr, 6zx, 6zal, (6zam), 6amk, 6arh, (7bk), (7bj), 7bb, 7br, (7bc), 7ck, 7cn, (7ba), 7ed, (7ge), (7gj), 7iy, (7jw), 7mi, 7mu, 7nn, 7nz, 7nl, (7mp), 7hf, 7ly, (7kb), 7qn, (7wm), (7tj), (7zt), 7zj, 7om, 7zm, 7yl, 7ya, 7yj, 7xp, 9yae, cl8.

BY 6XAF, PIEDMONT, CALIF., DURING FEBRUARY

C. W. only—(5za), 5xu, 6cu, 6ea, (6en), (6jd), 6ka, 6ky, 6pt, 6rr, 6zb, 6zf, 6zg, 6zz, (6aif), 6alu, (6xad), 6xaq, 7qt, 9bir, 9dva, 9xaq, 9zaf, 9bd (Canadian.)

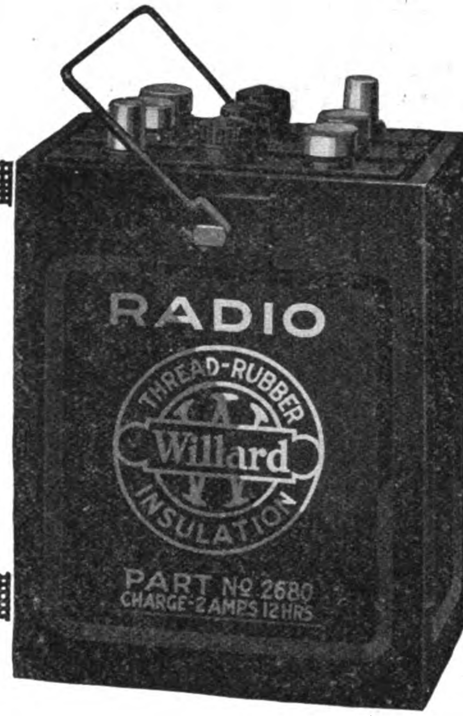
CALLS HEARD BY 6TV

5by, 5ew, 5fa, 5fo, 5hk, 5ir, 5is, (5if), 5lb, 5mf, 5mk, 5ns, 5of, 5tu, 5ug, 5xb, 5xj, 5xu, 5yi, 5yq, (5za), 5zaf, 5zam, 5zz, (6ahq), 6acy, 6adl, 6ada, 6aeh, (6amn), (6aib), (6aau), 6afn, (6asv), (6aah), (6alu), (6akl), 6ale, 6acr, (6aha), 6atg-cw, 6ald, 6abw, 6avr, (6ath), 6akw, (6afp), (6awx), 6agp, 6bgh, 6cu, (6en), (6ea), (6ft), (6gt), (6gp), (6gd-cw), (6iv), 6is, 6jd, (6ks), 6kh, 6ka-cw and spk, (6kc), (6ky-cw, 6km, (6mh), (6od), 6ol, 6ps, 6qk, (6rs), (6to), 6tf, 6uo, 6vz, 6xad-cw, (6zz), (6zr), 7bk, 7fi, 7ya, 7zo, 9aqe, 9aeg, 9amb, 9ays, 9alu, (9dug), (9dsd), 9dth, 9nx-cw, 9xaq.

HEARD BY DUDLEY NEBEKER, PIEDMONT, CALIFORNIA

Spark 5za, 6ak, 6aak, 6aau, 6aat, 6aaz, 6abx, 6acr, 6acy, 6adl, 6aeh, 6aei, 6aew, 6afn, 6afy, 6agf, 6agp, 6ahp, 6ahq, 6ahz, 6aid, 6aif, 6ail, 6aio, 6aiv, 6aix, 6aiy, 6ajr, 6akl, 6ale, 6alu, 6ana, 6anp, 6arc, 6ard, 6ark, 6asv, 6atf, 6awh, 6awm, 6cw, 6eh, 6en, 6ff, 6fh, 6gf, 6gn, 6gv, 6gt, 6gy, 6hf, 6ic, 6im, 6ir, 6is, 6iv, 6jd, 6jl, 6kc, 6km, 6lc, 6lu, 6lv, 6mx, 6od, 6ol, 6ov, 6pz, 6qf, 6qr, 6sa, 6sk, 6sq, 6tf, 6to, 6uo, 6xo, 6xa, 6zb, 6zg, 6zn, 6zr, 6xu, 6zz, 6zaa, 6zad, 6zal, 7bk, 7br, 7bj, 7ck, 7cn, 7ed, 7hf, 7jd, 7ke, 7mf, 7my, 7mu, 7nf, 7nz, 7om, 7tj, 7vo, 7vx, 7ya, 7yj, 7zm, 7zp, 7zt, 7zu, (c18, Seattle, Wash.), 9bd, 9hm, 9zaf, Canadian.

C. W.—5za, 6aat, 6aif, 6aiv, 6alu, 6aoz, 6asv, 6awp, 6cu, 6en, 6ir, 6lv, 6ny, 6za, 6zb, 6zf, 6zg, 6zn, 6zr, 6zz, 6xad, 6xaq, 6zad, 7cn, 7nf, 7zt, 7wm, 7yt, 9zaf, Canadian.



This special Radio Battery has all the Willard Threaded Rubber Battery features that are applicable to Radio work —plus many new ones *found only in this battery.*

Bring Your Set Up-to-Date with this All-Rubber Radio Battery

It's just as important in receiving, to have a good battery as to have a reliable and efficient set.

The Willard All-Rubber Radio Battery was designed and is being used especially for radio work. It gives you the same reliability in wireless work as the starting and lighting battery has always given in motor cars. These batteries are available at a considerable less cost than the motor car battery.

Willard Radio Batteries are made with the same care, and have the same Threaded Rubber Insulation as the larger batteries.

An important Radio feature is the All-Rubber Case. Cells and case are a solid piece of rubber that absolutely prevents leakage from cell to cell or to the ground, thus doing away with one of the most troublesome sources of noise.

Threaded Rubber Insulation and case are both tested with 24,000 volt wireless transformers before assembly. Freedom from leakage is thus assured.

For details about the Radio Battery, go to the nearest Willard Battery Station, or write us direct.

WILLARD STORAGE BATTERY CO., Cleveland, Ohio

Made in Canada by the **Willard Storage Battery Company of Canada, Limited, Toronto, Ontario**

Willard THREADED RUBBER BATTERY

BY 6AOW, 469 LIME ST., RIVERSIDE, CALIF.

Spark 5if, 5of, 5xu, 5yq, 5za, 5zj, 6ah, 6as, 6cp, 6ep, 6ex, 6fh, 6gf, 6gr, 6gx, 6hc, 6km, 6oh, 6pj, 6po, 6pr, 6qk, 6qr, 6sj, 6to, 6tu, 6tv, 6uw, 6vk, 6vx, 6wz, 6xh, 6zf, 6zk, 6zu, 6zx, 6zz, 6aah, 6aau, 6abm, 6abx, 6aci, 6afn, 6afp, 6agf, 6ahd, 6ahu, 6ahx, 6ahs, 6aif, 6ain, 6ait, 6ajt, 6akr, 6alv, 6ami, 6amk, 6ang, 6aor, 6ark, 6asa, 6asv, 6ath, 6atq, 6atu, 6auu, 6avl, 6awh, 6zae, 6zam, 6baj, 6bcb, 6bcj, 6bds, 6bfe, 6bgh, 6bip, 6biu, 7ck, 7dp, 7hf, 7hy, 7jw, 7jd, 7ln, 7ly, 7mf, 7mp, 7ty, 7ya, 7yj, 7yg, 7zj, 7zm, 7zt, 7zu, 7zv, cl-8, rz-6.

C. W.—4ul, 5za, 5xu, 6ak, 6gd, 6gy, 6iv, 6jj, 6ky, 6my, 6pj, 6vm, 6za, 6zt, 6zz, 6aag, 6aat, 6aif, 6akw, 6ale, 6aoz, 6awp, 6awt, 6xaf, 6bgg, 6bif, 6bhg, 7xb, 7ze, 9wh, 9wd, 9zy, 9amb, 9bji, 9dtm, 9dva, 9zaf.

Fone—6aag, 6bgg, 9zaf, dd-5, klc, kwg, kyj, kog, ksc, kzy.

HEARD BY CASSELBERRY, 620 PLUMAS ST., RENO, NEV. GREBE CR-5 & 1 TUBE

6ao, 6au, 6aad, 6aah, 6acy, 6adl, 6aef, 6alo, 6als, 6ajh, 6ark, 6atf, 6avr, 6baj, 6da, 6dn, 6fk, 6gh, 6gt, 6gx, 6ik, 6jr, 6jw, 6kc, 6km, 6lc, 6od, 6ol, 6qs, 6sb, 7ck, 7ed, 7mp, 7nn, 7nw, 7ya, 7zu.

C. W. & I. C. W.—4cb (Canadian), 5za, 6aag, 6aat, 6alu, 6aoy, 6awp (phone), 6asv, 6bm, 6cu, 6en, 6gy, 6jz, 6ka, 6kh, 6ky (phone), 6sg, 6zf, 6zn, 6zz, 7mf, 7nf, 7qt, 9dva, 9xaq.

HEARD AND WORKED BY 6VK, OAKLAND, CAL.

(6avr), (6aau), 6aak, (6acy), (6adl), (6aeh), 6agf, (6ahq), 6ahv, 6ahp, (6ain), (6aif), (6aio), 6aib, 6alu, (6ald), 6amn, (6aoe), 6ark, 6awx, 6da, (6fh), (6gt), (6gx), 6hy, (6is), (6iv), (6jy), (6km), (6kc), (6lc), 6ms, (6ol), (6od), (6pc), 6pr, 6zb, 6zz, 6zal, 7bb, 7bh, 7bk, 7cn, (7ed), 7fi, 7gl, 7hf, 7mo, (7mf), 7vo, (7zt), 7ya, 7abk, 9ax and 9bd (Canadian).

C. W.—5za, 6aif, 6aoz, 6ea, 6eb, 6en, (6jj), 6jd, 6za, 6zn, 6xad, cl8.

CALLS HEARD BY 7VO MEDFORD, ORE.

Spark—6aj, 6cd, 6cv, 6dl, (6dp), 6ea, 6eb, 6en, 6ex, 6fk, 6fh, 6gt, 6gx, 6id, (6ig), (6iv), 6kc, 6kn, 6lc, 6lr, 6oh, 6ot, 6ol, (6pr), 6qa, 6re, (6to), 6uo, 6vv, 6xc, 6zh, 6zr, 6aag, 6aak, 6aau, 6abw, (6abx), 6aew, 6afi, (6afn), (6agf), 6agu, 6agz, (6aph), (6aio), (6aix), 6alu, 6alv, 6aor, 6aoz, 6amf, (6amk), 6aru, 6atg, (6ath), (6atv), 6avb, 6avf, 6avr, 6awh, 6igw, 6xaf, 7bh, 7cd, 7ck, 7cw, (7ge), 7gu, 7hf, 7hi, 7hm, (7iw), (7jd), 7kb, 7ke, 7kg, (7kk), 7la, (7mp), (7ne), (7nz), 7oh, 7ot, 7oy, 7rb, 7tj, 7vk, 7vx, 7wg, 7xd, 7yg, 7yj, (7yl), 7ys, 7zj, 7zp, 7zm, 7zn, 7zt, 7zu, 7aaj, 9bd (Canadian).

C. W.—6gy, (6vm), 6aat, (6aif), 6ale, (6xwi), (7nf), 7rn, (7tq), 4cb (Canadian), 9ajh.

BY 7TF, BILLINGS, MONT.

Spark—5al, 5by, 5co, 5ew, 5fo, 5hk, 5if, 5la, 5lo, 5of, 5pg, 5xb, 5xo, 5yi, 5yq, 5za, 5zad, 5zac, 5zn, 5zo, 5zz, 6acb, 6ala, 6amk, 6ath, 6atq, 6awh, 6ba, 6lt, 6ot, 6ve, 6sj, 6tt, 6tv, 6wv, 6xh, 6za, 6zam, 6zv, 6zx, 6zz, 7an, 7aws, 7ba, 7cd, 7ck, 7fm, 7hm, 7im, 7jd, 7kb, 7lu, 7ly, 7mf, 7mo, 7mp, 7nz, 7om, 7xb, 7ya, 7yg, 7yi, 7yj, 7yl, 7yo, 7zh, 7zj, 7zm, 7zo, 7zs, 7zt, 7zu, 7zv, 8zp, 9acn, 9aeg, 9aey, 9agn, 9aig, 9aiw, 9ajs, 9apn, 9apt, 9aqe, 9avg, 9avz, 9asn, 9aul, 9auu, 9avv, 9avs, 9awv, 9axu, 9ayw, 9bdp, 9bdt, 9bow, 9dks, 9dkq, 9dpb, 9doc, 9dsd, 9dva, 9dze, 9ee, 9enc, 9fx, 9lv, 9lw, 9uv, 9pi, 9vx, 9ti, 9wi, 9wu, 9xaq, 9ya, 9yoc, 9yae, 9yok, 9yal, 9yam, 9yay, 9ym, 9yp, 9yq, 9zac, 9zc, 9zeb.

C. W.—5za, 6aif, 6ala, 6alu, 6atg, 6apd, 6en, 6pd, 6vm, 6wg, 9xad, 6xaq, 6xg, 6za, 6zt, 6zz, 7xd, 7xf, 9aao, 9abl, 9aej, 9agn, 9aib, 9aja, 9aje, 9ajp, 9aka, 9akv, 9amb, 9aqv, 9avy, 9aua, 9ays, 9ayu, 9bvp, 9bbf, 9bik, 9bji, 9bvi, 9bm, 9dcf, 9dyn, 9fm, 9hb, 9jd, 9jl, 9ji, 9nk, 9ux, 9pg, 9wu, 9wd, 9xai, 9xaq, 9xi, 9yc, 9zy, 9zz.

BY GAVM, 2318 K ST., SACRAMENTO, CALIF.

C. W.—4bq, 4cb, 5za, 6aif, 6atg, 6cu, 6za, 6aoz, 6zz, 6bcd, 6ka, 6ef, 6xaq, 6ek, 6jj, 6ale, 6en, 6zf, 6alu, 7nf, 7nx, 8agz, 8bk, 9aja, 9amb, 9wd.

Spark—6aeh, 6zz, 6ald, 6gt, 6hy, 6kc, 6bgl, 6od, 6alu, 6aif, 6auc, 6avr, 6bft, 6aud, 6jw, 6aoe, 6ol, 6bif, 6amn, 6qk, 6zal, 6gp, 6to, 6awh, 6tf, 6acy, 6biu, 6lc, 6adl, 6jy, 6aio, 6baj, 6ajh, 6hh, 6iv, 6aak, 6aix, 6da, 7zo, 7cn, 7om, 7nz, 7zt, (7mf), 7qn, 7vk, 7ly, 7ke, 7abk, 7ed, 7nn, 7hf, 7kj, 7ot, 7zb, 7nw, 7zu, 7mp, 7ju, 7ck, 7bk, 7to, 7kb, 7zv, 7in, 7tj. Anyone hearing 6avm pse qsl.

NY 7NW, HOQUIAM, WASH.

6ak-cw, 6bb, 6bm, 6cv, 6dr, 6eb, 6en-cw, 6ex, 6ff, 6fh, 6gf, 6gr, 6gx, 6hc, 6jj-cw, 6lc, 6lu, 6ng, 6oh, 6po, 6qk, (6qr), 6rm-cw, 6su, 6to, 6tu, 6uo, 6vc, 6vm, 6vx, 6xg-fone, 6xh, 6za, 6zk, 6zm, 6zr, 6zu, 6zx, 6aaf-cw-fone, 6aau, 6abw, 6abx-cw-spk, 6acr, 6aei, 6afn, 6agf, 6ahp, 6aif, (6ale-cw), 6alp, 6alv, 6amk, 6aoz-cw, 6ark, 6aru, 6ath, 6atv, 6avv, 6bbr, 6bca, 6xac-fone, 6zaa, 6zaf-cw, 6zam, 6zao, 7ab-fone, 7bc, 7bh, (7bj), 7br, 7ck, 7cn, 7cw, 7ed, 7fh, (7fi), 7ge, 7gj, 7gs, (7hf), 7hr, 7in, 7iu, (7iw), 7iy, 7jd, 7jf, 7kb, (7ke), 7kg, 7ks, 7ln, 7lw, 7md, 7mf, 7mu, 7my, 7nu, (7oh), 7om, 7rn-cw, (7sr), 7tj, 7tq-cw, 7vo, 7wi, 7wm, 7xf-fone, 7ya, 7yj, 7ys-fone-spk, 7zj, 7zm, 7zt, 9ax-cw-spk Canadian, 9bd Canadian, 9zaf-cw, cl8-fone.

BY 6AFO SAN FRANCISCO, ON 1 TUBE

6od, 6gi, 6hy, 6zu, 6wr, 6er, 6abw, 6aiu, 6aak, 6ef, 6en, 6aoy, 6aoz, 6da, 6fk, 6gp, 6hk, 6ka, 6lc, 6mh, 6mn, 6ol, 6pp, 6sk, 6wi, 6abg, 6acb, 6acy, 6adl, 6aei, 6aez, 6ahu, 6aib, 6ail, 6ajh, 6ale, 6alu, 6zb, 6aqu, 6avd, 6avy, 6jc, 6ky, 7bh, 7hf, 7in, 7kb, 7iw, 7zm, 7kg, 7kp, 7zt, 7zu, 7xd, 7tj, 7jw, 7nn, 7oz, 7to, 7zk, 7kj, 7zp, and 7ya.

Worked—6kc, 6eb, 6is, 7ed, 7mf, 7zj.

BY 7MF, EUGENE, OREGON

Spark—5if, 5hk, 5za, 5iw, 5yl, 5xu, 6's and 7's too numerous, 8zr, 9az, 9jw, 9als, 9zn, 9ww, Canadian (5bi), (5fe), (5ak), (9bd), (9ax), 9aau.

C. W.—5ot, 5an, 5za, 8dr, 8ii, 8wj, 8gv, 8jl, 8bk, 8xv, (vy-qsa), 8cl, 8bif (?), 8box, 8aij, 9zn, 9aao, 9amb, 9wd, 9nx, 9rv, 9bbf, 9un, 9ayv, 9aup, 9doc, 9xi, 9xaq, 9dtm, 2ze, 1bcg Canadian, (4cb), (9bd), (9ax), 9aw.

BY 7HF, EUGENE, ORE.

Spark—Canadian (5ak), 9bd, (7ba), (7bc), 7bg, (7bh), (7bj), (7bk), (7bz), 7cn, 7gj, 7hd, 7hi, (7iy), 7ke, (7kj), (7nw), 7nz, (7oh), (7om), (7tj), 7vo, (7vx), 7zj, 7zm, 7zt, 7zu, (6ah), (6as), 6bb, 6ch, 6cz, (6ex), (6fh), 6fk, (6gr), 6qt, 6gx, 6hc, (6hp), 6is, 6iv, 6kc, 6km, 6ms, 6od, (6oh), 6ol, 6om, 6po, (6pr), (6qr), 6rs, 6st, (6tu), 6uo, 6uq, (6vk), (6vx), 6aau, 6abm, (6abw), (6abx), 6acr, 6acy, 6aeo, (6afn), (6agf), 6agp, 6ahq, 6aif, 6aih, 6ain, 6aix, 6ajt, 6akt, 6ald, 6alk, (6aln), 6alv, (6amk), (6ang), 6ano, (6aor), 6are, (6ark), 6atf, 6atu, 6atv, 6auc, 6auu, 6azl, (6bbr), (6bcj), (6bgn), 6bhq, 6bin, 6biu.

C. W.—Canadian 4cb, 6aat, (6abx), 6en, (6jj), 6ale, 6ss, 6vm, 6awt, (cl3), 9amb, 7aav, 7ce.

BY 6BAJ, PASADENA, CALIF.

5za (spk-cw), 6ad, 6ah, 6ak (spk-cw), (6as), 6cp, 6dp, 6ex, 6fh, 6gf, 6gr, 6gx, 6hc, 6iv, 6km, 6tu, 6oc, 6oh, 6ot, 6pj, (6pr), 6qr, 6to, (6tu), 6tv, 6uo, 6vk, (6vx), 6wz, 6xh, 6zb, 6zk, 6zu, (6zx), (6zz), 6aah, 6aau, 6aat, 6abm, (6abw), 6abx, 6afn, 6agf, 6aif, 6aiw, 6ale(cw), (6alv), 6amk, 6ang, 6aor, 6aph, 6ark, 6awh, 6bak, 6baz, (6bbr), (6bca), 6bgh, 6biu, 7bd, 7bk, (7gj), 7jd, 7jw, 7in, 7iw, 7mf, 7of, 7tj, 7zj, 7st, 9go, 9bd (Canadian.)

BY 6RR, 415 N. GOWER ST., LOS ANGELES, CAL.

Spark—5za, 5yq, 5xu, 5zj, 6ak, 6qr, 6nm, 6ot, 6ej, 6tv, 6pj, 6uo, 6wv, 6xh, 6zk, 6zu, 6zz, 6zx, 6agf, 6ain, 6amk, 6awh, 7jd, 7mf, 7ya, 7yg, 7xj, 7zm, 7zt, 7zu, 7zz, 9yal, 9zx,cl8.

C. W.—5zak, 6ec, 6gd, 6ku, 6pj, 6pt, 6nm, 6nx, 6vm, 6za, 6zb, 6zz, 6ze, 6aat, 6aag, 6aif, 6ale, 6avj, 6azx, 6asv, 6awp, 6zaf, 6zak, 6zam, 6xaf, 7cs, 7og, 7tq, 8vy, 8jl, 8xv, 8sy, 8agz, 8box, 9ax, 9bd, 9jd, 9nx, 9ji, 9ha, 9hv, 9pe, 9wd, 9wu, 9pm, 9xu, 9zl, 9zv, 9aig, 9aja, 9aks, 9amb, 9ayu, 9bex, 9bji, 9dth, 9dtm, 9dva, 9xaq, 9zaf, 9zac, cl8, gr8, kdq, ag1, bf2, wv6, nof, Canadisn, 9bd, 4cb.

BY 6ASJ, OAKLAND, CALIF.

Spark—6acy, 6agk, 6ahq, 6ajr, 6ald, 6alu, 6amn, 6aoe, 6avy, 6ea. 6fh, 6fk, 6lc, 6od, 6ol, 7bk, 7iw, 7mf, 7mp, 6tj, 7zn, 7st, 9bd, (Canadian).

C. W.—4cb, 5ck, 5za, 6acb, 6aif, 6aoz, 6asv, (6cu), 6eb, 6en, 6gd, 6jd, 6ka, 6ky, 6pi, 6rr, 6xad, 6xaq, 6za, 6zn, 6zr, 6zz, 7ce, 7nf, 7nx, 7ny, 7qt, 7ln, 7rm, 7tq, 9ays, 9bd (Canadian), 9hz-kn, 9kp, 9ps, 9wd.

BY 6AUU, CANTON, OHIO

Spark—1ahl, 1ax, 1on, 1xx, 2aje, 2bej, 2bfx, 2bb, 2bj, 2fp, 2gk, 2om, 2tf, 2xq, 3aab, 3ahk, 3atz, 3arw, 3bex, 3cg, 3cm, 3el, 3fo, 3og, 3ud, 3wj, 3xm, 3xq, 4ag, 4cx, 4cy, 5cj, 5hk, 5py, 5xa, 5xb, 5xp, 5xu, 5ya, 5ye, 5yw, 5al, 5zw, 5zz, (8's too numerous 60), 9aap, 9aou, 9aek, 9acb, 9alo, 9arr, 9arg, 9axu, 9aza, 9ac, 9bee, 9bp, 9ca, 9cb, 9dfx, 9ddq, 9dcx, 9dfo, 9dso, 9dar, 9diw, 9dh, 9dy, 9fm, 9fs, 9gk, 9gy, 9hr, 9io, 9jl, 9ju, 9ke, 9ki, 9mc, 9ok, 9ox, 9qj, 9rc, 9ry, 9sj, 9tv, 9uu, 9wk, 9wn, 9ws, 9wt, 9wu, 9xe, 9xi, 9xm, 9xx, 9ya, 9yb, 9yc, 9yq, 9yae, 9ye, 9ym, 9yo, 9xaq, 9zl, 9zj.

C. W.—1aab, 1agi, 1abl, 1ary, 1aw, 1bcg, 1bdi, 1bdj, 1bel, 1bem, 1bes, 1brq, 1bvb, 1bkq, 1bei, 1bg, 1cmk, 1df, 1qn, 1rd, 1ts, 1xa, 1xj, 2afp, 2ayu, 2ajf, 2aax, 2anv, 2beb, 2bfz, 2bnq, 2bej, 2ccd, 2jw, 2ne, 2sq, 2va, 2zk, 2zn, 3ako, 3aad, 3aak, 3aat, 3any, 3aqr, 3arm, 3ber, 3bex, 3bgv, 3biy, 3btj, 3blf, 3bec, 3bfu, 3bav, 3bsl, 3brc, 3brx, 3cbq, scm, 3fs, 3iq, 3kg, 3ko, 3rw, 3ze, 3zo, 3zy, 3zz, 4bk, 4by, 4ew, 4ft, 4gk, 4gl, 4kk, 4ii, 4qe, 4ya, 4yb, 4ze, 5aam, 5an, 5cx, 5dq, 5ek, 5fv, 5ix, 5jb, 5kp, 5la, 5nq, 5nz, 5py, 5uu, 5ye, 5ze, 6ale, 7aa, 7dm, (8's too numerous 105), 9asl, 9aff, 9axf, 9ajf, 9akd, 9aja, 9als, 9ajh, 9ans, 9arg, 9atv, 9aft, 9ayh, 9ajv, 9ayv, 9amu, 9aay, 9as, 9at, 9bjb, 9bft, 9bwx, 9bbf, 9bdf, 9brl, 9cp, 9dej, 9dew, 9dtj, 9dts, 9dfa, 9dam, 9dwn, 9db, 9dj, 9fs, 9hk, 9hw, 9ii, 9io, 9jl, 9jn, 9ju, 9jr, 9kp, 9nx, 9ox, 9ps, 9qa, 9qe, 9ry, 9sj, 9wv, 9xj, 9xt, 9xm, 9yam, 9yaj, 9yb, 9yc, 9zac, 9za, 9zy, kzy, nmw (qra?).

Fone—1xe, 2xb, 3aa, 3zo, 8apu, 8ht, 8ju, 8xae, 8yg, 8zv, kdka, kqb, kyw, nof, wbl, wdy, wmh, wjz.

BY STATION 6OO, SAN FRANCISCO

4cb, 4bq, 5za, 6ak, (6cu), 6ea, 6ef, 6en, (6gy), 6jd, 6jq, 6ka, 6lf, 6nx, (6ec), 6za, 6zn, 6zz, 6fh, 6arb, 7gs, 7ln, 7nx, 7qe. 7wg, (7xf), 8bk, 8vv, 8agz, 8brl, 8cld, 9kp, 9ps, (9wd), 9aau, 9aja, 9ays, 9dth, 9zaf, 9bd (Canadian) also—6aby, (6aif), (6ale), (6amz), (6aoj), (6aoy), 6aqt, 6alu, 6xad, (6zad), 6xaq, (6bcd).

All C. W. stations; 5-watt C. W. here and .6 amps. radiation.

WASHINGTON RADIO CONFERENCE

Continued from page 10

are indeed today upon the threshold of a new means of widespread communication of intelligence that has the most profound importance from the point of view of public education and public welfare. The comparative cheapness with which receiving stations can be installed, and the fact that the genius of the American boy is equal to construction of such stations within the limits of his own savings, bid fair to make the possession of receiving sets almost universal in the American home.

I think that it will be agreed at the outset that the use of the radio telephone for communication between single individuals as in the case of the ordinary telephone is a perfectly hopeless notion. Obviously if ten million telephone subscribers are crying through the air for their mates they will never make a junction; the ether will be filled with frantic chaos, with no communication of any kind possible. In other words, the wireless telephone has one definite field, and that is for spread of certain pre-determined material of public interest from central stations. This material must be limited to news, to education, to entertainment, and the communication of such commercial matters as are of importance to large groups of the community at the same time.

It is therefore primarily a question of broadcasting, and it becomes of primary public interest to say who is to do the broadcasting, under what circumstances, and with what type of material. It is inconceivable that we should allow so great a possibility for service, for news, for entertainment, for education, and for vital commercial purposes, to be drowned in advertising chatter, or for commercial purposes that can be quite well served by our other means of communication.

Congress some few years ago authorized the Secretary of Commerce to license radio sending stations, and to impose certain conditions in the licenses designed to prevent interference between the stations and to serve the public good. This legislation was drawn before the development of the telephone was of consequential importance. Until the last four or five months there has been but little difficulty in handling these regulations, because sending purposes have been largely confined to radio telegraph, and to a very small extent to the radio telephone. The extraordinary development of the radio telephone, however, has brought us face to face with an entirely new condition upon which licenses should be issued. It raises questions to to what extension in the powers of the department should be requested of Congress in order that the maximum public good shall be secured from the development of this great invention. During the last five months, while this extraordinary rapid installation has been in progress, I and my colleagues in this department have felt that we should take a very conservative attitude on the issuance of sending licenses, and I am able to inform you that there are today, outside of government broadcasting stations and the field authorized to the American boy, but few licenses outstanding—and these are limited to a small proportion of the number of the available wavelengths. We have therefore kept the field clear for constructive development. The experience gained indicates that the time has arrived not only when this large mass of subscribers need protection as to the noises which fill their instruments, but also when there must be measures to stop the interferences which have already grown up between even the limited number of sending stations which threaten to destroy them all.

The problem is one of most intensely technical character, but is not one without hope of fairly complete solution. Fortunately, the sending of radio telephone messages can be arranged in wavelengths sufficiently far apart so as not to interfere with each other, and receivers can at their option tune their receiving instruments to the different wave bands. With the improvement in the art and in the delicacy of instruments, the distance between wavelengths may eventually decrease and thus the number of layers of messages increase. Furthermore, it is possible to increase the number of sending stations and thus the variety of material, if the power applied to certain wavelengths is limited so as to circumscribe the area of distribution from a given station. Beyond this again certain times a day may be set aside within certain wavelengths for certain types of information.

With the permutations possible to work out in different wavelengths, in different geographical areas, in different times of day, we should be able to make it possible for the owner of a receiving instrument, by tuning his instrument to different wavelengths, at different times, to possess himself of a great variety of entertainment, information, news, etc., at his own option. Even if we use all the ingenuity possible I do not believe there are enough premutations to allow unlimited numbers of sending stations.

One of the problems that enter into this whole question is that of who is to support the sending stations. In certain countries, the government has prohibited the use of receiving instruments except upon payment of a fee, out of which are supported government sending stations. I believe that such a plan would most seriously limit the development of the art and its and its social possibilities and that it is almost impossible to control. I believe that we ought to allow anyone to put in receiving stations who wishes to do so. But the immediate problem arises of who will do the broadcasting, and what will be his purpose. It is at once obvious that our universities, our technical schools, our government bureaus, are all of them willing and anxious to distribute material of extremely valuable order without remuneration. Also judging from the applications we have had, any number of merchants are prepared to distribute entertainment provided they are allowed to interlard discussion as to the approaching remnant sale. Many of the larger newspaper publishers are asking for licenses to install broadcasting sets in which news and entertainment will be distributed, and the commercial companies are requesting licenses for the establishment of systematic distribution of news and entertainment conditional upon their being given permission to undertake commercial broadcasting of one kind or another.

It is my belief that, with the variations that can be given through different wavelengths, through different times of day, and through the staggering of stations of different wavelengths in different parts of the country, it will be possible to accommodate the most proper demands and at the same time to protect that precious thing—the American small boy, to whom so much of this rapid expansion of interest is due.

It is, however, a problem of regulation, if we are to get the maximum use. It is one of the few instances that I know of where the whole industry and country is earnestly praying for more regulation. Regulation will need to be policed, if there is not to be great prejudice to the majority, and thus the celestial system—at least the ether part of it—comes within the province of the policeman. Fortunately the art permits such a policeman by listening in to detect those ether hogs that are endangering the traffic.

There is involved, however, in all of this regulation the necessity to so establish public right over the ether roads that there may be no national regret that we have parted with a great national asset into uncontrolled hands. I believe this conference with the high skill that it represents will be able to determine upon a method which should give satisfaction in all directions, and should stimulate the creation of a new addition to our national life.

Testimony From A. H. Griswold

The first witness called by the commission was A. H. Griswold, of the American Tel. and Tel. Co. He stated that his company's interests lie primarily in whatever relation radio telephony bears to public service. He stated that in his opinion the only real service which could be rendered through this means was for telephoning across wide stretches of water or from ship to shore or from airships to ground stations. He said that he knew of only one commercial application, namely the service given between Catalina Island and the mainland.

In regard to broadcasting he stated that his company is now constructing a sending station in New York which will be ready for service soon. It is the intention to lease this station to the public and not to give any definite program. His company, he stated, does not intend to promote the art of wireless telephony, but to give public service only by enabling a subscriber of their wire system to be directly connected to the wireless system. In his opinion it is difficult to subdivide transmission service, as there are not enough wavelengths to do this. He did, however, make the following suggestions as to the proper allocation:

Public radio telephone service, 325 to 425 meters.

Ship work, 1600 to 2200 meters.

International service, 4000 to 5000 meters.

Short range telephony, 100 to 150 meters.

In his opinion there are only 30 available wavelengths.

In answer to a question by Congressman White, Mr. Griswold stated that in his opinion there should be one governmental responsibility and that such control should be through the allocation of wavelengths. He stated further that the limit of their New York station would be transmission over 100 to 150 miles and that no service rates had been decided upon.

General Squier expressed the opinion that general broadcasting might interfere with all other service everywhere and that one radio station might do more harm than 1,000,000 miles of wire. Mr. Griswold thought that the only service which should be set apart would be that for international business and ship use. He thought also that every man should have the right to do broadcasting for his own business, but on short waves only.

In reply to a question by Secretary Hoover in regard to the patent situation, Mr. Griswold stated that two years ago the General Electric Co. and the American Tel. and Tel. Co. had at the request of the Government agreed to sell appliances. The former radio telegraph instruments and the latter radio telephone instruments. Thereafter certain rights were transferred by these companies to the Radio Corporation of America and the Western Electric Co. and later the Westinghouse Co. came into the field through an arrangement with the General Electric Co.

Statements From Radio Corporation Representatives

E. P. Edwards, manager of the radio department of the General Electric Co., was then requested by Secretary Hoover to testify. In his opinion the biggest advantages derived from radio telephony were those secured to the farmer. He thought that broadcasting in general should be curbed. He stated that the cost of a large sending installation is about $15,000, and that it costs about $2000 per month for the technical operation of such a plant. Furthermore that such an installation should be operated through a public service corporation. Also that daylight broadcasting for commercial purposes should be encouraged and that light and power companies and the U. S. Forest Service should have free access to such facilities. In his opinion there should be no limitation placed on the sale of receiving apparatus.

Mr. Edwards then gave the following account of the mutual agreement which exists between the large corporations:

The Westinghouse and General Electric Companies make radio appliances under license of the Radio Corporation and this is cross-licensed under certain telephone patents. The Radio Corporation can only sell General Electric and Westinghouse equipment and then only in the experimental and amateur field. The General Electric Co. sells about 51 different radio items, but in a few days expects to have a low-priced complete receiving set on the market. In his opinion the Radio Corporation could get business amounting to about $50,000,000, but that they are not equipped at this time to take on this amount of business. He said that his company is preparing to make about 60,000 large amplifier tubes per month, and that they are preparing to triple their tube production.

J. W. Elwood, secretary of the Radio Corporation of America, was called to the stand and stated that he will give full contract data in regard to the relation of his company to the other large companies to the commission for their own use. He admitted that his company was far behind in the filling of their orders and that they receive as many as 600 telegrams in one day. In reply to a question regarding interference from stations, he remarked that last year there was more human interference than God interference. In his opinion the relative importance of wavelength allocation should be as follows:

First—Government.
Second—Civil departments of the Government, such as agriculture, postoffice, forest service, etc.
Third—Protection of life and property.
Fourth—Education.
Fifth—Entertainment.
Sixth—Amateur service.
Seventh—Public service.

He felt that the amateur should be amply recognized and encouraged and also that all transmitting stations should be properly controlled by the Government through legislation.

L. R. Krumm of the Westinghouse, E. N. M. Co., then testified, stating that his company was the pioneer in general broadcasting and that they have stations at Pittsburgh, Springfield, Newark and Chicago and that these stations furnish high-class entertainment, also that they realize that in deciding upon legislation the interests of the receivers are more vital than those of the broadcasters, for while there are but few of the latter there must be nearly 1,000,000 of the former. He thought that a range of between 300 and 400 meters should be prescribed for such service. He stated that his company intends to extend their service and that they will transmit church services from chimes to collections. He thought that all public service for business in the daytime and entertainment in the evening could be taken care of by 12 to 15 stations. He stated that his company is making 5 different types of receiving sets, varying in price from $25 to $300, and that while they are now making 25,000 of the cheap sets per month they can see no drop in the sales for a long time, as long as the quality of the broadcasting programs is maintained. At this point Mr. Griswold stated that the license agreement forbids connection between the A. T. & T. lines and the wireless service.

Congressman White wanted to know whether a state franchise or a tax on broadcasting stations had ever been suggested and Mr. Krumm thought not, to the best of his knowledge.

H. W. Nichols, Western Electric Company, then expressed the opinion that the only real important service rendered by wireless telephony is ship service or exceptional island service and that this should be done at short wavelengths. He stated that for two-way telephone work 10,000 cycles would be required, that for 300 meter service 1,000,000 cycles have to be used and for 400 meters about 700,000 cycles, so that in view of this relationship 25 messages could be sent in each direction. He expressed the opinion that very little advertising would be done in broadcasting and also stated that a movement was on foot tending to the manufacture of receiving apparatus by his company.

Consideration of the Pacific Plan

Max Loewenthal, representing the Pacific Radio Trade Association, was then requested by Secretary Hoover to state the manner in which various problems had been approached and solved on the Pacific Coast. He dwelt at some length on the splendid spirit of co-operation evidenced on the coast which has resulted in the preparation and execution of a broadcasting schedule which has met with the approval of all interests concerned and permits of little or no interference. This schedule is based on a time schedule rather than on wavelengths, as all the broadcasting is being done on 360 meters. He expressed the opinion that such a basis could be worked out to advantage in most localities by local interests. Considerable interest was manifested by the commission in this method of solving the problem through co-operation, and through the policing power transferred to and accepted by local radio clubs, who assume such duty by authority of the U. S. Radio Inspector. Copies of the various schedules and plan were given to the commission. He stated in conclusion that he believes the use of the ether should be standardized and supervised and not commercialized or monopolized.

The Ship Operators' Side

C. B. Cooper, vice-president and general manager of the Ship Owners Radio Service, then appeared before the commission and stated that in his opinion the most important service which can be rendered by radio is the service from ship to shore and vice versa. He thought that for amateur broadcasting, which is important, 200 to 225 meters should be reserved, having reference to spark work. For C. W. transmission 225 to 275 meters, for spark sets 275 meters, and for special work 325 to 350 meters. For advertising broadcasting 400 meters, for general broadcasting, like concerts, 1500 to 1700 meters, for commercial broadcasting 900 to 1200 meters. He stated that his company handles about one-third of all the service of the Shipping Board.

Congressman White expressed an opinion that Congress might do well not to try to legislate according to wavelength.

The Amateurs' Side

Secretary Hoover then called P. F. Godley, of the American Radio Relay League, to present the case of the amateurs to the commission. Mr. Godley made the statement that in his opinion, or rather that of most of the amateurs throughout the country, the large interests are trying to curtail the rights of the amateur and that these interests believe that the receiving sets of the amateurs are interfering with the service which they are trying to give. Also that the manufacturing companies believe that the novices can only use sets with a single knob, while in his opinion sets with several knobs for proper tuning should be produced. He suggested that wavelengths varying from 150 to 275 meters be employed and that 1200 to 1800 meters be reserved for the broadcasting stations. In his opinion "fading in" is negligible with longer wavelengths.

At this juncture Secretary Hoover interjected a few remarks with considerable emphasis to the effect that it is his intention and he knows it is the sense of the commission to protect the interests of the amateur to the fullest extent. And that he will, using his own words, sit on any misrepresentation as to their intentions and that he is very solicitous for the American boy and the radio amateur.

In answer to a question by Mr. Maxim as to whether the public can use selective receivers, Mr. Godley stated that the spark for the amateur should be kept below 200 meters. Secretary Hoover thought that most of the nuisance through interference has been created by the amateurs themselves. Mr. Godley thought that self-policing by radio clubs would probably keep the amateurs in line, but that this should be done through governmental regulation. He suggested the following schedule of wave allocation: For the first year man 150 to 175 meters, for telephone, spark or C. W. For the second year man, spark 175 to 200, modulated C. W. 200 to 225, telephone 225 to 250, pure D. C. C. W. 250 to 275. In his opinion sending amateurs should be compelled to take out operators' licenses. Secretary Hoover thought that then we should have regulation over all receiving equipment sold, in answer to which Mr. Godley said that to simplify this matter all radiating receivers should be considered unlawful.

K. B. Warner, secretary of the American Radio Relay League, supported Mr. Godley's plan of regulation and expressed the opinion that the operators would all be willing to pay license fees. He also did not approve in general of cheap or one knob sets. He stated that he has known of cases where 360 meter service interferred with ship traffic in New York Bay. He then made a plea for the necessity of writing the amateur interests into the new law. Congressman White thought that it might be well to license all transmitting receiving sets. Mr. Griswold stated that he was not so sure about the amateurs not wanting the cheap sets, but was anxious to get further information on this subject.

L. C. F. Harle of the Federal T. & T. Co., then testified, stating that in his opinion the entire question of broadcasting was an enormous experiment. He suggested the following wave allocation: For amateurs, 150 to 250 meters; for broadcasting, 3 sets of bands, 1 from 300 to 500, another 500 to 700 and another 800 to 900. He said that for commercial ship work 300 meters is no longer used. He expressed the opinion that the amateur is largely responsible for the wonderful radio development.

The Public Service Side

F. A. Allner, chairman of the Radio Committee of the N. E. L. A., then put in a plea for the central station, which are at times greatly in need of wireless service in order that service may be secured between various stations and sub-stations, especially when other service has been interrupted through storms. He stated that under no circumstances would any broadcasting be indulged in. He suggested the most flexible regulation.

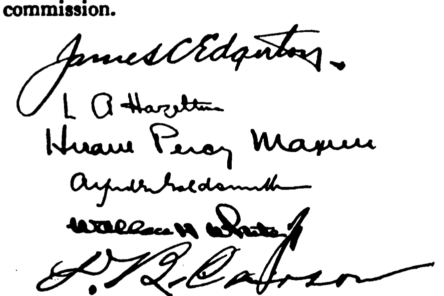
Frank E. Doremus, of the Detroit News, then made an eloquent plea in behalf of newspaper interests, expressing the opinion that broadcasting service can best be given through such means. He stated that in and about Detroit about 250,000 receiving sets are in use and that the service which his paper is giving is being received with general satisfaction.

Secretary Hoover stated that the question of licensing might involve a more difficult problem, namely, as to whether the Government can be held responsible for the moral and intellectual welfare of the people, for the question might come up continuously as to what constitutes a right form of information for broadcasting in order to reach a decision as to whether a license should or should not be withdrawn. In a humorous vein he suggested one wavelength for a prize fight and another for a sermon, if it is thought desirable that both be transmitted. Ex-Congressman Shirley thought that the Government should regulate and not censor. Secretary Hoover replied that by having at least two sending stations in a city competition might be created and in that manner might lead to a higher moral tone.

H. R. Young, representing the National Retail Dry Goods Association, stated that it is the intention of dry goods stores to broadcast for educational purposes only and that they do not advocate the use of wireless service for advertising purposes. He admitted, of course, that indirectly the store would be benefited through the sale of appliances. At this juncture Secretary Hoover interjected the thought that if every department store in the 260 cities in the U. S. wanted a license for broadcasting or only one in each city would want such a license, there would not be enough wavelengths to serve the purpose.

P. E. Wiggin, of the Radio Electric Co., Pittsburgh, stated that in his opinion 500 members of the Pittsburgh Radio Club would all be willing to pay a $2 license fee and another $10 for an operator's license.

F. P. Guthrie, of the U. S. Shipping Board, stated that there were 3 important factors which he would like to bring before the commission.



Signatures of some radio notables at the conference

First—That there is no real need for wireless telephone equipment for ships.

Second—That 300 meter service is not desired by the board.

Third—That the large interests are not permitting the board to buy tubes because they believe that they will be used for the purpose of making money with them, which has been a hardship in many cases.

A representative of the Boy Scouts of America made an eloquent plea for closer cooperation between the various U. S. departments and the broadcasting stations so that the younger element of a community in par-

ticular, might receive important information direct from Government sources, even to the extent of having them listen in to debates in Congress and have the prominent Government officials talk directly to the youth of the country.

Dr. Stratton, the chairman of the commission, then asked for any further remarks from anyone in attendance and as there were no further suggestions offered he adjourned the hearing after thanking everyone for their co-operation with the commission. He stated that the committees would require probably ten days or longer to report and that some recommendations would probably be made tending towards some legislation by Congress giving the Department of Commerce broad discretionary powers for the regulation of all sending and receiving stations.

TEXAS RADIO MARKET NEWS SERVICE

Continued from page 25

Markets and Warehouse Department and the Department of Agriculture, who in addition to his other duties, will for the present have charge of the office details of the "Texas Radio Market News Service," and those wishing further information will please address, J. Austen Hunter, Assistant Marketing Agent, Texas Radio Market News Service, Austin, Texas.

A Dependable and Serviceable Battery
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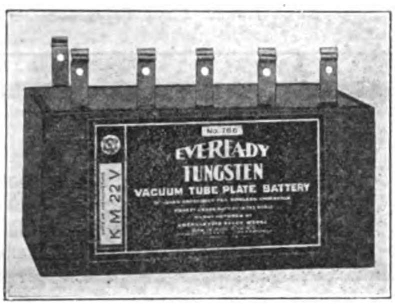
No. 766— EVEREADY



Order from your regular dealer and specify No. 766 Eveready Wireless Battery.

This is just the thing for the amateur—will give long and valuable service and can be absolutely relied upon to deliver a clear, steady current.

This battery has 1 negative and 5 positive leads, each having a flat brass strip with a 3/16-inch hole in the end for connection with the binding posts. These 5 positive leads allow a range of 16½, 18, 19½, 21 and 22½ volts in steps of 1½ volts.

15 cells connected in series and packed in a strong box make this battery substantial and easily handled. All cells are solidly packed and are sealed in paraffine and packed with ½-inch of sealing wax, rendering a weather proof unit and one that will withstand practically all variations of climate and temperature. This Wireless B Battery has been standardized for use in the United States Navy.

And the price—only **$3.00.**

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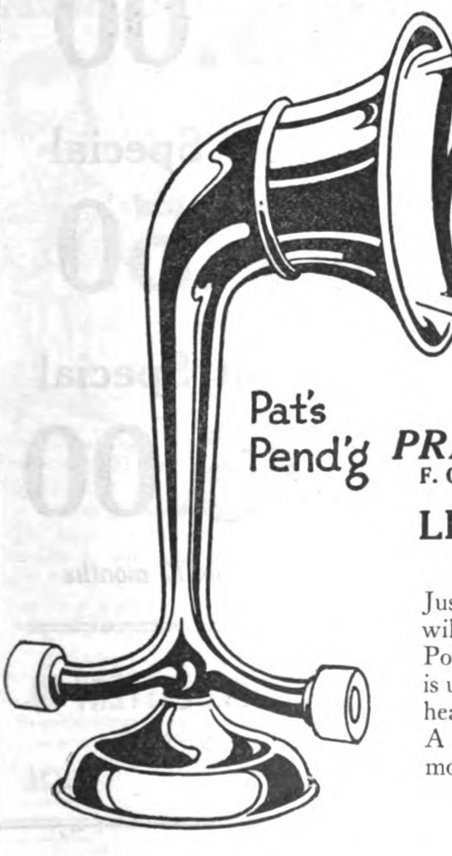
599 EIGHTH STREET

Compare it with ANY
It SPEAKS for ITSELF

INTRODUCING THE KING "AM-PLI-TONE" A RADIO SURPRISE



Pat's Pend'g

PRICE $12.00
F. O. B. New York City

LISTEN TO THE CONCERTS, NEWS AND DANCE WITH A KING *"AM-PLI-TONE"*

Just slip your head phones on the "AM-PLI-TONE" and you and your friends will be *SURPRISED!*

Polished cast aluminum body with nickel plated base and horn. No sheet metal is used. The tinny sound is left out. The volume is *DOUBLED* because *TWO* head phones are blended into one *POWERFUL* tone.

A big hit, a big seller, and immediate deliveries. Dealers and distributors, what more can you ask? Write today for territory—KING "AM-PLI-TONE."

NOTICE—All infringers of this device will be vigorously prosecuted.

82 Church St., New York City

A RADIO PRIMER

Continued from page 24

The range of communication varies from day to day due to the electrical condition of the atmosphere. When the weather is warm the moisture in the air is usually heavily charged with electricity. The static electricity, as it is called, not only absorbs energy, but collects on the receiving aerial and makes considerable noise in the receiving instrument which interferes with the reception of radio signals. For this reason better distances can be covered during winter than during summer.

You can reflect light waves with a mirror; "radio waves," that is the waves used in radio communication, are reflected by conducting surfaces such as heavily charged clouds or bodies of electrified air.

Radio waves are subject to refraction, a bending action which takes place when they pass through atmosphere of varying density. You can study the refraction of light waves by holding a stick in a bowl of water at an angle; the stick appears to be bent. Refraction changes the direction of radio waves.

Radio waves are also subject to diffraction, or a bending around objects in their path such as mountains. The mountain sets up counter waves and an electrical shadow exists on the lee side similar to the conditions which exist when a rock is in the path of water waves.

Unusual long distance "freak" messages are the result of combinations of reflection, refraction and non-absorption.

BROADCASTING STATIONS OF U. S.

Continued from page 17

The Emporium, San Francisco. Daily, except Sunday, 10:00-11:00 a. m. and 2:30-3:30 p. m., music after April 15.

Seventh District

KFC—Post-Intelligencer, 600 Pine St., Seattle, Wash. News, music and special entertainment each evening.

Ship Owners' Radio Service, Wooster Bldg., Portland, Ore.

Hallock & Watkins, 192 Post St., Portland, Ore.

Northwestern Radio Mfg. Co., Portland, Ore.

Eighth District

KDKA—Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. Daily, except Sunday, music 10:00-10:15 a. m. and 12:30-1:00, 2:00-2:20 and 4:00-4:20 p. m., with special Saturday concert 3:00-4:00 p.m.; bedtime stories, 7:30 p. m.; press, 7:45; special features and vandeville acts, 8:00 p. m.; music and news, 8:30-9:30; Sunday, church service, 10:45 a. m., 3:00 p. m. and 7:30 p. m.

WBL—The Detroit News, 615 Lafayette Bldg., Detroit, Mich. Daily, except Sunday, 11:30-11:55 a. m. and 3:30-4:00 p. m., phonograph music; 7:00-8:30 p. m., special musical programs by selected artists.

KQV—Doubleday-Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa. Daily except Saturday and Sunday, music, 4:30-5:00 p. m.; Sunday 1:00-1:30 p. m. and 4:00 to 5:00 p. m.; Monday, Wednesday and Friday, 9:30 to 10:30 p. m.

WDZ—Marshall-Gerken Co., 27 Ontario Ave., Toledo, Ohio.

WPB—Pittsburgh Gazette-Times, Gazette Square, Pittsburgh, Pa.

WMH—Precision Equipment Co., Cincinnati, Ohio. Monday, Wednesday and Saturday, 8:15-10:00 p. m., music, speeches and news; daily 485 meters; 11:00 a. m. and 4:00 p. m., weather reports.

Ninth District

WOV—R. B. Howell, 1802 Farum St., Omaha, Neb.

WHA—University of Wisconsin, Madison, Wis. Daily, except Sunday, weather reports at 12:35 p.m., Friday at 8:15 p. m.; special music and other dates as announced. Midnight to 1:00 a. m., university news on 410 meters.

WLB—University of Minnesota, Minneapolis, Minn. 485 meters; daily 12 noon, weather and stock reports; 7:30 p. m., wheat and potato market; 7:45 p.m. Wednesday only, music, 360 meters.

WLK—Hamilton Mfg. Co., 2011 North Alabama St., Indianapolis, Ind. Sunday, 8:00-8:55, religious, vocal and instrumental music; Tuesday, 8:00-8:55 p. m., jazz, vocal and instrumental music; 9:00-10:00 p. m., local theater numbers and news items; Thursday, 8:00-8:55, special numbers from local singers and orchestras, stories, news and speeches.

KYW—Westinghouse Electric & Mfg. Co., 111 W. Washington St., Chicago, Ill. Daily, except Sunday, 9:30, 10:00, 10:30, 11:00, 11:30 and 12:00 a. m. and 2:45 p. m., stock and market reports; 2:15, 4:15 and 6:00 p. m., news and market reports; 7:00 p. m., summary of financial report; 7:30 p. m., children's bedtime story; 8:00-9:00 p. m., musical program; 9:00 p. m., news and sports; Sunday, 3:30 p. m., Radio Chapel.

9XAB—Western Radio Co., Kansas City, Mo. Market reports and weather forecast, 11:30 a. m. and 2:30 p. m.; concerts in the evening.

9ZAF—Reynolds Radio Co., Denver, Colo. News twice daily and concert Sunday evening.

RADIO IN CHINA

Continued from page 13

as it very often does in China, and we had to ride in sedan chairs to the Yamen or magistrate's building, where we presented our credentials. As the city officials had not been expecting us yet, no provision had been made for quarters, but with the usual Chinese hospitality they gave us the best that they had, with all sorts of apologies.

The immediate problem was to transport the masts and all to the station site, which was nearly a mile and a half inside the city. Most Chinese cities have walls around them, walls with small gates and the gates have semi-circular compounds outside them. The streets are very narrow, averaging 7 ft., and there are many right angled turns.

Several contractors were called in (we did the most of our work on a contract basis) and asked to bid on this job, but the only man who would consider it gave us a fantastic story about the necessity of breaking holes in the city walls, repairing the holes afterwards, of building matchwork bridges over the roofs of the houses at the street turns, and of the great army of coolies which he would have to employ to carry the masts; he ended up by giving his price of "baat sap ng mun," or about $45.00 gold. As there was about seven tons to be moved we did not see how he could do it at that price, especially under the conditions as he stated them. He was awarded the contract.

The writer then returned to Canton to arrange for the carrying forward of the plans for the other stations, and that contractor still prides himself on having put one over on the foreign engineer.

The truth of the matter was that the contractor, by virtue of knowing the country so well, was able to float the poles back down the river for a couple of miles, into a canal and in back of the city. One hole had to be cut into the wall and then he had a straight street of only a quarter of a mile to carry them. When this was discovered later we had a good laugh over it, but we still maintain that we had the best of the bargain.

The "Bell and Drum" tower was allotted to us for a station room and operators' quarters. This building was so named because of its having a large bell and a larger drum which served the purpose of warning the inhabitants of the city of any attempted invasion by hostile troops or bandits.

The masts for the Shiu Hing station were set 250 feet apart in a line of east and west, that giving the best directional effect with Canton. Each mast was raised in three sections, making a total of 160 ft. high. They were guyed at each joint and also at the top, in four directions. The joints were made by lapping the top of one section to the lower end of the next section, and secured by two iron clamps or bands made from ¾" x 2½" strap iron. Trouble was experienced in getting these bands made up by the blacksmith, as he did not believe in working to size. We finally had the bands all made the same size and trimmed the poles to fit the bands.

Before raising, the poles were shaved smoothly and creosoted, then the first section was set in cement, and the remaining two sections were successfully pulled up through the bands by means of rope blocks and a hand windlass. This part of the construction always drew a large crowd, many of the curious even getting in the way of the riggers and interfering with their work. The project could have been successfully commercialized right there by merely charging an admission fee.

Six 7/22 bronze wires spaced 3½ ft. apart on fir spreaders made the antenna. The lead-in was taken off one end. This gave a natural period of 485 meters.

In addition to a regular ground made by digging down 10 ft., where we found wet earth, and burying a bundle of copper wires in charcoal, we laid out a counterpoise, fan shaped, under the antenna, and just under the surface of the earth.

A cement foundation was laid for the Genco set and the 55 cell storage battery. The masonry contractor knew all about cement mixtures, as he "had mixed all the concrete for a mission building"; we had a hard time convincing him that a 1-2-4 mixture of cement, sand, and gravel would hold up. He had been taught differently and said that it would all fall to pieces, that it would never set, and that he would lose his reputation. Finally we told him that we would take the responsibility, and he was then happy.

Most of this work had to be directed by means of the sign language, owing to the fact that our interpreter was taken sick. The workmen are very quick at grasping an idea and for a period of three weeks we made out quite well by giving orders in pantomime.

The motor-generator, the panels and the lead-in were installed, the wiring run and the construction crew moved on to the next station, which was further up on the West River at Wuchow.

The construction details of the other stations were similar to Shiu Hing, and the same difficulties were encountered. About the only difference was that of time. Where it took six weeks to build the first station, the last on the list was completed in a total of nine days. Incidently the last station was a better piece of work.

THE C. W. MANUAL

Continued from page 16

point, to which the small brass lugs of Fig. 36 may be soldered quite easily. Care and practice will expedite the whole process of soldering a tap to about three minutes.

In Fig. 30, it will be observed that three multi-contact tuning switches are provided; the points, of course, are connected to the lugs on the inductance in accordance with the table, Fig. 37, and the switch arms, to the antenna (via radiation ammeter), to the plate condenser, and to the key condenser, respectively, as shown in Fig. 33. No details are given for these multi-contact switches, nor the changeover switches shown in the same figure.

The buzzer for interrupting the continuous waves into small groups at audio frequency, is shown in the lower right corner of Fig. 30, and its control rheostat is in the lower center of the same figure.

The indicating instruments must be selected with due consideration to the type of tubes that will ultimately be used. In the original apparatus herein described, the author used a milliammeter with a scale reading to 100, which restricted its use to the measurement of the current to the oscillator tubes only.

Western Electric Co. tubes have been used at all times with this apparatus, which made the use of a 5 ampere filament ammeter possible.

In constructing this apparatus for use with any type of 5 watt tube on the market at the present time, it is suggested that a milliammeter reading to 300 milliamperes be used in the plate circuit, that an ammeter reading to 10 amperes be used in the filament circuit, and that a radiation ammeter reading to 1.5 to 2 amperes be used in the antenna lead. As a matter of information, in connection with this latter instrument, the radiation, using two 5 watt tubes as oscillators, will vary from 1 to 1.3 amperes at the most efficient wavelength.

Details for the construction of the various panels and sub-panels will be found in Figs. 37 and 38. These panels are constructed of 3/8 in. Bakelite sheet. The details of the cabinet for this apparatus are left to the constructor. It may be stated, however, that one having inside dimensions not smaller than 11 by 16 by 9 1/4 inches deep is recommended.

FALLACY OF TOO MUCH AMPLIFICATION

Continued from page 29

used. In the majority of cases but 1-step, and in some cases—even as far as Buffalo, N. Y.—only a "pickle tube" was used!

It will also be remarked that in these cases we have no *all-way* transmission over the Atlantic Ocean—at all! The above splendid reception work was done *all overland!!*

Mr. Dow, 6ZAC, at Wailuku, Honolulu, writes: *"You are very QSA on 1-step and all over the room on 2."*

WHERE, then, enters the idiotic fallacy of multi-stages of amplification, with their attendant expense of tubes, upkeep, numerous storage and "B" batteries, etc?

It is, to my mind, little short of the criminal to foist upon the rapidly-growing amateur class the entirely erroneous belief that vast power to send, and much amplification to receive, are obligatory! Nothing could be further from the truth, and it is to this end that I herewith take pleasure in exposing the fallacy!

UNPREMEDITATED TRANS-CON. WORK

By MAJOR LAWRENCE MOTT,
O. R. C. Signal Corps, U. S. A.

By dint of liberal use of the Western Union, and by a large patronizing of one Uncle Sam's postoffices, there have—in the past—been DX *signals* arranged for, listened for—and heard!

I believe, however, that I err not when I say that to 3ALN, the station of H. F. Hastings, situate at 905 "B" street, Washington, N. E., D. C., goes the prize of PRIZES for effective DX reception—and transmission! An honor in which 6XAD is privileged to share—with all due modesty—and so forth!

Mr. Hastings and I had been exchanging letters with regard to our signals—as each could hear t'other very well—when, on the night of February 16th he was plainly heard, working an "8" station. As soon as he cleared I called him, and he came back at me—at once. Time: 12:34 a. m.—PCT. I briefly asked him if conditions were such, with him, that he could take a message, to which he replied: "R—OK—GA!"

I sent him the following:

"Jordan Mott—Biscayne Yacht Club—Miami—Florida. First transcon to Washington DC—sig. Law"

3ALN at once came back with: "Nr 1—R—Nr 1—R—FB"—etc.—etc.

From my father, at Miami, I have received word that Mr. Hastings was so good as to forward the message via Western Union, from Washington, and it was correct in every particular.

On the night of March 5th-6th—at 1:09 a. m.—PCT—I had been working some "8's"—and heard, beneath a lot of

QST QSP All Amateurs QSQ QSL

HALLOCK & WATSON RADIO SERVICE Announce

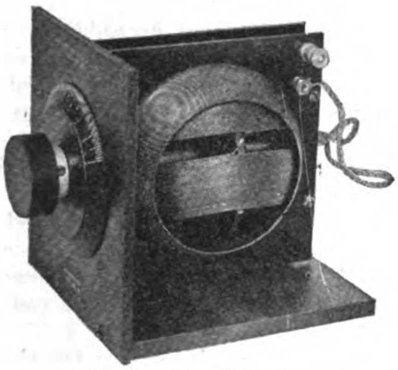
THE OPENING OF THEIR RADIO SUPPLY STORE IN PORTLAND, OREGON, WITH A COMPLETE STOCK OF RADIO TELEPHONE AND TELEGRAPH EQUIPMENT OF STANDARD MAKES.

PERSONNEL

J. H. HALLOCK
Formerly Radio Construction Engineer, U. S. Navy Dept. and Federal Telegraph Co.

C. H. WATSON
Formerly in charge U. S. Naval Radio Laboratory, Mare Island, California.

We believe we have the MOST EFFICIENT short wave receiving equipment on the market today and would like you to prove that statement to your own satisfaction.



Northwestern Variometer Mounted $10.00

We refer to the new UNIT VARIOMETER and VARIOCOUPLER built by the Northwestern Radio Mfg. Co. of Portland, with whom we are co-operating in design work and whom we also represent as exclusive distributors.

Here are a few points of design that make the efficiency of the set apparent:

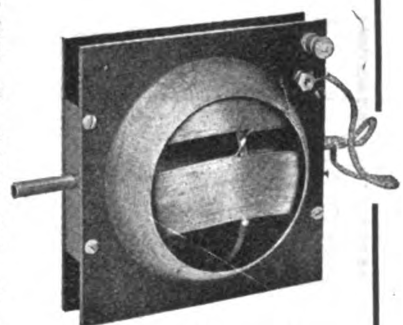
NO DIELECTRIC WHATEVER in or around the field of the coils, thereby reducing the dielectric hysteresis to a minimum—"NOTHING THERE BUT THE WIRE."

NO SPRING OR BEARING CONTACTS between stator and rotor. Flexible conductors permanently connected to binding posts in rear.

NO moulded material to warp or chip. Panel, knobs and dials machined from XX bakelite.

NO small, high resistance wire; No. 20 double SILK thruout.

NO binding posts or switch points on fronts of panels.



Northwestern Variometer Unmounted $6.50

AND FURTHERMORE—NO TROUBLE getting that distant fone station. We're putting Avalon on the Magnavox with an indoor antenna in a first story flat!

INCIDENTALLY our 100 watt fone will be in operation the latter part of March. Drop us a line and get acquainted.

HALLOCK & WATSON RADIO SERVICE

192 Park Street **Portland, Oregon**

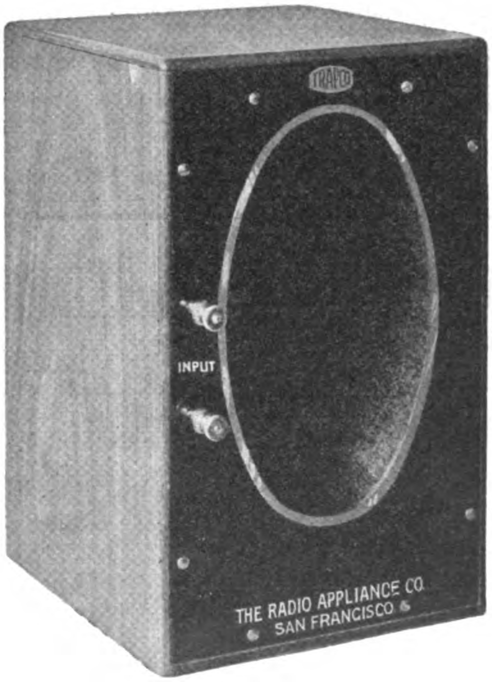
A New Type of Superior Loud Speaker

The Most Artistic Loud Speaker Manufactured.

Improve the appearance of your receiving outfit and increase the loudness and quality of the music and speech

The TRACO LOUD SPEAKER

fills a long felt want for a compact unit—uniform in appearance with the rest of the set and giving much better results than are possible with the ordinary horn.



HIGHLY FINISHED WALNUT CABINET

will make this instrument a beautiful addition to your most elaborate receiver. Combines a Baldwin phone and a scientifically designed tone chamber, assembled in Kennedy 525 Walnut Cabinet, 8″ long x 12½″ x 8½″.

Write for Prices and Information regarding other New Radio Accessories.

THE RADIO APPLIANCE CO.

961 Pine Street, San Francisco, California

QRM, and uncomfortable QRN—a "3" station calling me. By dint of ear-straining I finally made him out to be 3ALN—and very QSA, when the local—and infernal!— interference permitted ANYTHING to be heard! I shot back: "R—QRM—and QRN—but GA—GA—." He came back with: *"Hr—Nr—1—to 6XAD—sending picture tomorrow—sig. 3ALN."*

In brief, the above are the extraordinarily good results of that which I call "unpremeditated" transcontinental work! In here reporting it I have omitted the numerous preambles to the message—the oft-repeated calls and signs—as these are, of course, understood to have been exchanged. The message to me from 3ALN refers to a letter of mine, in which asked for a photograph of his station for reproduction in RADIO.

It will carefully be noted that 3ALN uses but *one 50 watt tube, ICW*, and that 6XAD was using its now "famous" smallest transmitter. But little can be added.

The results speak volubly for themselves!

CONSTRUCTION OF CRYSTAL SET

Continued from page 20

operation is to adjust the little piece of wire, which rests lightly on the crystal, to a sensitive point. This may be accomplished in several different ways; the use of a miniature buzzer transmitter is very satisfactory. Assuming that the most sensitive point on the crystal has been found by method described in paragraph below, "The Test Buzzer," the rest of the operation is to get the radio receiving set in resonance or in tune with the station from which one wishes to hear messages. The tuning of the receiving set is attained by adjusting the inductance of the tuner. That is, one or both of the switch arms are rotated until the proper number of turns of wire of the tuner are made a part of the metallic circuit between the antenna and ground, so that together with the capacity of the antenna the receiving circuit is in resonance with the particular transmitting station. It will be remembered that there are 10 turns of wire between each of the first 8 switch contacts and only one turn of wire between each 2 of the other contacts. The tuning of the receiving set is best accomplished by setting the right-hand switch arm on contact (1) and rotating the left-hand switch arm over all its contacts. If the desired signals are not heard, move the right-hand switch arm to contact (2) and again rotate the left-hand switch arm throughout its range. Proceed in this manner until the desired signals are heard.

It will be advantageous for the one using this radio receiving equipment to find out the wave frequencies (wave-

length) used by the several radio transmitting stations in his immediate vicinity.

The Test Buzzer (Z, Fig. 3)—As mentioned previously, it is easy to find the more sensitive spots on the crystal by using a test buzzer. The test buzzer is used as a miniature local transmitting set. When connected to the receiving set as shown at Z, Fig. 3, the current produced by the buzzer will be converted into sound by the telephone receivers and the crystal, the loudness of the sound depending on what part of the crystal is in contact with the fine wire. To find the most sensitive spot connect the test buzzer to the receiving set as directed, close the switch (5, Fig. 3) (and if necessary adjust the buzzer armature so that a clear note is emitted by the buzzer), set the right-hand switch arm on contact point No. 8, fasten the telephone receivers to the binding posts marked "phones," loosen the set screw of the binding post slightly and change the position of the fine wire (6, Fig. 3) to several positions of contact with the crystal unit until the loudest sound is heard in the phones, then tighten the binding post set screw (4) slightly.

Approximate Cost of Parts

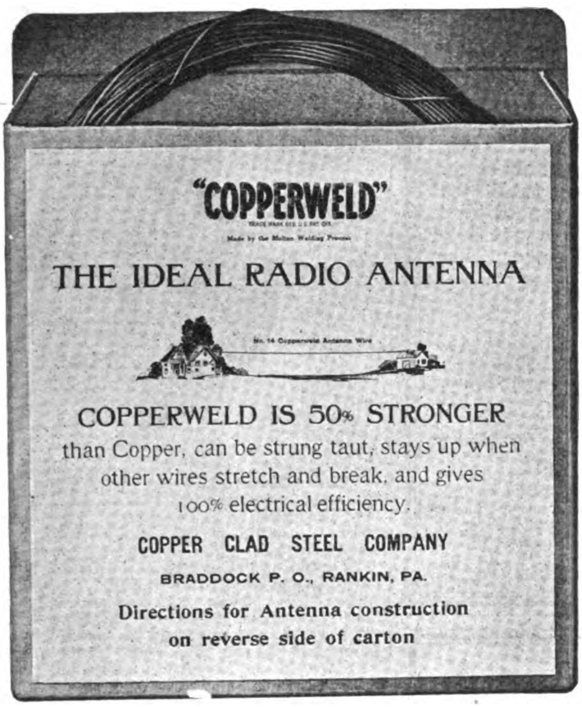
The following list shows the approximate cost of the parts used in the construction of this radio receiving station. The total cost will depend largely on the kind of apparatus purchased and on the number of parts constructed at home.

Antenna—		
Wire—Copper, bare or insulated, No. 14, 100 to 150 ft., about ....$	.75	
Rope— ⅝ or ½ inch. 2c per foot.		
2 insulators, porcelain........	.20	
1 pulley	.15	
Lightning switch — 30 ampere battery switch	.30	
1 porcelain tube	.10	
Ground connections—		
Wire (same kind as antenna wire.)		
1 clamp	.15	
1 iron pipe or rod..........	.25	
Receiving set—		
½ pound No. 24 copper wire double cotton covered.....	.75	
1 cardboard box.		
2 switch knobs and blades complete	1.00	
18 switch contacts and nuts.	.75	
3 binding posts—set screw type	.45	
2 binding posts—any type..	.30	
1 crystal—tested	.25	
3 wood screws, brass, ¾ in. long	.03	
Wood for panels (from packing box.)		
2 pounds paraffin	.30	
Lamp cord, 2 to 3c per ft.		
Test buzzer	.50	
Dry battery	.30	
Telephone receivers	4.00 to	$8.00*
Total ....$	11.00	$15.00

If nothing but the antenna wire, lightning switch, porcelain tube, crystal, telephone receiver, bolts and buzzer are purchased this total can be reduced to about $6.00.

*Still more efficient and expensive telephone receivers are available at prices ranging to about $20.00.

High Conductivity—High Strength



The pure copper exterior of the wire conducts all radio waves due to "skin effect" of high frequency currents. This conducting metal is permanently welded to the high strength steel core.

You will be proud of your antenna when built of Copperweld—

It will not stretch nor sag.

A tight antenna insures clear receiving.

RADIO DEPARTMENT

COPPER CLAD STEEL CO.

Braddock P. O., Rankin, Pa.

Buy Copperweld In Cartons

100 or 200 ft. lengths

THE ONE BEST WAY—PACENTIZE!

Why fuss about with binding posts and unsightly frayed wires when Pacent Radio Essentials will allow you to change connections in the twinkling of an eye? This Pacent combination was made to work as a unit in overcoming all connection problems in both receiving and transmitting apparatus. When the Plug, Twin-Adapter and Multi-jack are used together, they replace no less than fourteen binding posts!

PRICE $1.25

PACENT UNIVERSAL PLUG

This plug was the first real radio plug to make an appearance and it remains the first radio plug in quality. A solderless, biting contact is made which will not give rise to disturbing noises. You can use the Pacent Plug with 'phones, Duo-Lateral Coils, microphones, keys, etc. The Pacent Plug fits any jack. With its soft, velvety black finish it will add a touch of beauty to any receiver.

Catalog No. 50 PACENT UNIVERSAL PLUG, Price $1.25

PRICE $1.50

PACENT TWIN-ADAPTER

You can't put two plugs in a single jack, but you can make a single jack serve the purpose of two jacks with a Pacent Twin-Adapter. Just insert the Twin-Adapter and presto!—the usefulness of the jack is multiplied by two. Just the thing to use with a loud speaker; tune with the 'phones and then plug in the loud speaker. The Twin-Adapter has a multitude of uses in C. W. work.

Catalog No. 51 Pacent Twin-Adapter, Price $1.50

PRICE $1.50

PACENT MULTI-JACK

Here is another worthy member of the Pacent plug and jack combination. This is really three independent jacks built into a beautiful composition base. Screwed to the side of a receiving outfit it will allow three sets of 'phones to be plugged in or two sets of 'phones and a loud speaker. It may also be screwed to the table or the testing board. All standard plugs will fit into it, but it was designed especially for use with the Pacent Universal Plug or Pacent Twin-Adapter.

Catalog No. 52 PACENT MULTI-JACK, Price $1.50

Send for copy of circular N100

See the Pacent Radio Essentials at your dealers. **Dealers and Jobbers—Write for our sales plan**

PACENT ELECTRIC COMPANY

INCORPORATED

LOUIS GERARD PACENT, President

150 NASSAU STREET **NEW YORK CITY**

Member Associated Manufacturers of Electrical Supplies

The range of a radio set, whether transmitter or receiver, is variable. To say that a set has a range of sixty or of one hundred miles is wrong, as the distance of reception depends upon many factors. The range of transmission is greater over water than over land, greater at night than during the day, and is decreased by electrical disturbances in the atmosphere. The skill of the receiving operator is also an important factor.

For Prompt Shipments—BENWOOD

"WORLD WIDE MAIL ORDER SERVICE"

THE above photo shows our new 3-story building in the heart of the St. Louis business district. Our mail order department is complete in itself and we give you immediate service on all mail orders.

Amplifying Transformers
Acme—mounted $5.00
Acme—unmounted 4.50
Clapp-Eastham 4.00
Thordarson—Shielded 4.00
Rhamstine 3.50

Antennae Wire
Benwood No. 14 Spec. per 100 ft. 35c
7 strands No. 22 per ft. 1c
7 strands No. 20 per ft. 1½c
Aeroplane Special per 100 ft. 50c

Audion Control Panels
Remler $8.00
Acme 10.00
Paragon 6.00
Benwood 9.50

"B" Batteries
Burgess small 22½ V. $2.25
Burgess tapped 22½ V. 2.75
Burgess large 22½ V. 3.00

Buzzers
Benwood test buzzer $0.60
Century high frequency 2.50

Condensers (Grid)
Benwood Universal Grid condenser and leak $1.00

Condensers (Variable)
Chelsea No. 1 Mounted $5.00
Chelsea No. 1 Unmounted 4.75
Chelsea No. 2 Mounted 4.50
Chelsea No. 2 Unmounted 4.25
Murdock No. 366 .... 4.75
Murdock No. 368 .... 4.00
DeForest knocked down 3.75
DeForest knocked down large 4.75

Crystal Detectors
Murdock $0.60
DeForest (dustproof) 2.60
Galena and silicon .... .25

Dials
Benwood Nickel or Brass Metal with knob $1.50
Chelsea Dial and Knob 1.00
Clapp-Eastham Dial and Knob .75
Tuska Dial and Knob 1.50
Corwin (large) 1.50

Insulators
Electrose (ball type) $0.35
Electros 4 in. .... .45
Electros 10 in. .... .85

Jacks
Federal, open circuit $0.70
Federal, closed circuit .... .85
Federal Double Circuit 1.00
Federal, with filament control 1.50
Rhamstine Double Circuit... .85

Plugs
Firth Bull Dog grip $2.50
Federal 2.00
Pacent 2.00

Send for Catalog
Send 10c in stamps for the new Benwood Radio Catalog comprising the latest price directory.

Rheostats
Fada (filament) $1.00
Fada (power) 1.35
General Radio 2.50
DeForest 1.65
Clapp-Eastham (panel) .... .90
Murdock (panel) 1.00
Remler 1.00
Paragon 1.50

Sockets
Benwood (bakelite) panel or table mounting $1.50
Remler (bakelite) 1.50
Rhamstine (bakelite and metal) 1.00
Murdock Moulded 1.00
General Radio Moulded 1.50
Crosley (porcelain) .... .60

Telephone Receivers
Baldwin Type "C" $12.00
Baldwin Type "E" 13.00
Baldwin Type "F" small .. 14.00
Baldwin single "6" unit for loud speakers 6.00
Murdock No. 56 2000 ohm .. 5.00
Murdock No. 56 3000 ohm .. 6.00
Brandes superior 8.00

Variometers
Benwood assembled $5.00
Benwood knock down 4.00
Clapp-Eastham 5.75
Remler moulded 6.00

Variocouplers
Benwood (assembled) $4.00
Benwood K D 3.50
Clapp-Eastham 6.75

Vacuum Tubes
Cunningham UV-300 .... $5.00
Cunningham UV-301 .... 6.50
Cunningham UV-302 .... 8.00
A-P detector 5.00
A-P amplifier 6.50

Jewell Meters, Any Style Made
O—2½ amp thermo couple. $12.00
O—300 milliamps 8.00
O—500 DC Volts 16.00
O—1000 DC Volts 23.00
Pattern 74 AC Meters 8.00
General Radio (all types) ... 7.75

Microphones
DeForest (hand) $5.00
Federal (hand) 7.50
Federal (panel) 5.25
Federal (desk) 6.50

CW Inductance
Benwood knock down 25 turn $6.75
Benwood Assembled 25 turn. 8.50
Benwood 50 turn size 15.00

Modulation Transformers
General Radio $5.00
Acme 5.00
Rhamstine 4.50
Clapp-Eastham 4.50

CW Condensers
Benwood (tested 2000 volts). $2.00

Choke Coils
Acme 1½ Henry 500MA $6.00
Acme 1½ Henry Double 8.00
Ideal 1 Henry 200MA 5.00
Ideal Henry 200 Double 7.00

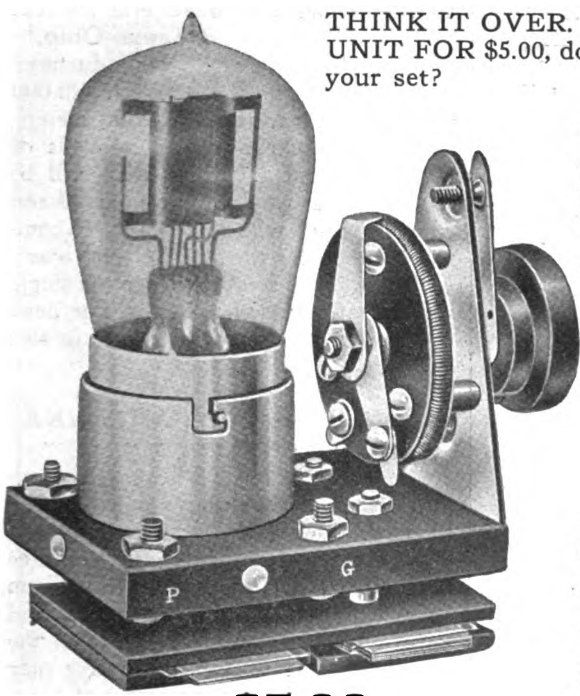
Power Transformers
Acme 200 Watt 550 V 12 V. $16.00
Acme 200 Watt 550 Mounted 20.00
All other sizes in stock.

Filament Heating Transformers
Thordarson 80 Watt 8 Volt .. $8.00
Thordarson 100 Watt 12 V .. 12.00
Acme 75 Watt 10 V mounted. 12.00
Acme 75 Watt 10 Volt unmounted 9.00

THE BENWOOD CO., Inc.

1113 OLIVE STREET
ST. LOUIS, MO.

A REAL DETECTOR



THINK IT OVER. WHEN YOU CAN BUY A COMPLETE AUDION CONTROL UNIT FOR $5.00, does it pay you to buy the separate instruments and mount them in your set?

The NEW NO. 40 WIRELESS SHOP AUDION CONTROL UNIT is complete in every detail, and includes a socket, filament rheostat, mica grid condenser and mica bypass condenser. It is easily attached to your panel by only two screws, and can be wired into your set in a jiffy.

WHAT MORE COULD YOU WANT? Every detail is complete. Each and every part is manufactured by THE WIRELESS SHOP—A GUARANTEE THAT YOU WILL GET A REAL BARGAIN, AND A STRICTLY QUALITY PRODUCT. ASK THE OTHER FELLOWS.

$5.00

And the Amplifier Unit to Match the Detector

The No. 41 Amplifier unit is identical to the detector in general construction, with the addition of a high grade shell type amplifying transformer, which is mounted directly on the back of the socket shelf. And this unit costs you ONLY $11.00. We can also furnish the front formica panel, with all holes drilled, panels engraved, and all necessary parts for completing the set, less the case. All of these parts are fully described and listed in our new BULLETIN No. 3, which will be mailed to you upon request. Where shall we send yours?

USING "WIRELESS SHOP" STANDARD UNITS, YOU CAN BUILD UP A COMPLETE 2-STEP AMPLIFIER, INCLUDING 2 No. 41 AMPLIFIER UNITS, ONE GORTON ENGRAVED PANEL with all holes drilled, 2 SPECIAL GORTON ENGRAVED RHEOSTAT DIALS WITH KNOBS, 2 "WIRELESS SHOP" JACKS, and 8 RUBBER TOPPED BINDING POSTS, for the sum of only **$30.00**

AND REMEMBER—QUALITY WILL ALWAYS PREDOMINATE WITH

THE WIRELESS SHOP

A. J. EDGCOMB

1262 WEST SECOND STREET **LOS ANGELES, CAL.**

C. W. QUERIES AND REPLIES

Continued from page 28

will have to be changed, both sets increasing in size in about the same proportion. The following table will give you an idea of what you would need for reception over a wavelength range of 175-3000 meters:

	Number of Turns		
Wavelength	Primary	Secondary	Het. Osc.
150-300	25	35	25
300-800	35	75	50
800-3000	75	150	100

For wavelengths of over 3000 meters, the 50,000 cycle tuned circuit would have to be changed to one of lower frequency for best results, say to about 30,000 cycles, and honeycomb coils of about 1250 turns each would then be necessary. The Heterodyne Oscillator coils should be variable since some tubes require a closer coupling than others.

Question: What would be the wave length range of my two loose couplers, one having 180 turns 5 inches in diameter in the primary, and a secondary of 250 turns 4 and ½ inches in diameter, each coil having 9 taps equally spaced, and the other having half the number of turns in each coil. N. N., S. F.

Answer: Approximately 175 to 2500 meters for the larger, and 150 to 1000 meters for the smaller loose coupler.

Question: Please give the number of turns of No. 24 S. C. C. wire on a 4-inch bakelite tube, necessary to tune from 400 to 20,000 meters, with the number of taps and the inductance of the coil. This coil would be used in a single coil circuit with an air condenser and dead end switch. ?, Lima, Ohio.

Answer: It will require an inductance of 150 millihenrys to reach 20,000 meters. For waves up to 2500 meters, a group of four bank wound coils of 20, 35, 75 and 150 turns each will be required, and bank windings of 400 and 750 turns each will be necessary to complete the coil for the 20,000 meter wave. This applies, of course, only to the single coil circuit you wish to use. The dead end switch will work very well in this circuit.

DESIGN OF C. W. ANTENNA

Continued from page 28

duces the radiation, but adds to the adjustments of the transmitter, if the series condenser is variable, as is generally the case. If the fundamental wavelength of the antenna is 175 meters or less, no series condenser will be necessary, and whatever variations are required in the antenna circuit of the transmitter may be made by varying the number of turns in the antenna inductance.

The other reason is that the wavelength will surely be within the law, and this is by far the most important consideration for obvious reasons.

Continued on page 70

"CHELSEA"

No. 50 Amplifying Transformer

was designed for use with the present day models of vacuum tubes, and when so used produces remarkable amplification, with minimum noise. It is well adapted for table mounting or may be panel mounted in any position.

Terminals are marked for best connection. Only highest grade materials and workmanship employed. Its high efficiency together with its neat appearance and compactness, makes it a predominating feature in any radio receiving equipment.

IMMEDIATE DELIVERY

Price as shown, $4.50

Unmounted . . $3.75

Bulletin sent upon request. Purchase from your dealer. If he does not have it, send to us.

CHELSEA RADIO COMPANY

150-156 Fifth St. Chelsea, Mass.

SERVICE-TESTED RADIO EQUIPMENT

We have determined to secure a portion of the radio business on the Pacific Coast and realize that to do so we must offer some inducement to make our efforts successful. Our idea of the reasons that Western amateurs do not purchase from Eastern markets on a larger scale is that we dealers are located too far away from would-be customers. To eliminate objections arising from this handicap we have inaugurated our "SERVICE-TESTED" plan of selling equipment.

Every article which we ship out will be tested thoroughly in our laboratories before it is sent to our customer. There will be no such things as tubes which do not oscillate or "B" batteries which go dead in a short time for the simple reason that any of these articles will be exhaustively tested in ACTUAL SERVICE before the purchaser receives it.

Secondly we will pay all postage charges on orders exceeding $5.00. This will make our equipment even cheaper than it can be bought on the coast where prices are often higher than listed by the manufacturer. It is needless to mention that our prices are strictly list as can be seen by the following list:

Radio Corporation Products

We are distributors and jobbers for the Radio Corporation of America and always carry a complete stock of their apparatus. We list below their complete line and in addition can supply you with the Radio Corporation C. W. instruction book at 25c per copy.

Item	VACUUM TUBES	List Price
1	Radiotron (detector) UV—200	$ 5.00
2	Radiotron (amplifier) UV—201	6.50
3	Radiotron (5-watt) UV—202	8.00
4	Radiotron (50-watt) UV—203	30.00
5	Radiotron (250-watt) UV—204	110.00
	POWER TRANSFORMERS FOR C.W. SETS	
12	325-watt, UP—1368	25.60
13	750-watt, UP—1016	38.50
	A—Filament heating Transformer for UV—204, UP—1633	.....
	B—Power Transformer for UV—204, UP—1636	.....
	C.W. ACCESSORIES	
14	Oscillation Transformer UL—1008	11.00
15	Magnetic Modulator (½ to 1½ amp.) UT—1643	9.50
16	Magnetic Modulator (1½ to 3½ amp.) UT—1357	12.00
17	Magnetic Modulator (3½ to 5 amp.) UT—1367	17.00
18	Filter Reactor (160 mill amp.) UP—1626	11.50
19	Filter Reactor (300 mill amp.) UP—1627	15.75
20	Plate Circuit Reactor, UP—415	5.75
21	Filter Condenser ½ mfd.—750 V., UC—1631	1.35
22	Filter Condenser, 1 mfd.—750 V., UC—1632	1.85
23	Filter Condenser, ½ mfd.—1750 V., UC—1634	1.50
24	Filter Condenser, 1 mfd.—1750 V., UC—1635	2.00
25	Transmitter Grid Leak (5-watt tubes), 5000 ohms UP—1719	1.10
26	Transmitter Grid Leak (50 and 250-watt tubes), 5000 ohms, UP—1718	1.65
27	Antenna Ammeter, 0-2.5 amp., UM—530	6.00
28	Antenna Ammeter, 0-5 amp., UM—533	6.25
29	Sending Key UQ—809	3.00
30	Microphone Transformer UP—414	7.25
31	Filament Rheostat (for UV—200, 201 and 202) PR—535	3.00
32	Filament Rheostat (for UV—203 and 204) PT—537	10.00
33	Rotary Grid Chopper PX—1638	7.25
34	Shaft Bushings for ¼″ or 5/16″ motor shaft	.20

Item	KENETRON RECTIFIERS	List Price
6	20-watt Kenotron, UV—216	$ 7.50
7	150-watt Kenotron, UV—217	26.50
	VACUUM TUBE SOCKETS	
8	Porcelain Socket (for UV—200, 201, 202, 216) UR—542	1.00
9	Porcelain Socket (for UV—203 and UV—217) UT—541	2.50
10	Bakelite Socket (for UV—200, 201, 202, 216) UP—552	1.50
11	Mountings (250-watt tube) UT—501, UT—502	2.00
	SPECIAL CONDENSERS FOR C.W. SETS	
35	Antenna Series Condenser, 7500 V. .0003, .0004, .0005 mfd., UC—1015	5.40
36	Plate and Grid Condenser—3000 V. .002 mfd., UC—1014	2.00
37	Special Condenser—10,000 V. .000025 mfd., UC—1803	5.00
38	Special Condenser—.002 mfd., 6000 V., UC—1806	7.00
	VACUUM TUBE DETECTOR ACCESSORIES	
39	Intervalve Amplifying Transformer, UV—712	7.00
40	Special "A" Battery Potentiometer, PR—536	2.00
41	Tabular Grid and Plate Condenser	
	.00025 mfd. UC—567	1.26
	.0005 mfd. UC—568	1.35
	.001 mfd. UC—569	1.50
	.0025 mfd. UC—570	2.00
42	Grid Leaks	
	UP—509, .05 megohm; UP—510, .1 "; UP—511, .15 "; UP—512, .20 "; UP—513, .25 "; UP—514, .30 "; UP—515, .40 "; UP—516, .50 "; UP—517, .60 "; UP—527, 5.00 "; UP—518, .75 megohm; UP—519, 1.0 "; UP—520, 1.25 "; UP—521, 1.5 "; UP—522, 1.75 "; UP—523, 2.00 "; UP—524, 2.50 "; UP—525, 3.00 "; UP—526, 4.00 " ... each	$0.75
43	Grid Leak Mounting UX—543 "	.50

Send 15c for our complete literature

ELECTRICAL SPECIALTY COMPANY, 48-50 South Front Street, Columbus, Ohio

Now comes the question of how large the antenna may be and yet keep within the agreed limits. For maximum results on 200 meters, the total length of the antenna, including the antenna proper, lead-in and ground wire, should not exceed 100 ft., with 125 ft. as an absolute limit. This rule holds true for practically any style of antenna construction, and if the antenna greatly exceeds 125 ft., the C.W. transmitter will simply refuse to oscillate on 200 meters, no matter how many adjustments are made. In other words, to avoid using a series condenser, limit the length over all to 100 ft. If a series condenser is desired, or is to be tolerated, then the length may be 125 ft.

Let us take a practical problem as an illustration of how your antenna dimensions may be determined. An amateur has a single mast 60 ft. high, which he proposes to place at the far end of a slanting, inverted "L" antenna, the lower end of which will be fastened to the roof of his home, say at a height of 20 ft., and he desires to know how long the antenna proper can be, as well as the location of the pole.

Deducting 20 ft. for the lead-in and ground lead, from the 100 ft. total, the antenna can be 80 ft., measured from the top of the mast to the lead-in. By the simple formula of the square of the hypotenuse of a right triangle being equal to the sum of the squares of the two sides, where the 80 ft. antenna is the hypotenuse and one side is the 60 ft. mast less 20 ft. for the lead-in, we find that 70 ft. is approximately the correct distance from the base of the mast to the point directly under the lower end of the antenna. If the mast were 80 ft., then this distance is reduced to 55 ft., and so on in proportion to the height of the mast. The most difficult case of the slanting antenna is taken mainly because it is a favorite in cities, where backyards are small, and C.W. enthusiasts plentiful. Where the two supports are of the same height, simply deduct the length of the lead-in from the total allowable length and the remainder will give you the number of feet in the antenna proper.

Just a word in regard to insulation. If you have a four-wire flat top, don't place an insulator at each end of each separate wire. A single insulator placed at each end of the antenna will give four times the insulation, since when you have the former condition, there would be the equivalent of four resistances in parallel to ground, or one-fourth the resistance of one insulator. This point is often overlooked and is important from an economic standpoint as well as being more efficient electrically.

To some readers this discussion may seem very elementary, but it is quite apparent from the numerous questions received by the writer, that it is necessary.

CREMATE YOUR SPARK COIL

By THEO. MCKEON

If this article is published, I hope the guys that still dust their spark-coil contacts will put the ashes of them in a can and bury them among old relics. You ask: "Didn't you use one yourself?" Certainly; but read on: I had one or two, as is always the case with a beginner, along with my crystal detector and loose coupler. Night after night I punctured the ether for twelve miles on a single Ford coil. It was when the audion came to our town circle that I wanted to rise. An audiotron and a storage battery soon was at my disposal. In a couple of months I was happily hearing the singing rotary gaps. From then on I began to despair at the sound of the "static machines" which broke into the music so often.

I oiled some of the dry wheels, and soon had my head thinking about a transformer. No sooner said than done, I was at the operating table, two spark coils in hand. These I dissected, taking out the secondaries, then binding them on to a suitable laminated core, and forming a primary of 400 turns of No. 14 D. C. C. on a core of the same length. I made a closed core transformer which, although it took 200 watts from the line, sent far more audible signals to Seattle—30 miles as the crow travels—than did my former rock-crusher.

Now, fellers, it would cost you practically nothing to build your transformer from your spark coils. A recent article by Chas. Dalziel attracted my attention, and I may honestly say there is not a reliable ham on the brass that does not curse the spark coils.

Why not try C. W.? Each issue of the RADIO displays very simple tube circuits, some very good ones, with the cost as low as that bicycle you want. You can wind your own choke coils and transformers with but little cost.

I have not erected my station at Paso Robles yet, but expect to by fall. I will be one of the many "C. W. and fone" uplifters, and another "6" on the key, formerly "7FX."

6XAD HEARD IN ALASKA

G. E. Maddox, operator on U. S. L. H. T. "Fern," writes from Ketchikan, Alaska, under date of February 16: "As soon as I completed my short wave set and hooked it up, the very first static I heard was you, calling 6ZAC, Dow, Wailuku, Honolulu. We were in Funter Bay, Alaska, which is nearly entirely surrounded by high mountains, the distance to you being nearly 1826 miles in an air line and almost all of it overland. Your signals are very QSA every night all over southeast Alaska, and I have no trouble in copying everything you send.

COMMON OPERATING FAULTS

Continued from page 31

of people. First, the operators that start up at sea, and test, and fool around for a while, sending V's and calling; and second, to the boneheads who test and attempt to tune their sets while the ship is in port, and especially, the shop men and others who have a perfect right to tune and test under proper conditions.

When at sea, it is usually only necessary to make a few small changes in the modern quenched set to bring it up to normal working efficiency; the addition or sorting out of a gap or two, and a few small adjustments of coupling, the adjustment of the antenna inductance, and the exact proper point on the field rheostat are all that should be touched to clear the "note," and usually these all could be carried up while calling, and certainly could be completed when the preamble of a message is being sent, altho this should have the operator's complete attention, due to the possibility of error. There is no excuse for an operator to start up and tune and test for ten minutes before he starts to send. Such actions show one of two things. Either that the man is a "hog" and doesn't care for the rights of others on the air, or that he is absolutely ignorant of the way to handle his set. In either case he had better find some more suitable occupation—in a soup kitchen, for example—or mend his ways. There is no room for him in the modern radio business.

The testers who go aboard the ship when in port are even worse than the first mentioned class. A more senseless, and pigheaded, and selfish attitude cannot be imagined than that possessed by the man (?) who starts up a ship set and proceeds to tune and test for a period of uncertain duration without listening in or signing off. There are, fortunately, very few of such men in the radio game, still there must be some, otherwise how would so much of the unaccounted for interference be caused?

Possibly I have been too hard on the "shore-going" men; possibly ship operators themselves are guilty. The license of a ship station states that the station is licensed to be operated "while the vessel is being navigated." This does not, and cannot mean that this is permission to operate as it pleases the operator when the ship is tied to the dock, or at anchor. If it is necessary to test, why not start the set and make a single dash, simply to see if the set will radiate, if you are listening in, and just want to see that it is O. K.? Few do this, even tho they are so selfish that they want to get ashore, or off on their own business, and the result is that they test and fool around until it pleases them to stop. To my way of thinking, such men should be simply eliminated from the radio field whenever and wherever caught. It is hoped that it will be possible at some time to locate the exact ship where unauthorized, unsigned testing is carried on, by radio compass, and to punish the party who has been doing the dirty work. The elimination of a few of such troublemakers would go far towards deterring others from trying the same tactics, who cannot be reached by any regulations or rules, but thru fear of the results only.

The life of a vacuum tube can be lengthened by care in not using too much current to heat the filaments. The simplest index is to employ a voltmeter in shunt with the filament terminals. After observing the voltage at which each tube gives the best results this voltage should never be exceeded. The voltage from a storage battery is highest when the battery is fully charged, at which time especial care should be exercised.

ELIMINATING THE GRID BATTERY

Continued from page 21

20 volts negative in respect to the filament.

An outstanding feature is the practically automatic control of the grid potential with increasing or decreasing plate voltages. As the plate potential applied to the tubes is raised, the plate current increases. However, this increase in plate current causes an increase in the drop across the series resistance and this increase drop makes the grid more negative; which is essential. Any decrease in plate current will be accompanied by a proportional decrease drop in grid potential. In this way, any changes in plate supply voltage will be compensated for by proportional changes in grid potential.

By making this resistance variable in twenty ohm steps, the grid bias potential can be changed in 2 volt steps. This is important in adjusting the modulator plate current to the proper value.

In the event that a speech amplifier tube is used to amplify the voice currents before reaching the modulator tube proper, another tap can be taken off of this same resistance to supply the proper negative potential for the speech amplifier tube.

DIRECTIVE RECEPTION AND INTERFERENCE ELIMINATION

By HUGH R. SPRADO

Owing to the great interest taken in the article on "Directive Reception and Interference Elimination," in March RADIO, and the numerous requests for additional information on the various parts that make up an Antenna-Loop Barrage, the following may be of value to the experimenter.

The first question which arises is the size of loop for short wave work. An excellent article on loops, appearing in the November issue of Q. S. T., tells us that the proper loop size is four to six feet square, having six turns of wire spaced approximately ¼" apart.

Referring to the "Antenna-Loop Barrage," circuit shown in Figure 6, on page 17, of March RADIO.

The antenna variable condenser capacity should be between .0005 and .001 MF. maximum.

The series variable resistance in the antenna circuit should be in the order of 5000 to 10,000 ohms. Five 25 watt 220 volt Mazda lamps in series serve the purpose admirably, the variation in resistance from lamp to lamp being sufficiently close to give proper adjustment. The coupling coils shown in the circuit can be either honeycomb windings or standard variocouplers.

The variable condenser C. should be of .0005 max. capacity.

FONES AND CALLS HEARD ON KOPS (KX6AIW) SAN PEDRO TO ALASKA AND RETURN (M. S. COOLCHA)

Feb. 12 (just out San Pedro 6 p.m.) 7-9 p.m. 9zaf a number of times.

Feb. 13 (150 miles north Pedro) 5.30 p.m. Sacto. Bee (kvq); 7.30 p.m. Los Altos; 8.30 p.m. Fairmont Hotel; 9 p.m. Seattle P. I. vry qsa.

Feb. 14 (60 miles north S. F.) 3.30 p.m. Hotel Oakland; 4.30 p.m. Fairmont Hotel; 6 p.m. kvq Sacto. Bee; 6.35 p.m. 6anj calling 6ak fone qsa; 6.40 p.m. 6anj vry clear and qsa.

Feb. 16 (125 miles South Flattery) 4 p.m. Seattle P. I.; 4.30 p.m. kwg Stockton qsa; 6 p.m. Seattle P. I; 6.35 p.m. 6 ahj calling 6ak (fone) vry qsa; 6.45 p.m. Atlantic Pacific Radio Supplies Co.; 7 p.m. Fairmont Hotel; 7.15 p.m. Hotel Oakland; 7.30 p.m. Fairmont; 8.30 p.m. Los Altos.

Feb. 17 (100 miles north Seattle) 8 p.m. kjj (?) Radio Shop; 8.15 p.m. Hotel Oakland; 8.30 p.m. kwg Stockton.

Feb. 18 (350 miles north Seattle) 6 p.m. kvq Sacto. Bee; 8.30 p.m. Rocklin (?) vry qsa (jazz orchestra); 5.45 p.m. kvq Sacto Bee; 8.50 p.m. Seattle P. I.; 8.59 p.m. 6vm (cw) vry qsa; 9.05 p.m. 7zm de cl8 spk qsa; 9.06 p.m. 6zx de 6sam; 9.07 p.m. 6amn de 6zx; 9.15 p.m. 6amn de 6qr; 9.10 p.m. 7bx de 7zt; 9.13 p.m. 6fj de 6bm; 9.14 p.m. 6qr de 7ge.

Feb. 19 (550 miles north Seattle) 6.45 p.m. Seattle P. I.; 7.22 p.m. 5za de 6zs (cw) vry qsa; 7.45 p.m. agl Presidio qsa; 8 p.m. Seattle P. I.; 9.36 p.m. 7bk spk qsa; 9.42 p.m. 6aau qsa but qss bad; 9.45 p.m. 6ajh de 6zx vry qsa.

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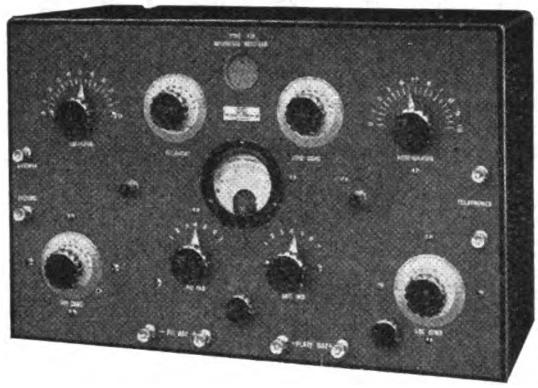

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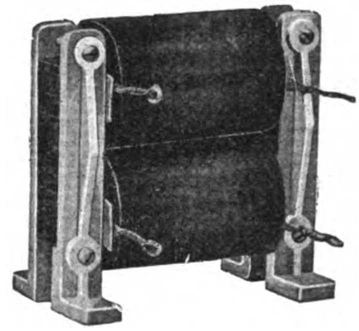

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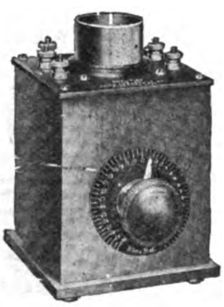

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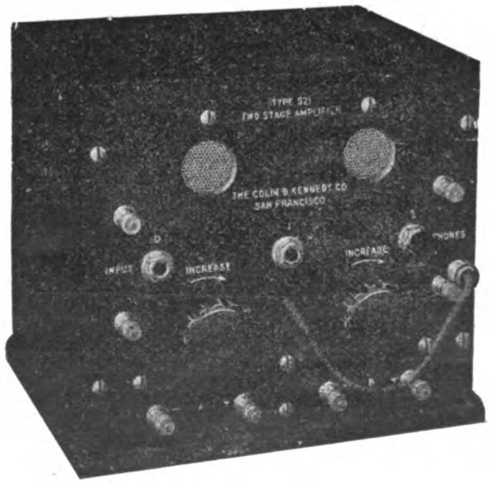

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FOR SALE: 600-20,000 meter Receiver, including Radiotron, $35. Ten mile Radiophone complete, operates on 60 volt "B" battery, $35. Box 205, Williamsport, Penna.

25c! For Hook-up diagram for combination long and short wave receiver 180 to 20,000 meters. Stations heard here in Lansdale on set off this hook-up (3JI) include Pittsburg (KDKA), Concerts and others too numerous to mention. Instructions with print and prices of parts accompany hook-up diagram. Immediate delivery. I pay postage. G. W. CALVERT, LANSDALE, PENNA.

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RADIO

Established 1917 as Pacific Radio News

Volume IV *for* MAY, 1922 *Number 5*

CONTENTS *for* MAY, 1922

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Forecast of Contributions for June Issue

Announcement is made elsewhere in these columns of an increase in size to one hundred pages monthly, commencing with the next issue. The addition of sixteen pages to the present size will enable the presentation of much more material of interest and value to the radio amateur and experimenter without in any way detracting from the high editorial standard of contents which the editor tries to maintain.

The leading article will be an illustrated description of the new army station at the Presidio of San Francisco, the first of a series of new stations which will enable the establishment of regular communication across the continent. This will be written by Captain C. I. Hoppough, Signal Corps, U. S. Army.

The next installment of the "C. W. Manual," by Ensign J. B. Dow, will give full details for constructing an inexpensive 50 watt transmitter for use when 60 cycle a.c. is available.

In the line of fiction V. C. Mathison has a story entitled "The Conquest of Ouglamuck," which tells of the exciting experiences of a wireless engineer in Alaska. Earl Ennis will have some more enjoyable "Grid Leaks," with cartoons by C. J. Dow. David Gibbons will have Scratchi say some serious truths in a humorous way.

Gerald M. Best has found a remarkable crystal detector with tube amplifier which gives almost unbelievably good results. He will tell all about it in June RADIO. D. B. McGown will discuss "Navy Standard Transmitters." Many other articles of a practical nature are in store for you in the June issue, "the best yet."

O. Schuwendt, whose excellent mechanical drawings of circuits and apparatus add to the value and appearance of most of our technical articles, will contribute an article on the construction of a 10-watt, self-rectifying transmitter which he has recently tested out with excellent results. The detail drawings accompanying the article should prove particularly helpful to those who will use them as a guide in making a similar set for themselves.

R. C. Anderson has an unusually good regenerative receiver tuning from 200 to 5000 meters with great selectivity and high amplification which he will offer to those who prefer to "roll their own."

"The Simple Receiving Set" will be the subject of the next in the series of the Radio Primer being written by H. A. Eveleth. It will include an understandable discussion of inductance and capacity and also brief reference to the principles of the radio compass.


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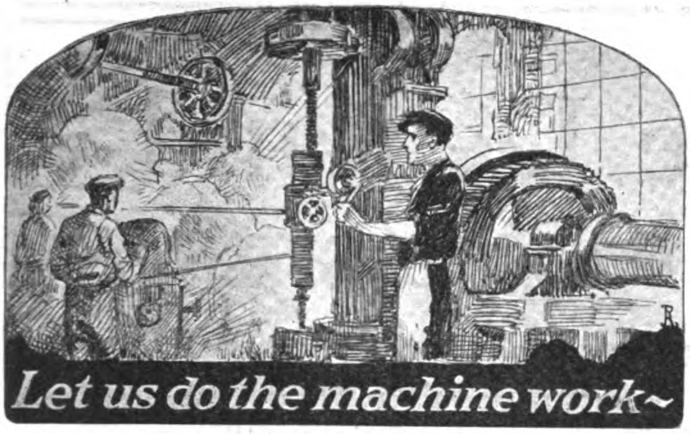

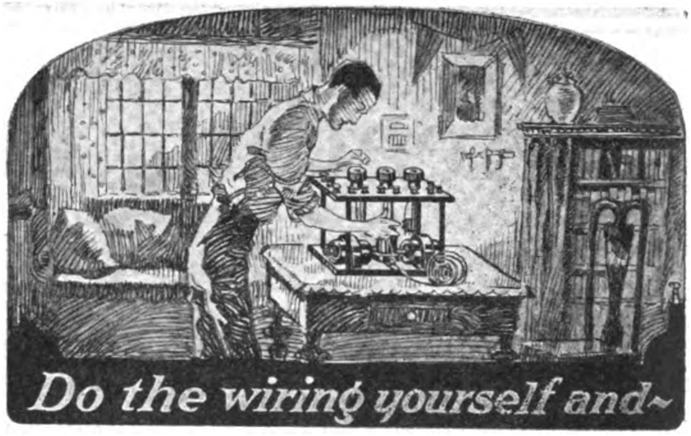

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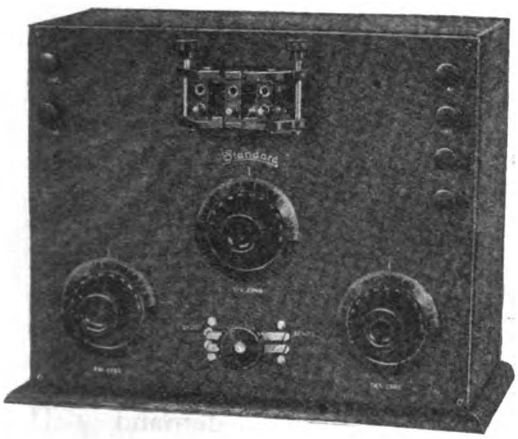

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IT is natural that broadcasting, *carrying news, music, lectures, concerts and even grand opera* into the homes of the American people, should have created a concerted and impatient demand for radio sets and apparatus—especially the popular radio receiving sets.

If the demand for radio sets and apparatus had grown normally, the well-equipped and highly-organized factories supplying the Radio Corporation of America would now be producing an excess over the market requirements.

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The assurance can be given that every scientific, manufacturing, organizing and financial resource of the Radio Corporation of America is being used to meet the demand for radio devices.

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We are asking the aid of our distributors and dealers in explaining the capabilities and limitations of radio sets and apparatus, and we welcome their co-operation and indulgence, as well as that of the public itself, until the present expansion program is carried out.

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May, 1922 **RADIO** Vol. 4 No. 5

Radiotorial Comment

MANY people are raising the question as to who will maintain radiophone broadcasting stations in the future. Most of the present stations are maintained by manufacturers or dealers as a means for stimulating the sale of radio receiving sets, or by newspapers as a means for sensational publicity. As the expense of installation and maintenance is relatively high and as there is no present practical method of charging for this service to the public, there is likelihood that the manufacturers and dealers will be compelled to discontinue this service when the market becomes saturated, and there is a possibility that the newspapers likewise may cease broadcasting as the novelty wears off.

The answer is found in the recommendation of the Washington Radio Conference "that radio communication is a public utility," and in the fact that definite bands of wavelengths have been set aside for broadcasting from government stations and public institutions. The broadcasting of information of all kinds will soon become as much of a public necessity as are good roads. The inaugural address of the next president of the United States will undoubtedly be heard by the people of the country by radiophone. The Borough of Queens, New York City, is considering the installation of a municipal station. On every hand there are signs to show that the broadcasting of the future will be conducted as a governmental function or at least as a governmentally regulated monopoly.

AMERICA has gone insane over radio. Its fascination and wonderful possibilities have fired the popular imagination and created an overwhelming demand for any old thing that will receive radiophone speech and music. Overnight, a boy's toy and a laboratory instrument has become a necessity for every real home.

Radio's rapid rise to popularity is as unprecedented as it was unexpected. The manufacturer, jobber and dealer were unprepared for the onslaught of orders with which they have been bombarded. Dealer's shelves are empty, jobbers are six months behind in deliveries and manufacturers have doubled, trebled and quadrupled production facilities in a frantic effort to meet the demand. Newspapers all over the country have started radio pages and broadcasting stations. Department, drug, clothing and delicatessen stores are selling radio apparatus.

Such a time of wild, crazy enthusiasm calls for cool heads and words of caution. The radiophone is a new and unperfected piece of apparatus. It has been developing in the short period since the war. It is still a crude and inefficient device compared to what it will ultimately be. The few men who really know something about it are hard at work making improvements in transmitters and receptors that will soon make the present apparatus as obsolete as the Chinese junk. Meantime, men who know little or nothing about radio are busily making Chinese copies of old stuff to be sold to an unsuspecting public at fabulous prices.

These are disagreeable facts; but they are true. When the disillusioned public learns that it is being bunked with junk there is likelihood of a reaction and refusal to buy until the radio art catches up with the standard of its possibilities.

Much of the responsibility for this condition rests upon the daily newspapers which sensationally paint the future as an accomplished fact. Radio is too wonderful and useful as it is to require the playing up of any false ideas as to what it is accomplishing. It is also a highly technical subject which calls for a thorough understanding of electrical principles in order to get the best results. But its very complexity gives it the attraction that always attaches to the unknown and its very mysteries inspire the desire to solve them.

The mass of gross misinformation on radio that is being printed by the daily press is as dangerous as it is deplorable. Some fool is going to try to "hook up" a radio set to an electric power wire so as to take advantage of the newspaper accounts of General Squier's able development of "wired wireless." Other ambitious youths will spend much time and money in the erection of the inefficient aerials and in the installation of the discredited hook-ups now appearing in many radio pages. Others will waste hours of valuable time reading articles written by men who know nothing about what they are writing. It is difficult enough for the technical editor to discriminate between the good and the bad without passing the burden on to the uninformed reporter who has been drafted to the service because no one else was available. This structure does not apply to all the papers, for some are publishing worthwhile information. But the average reader should realize that a story is not necessarily true because it is interesting, and that in the hurry and scurry of getting out a daily newspaper there are many errors, both technical and typographical, that get by.

In the citation of these facts we do not mean to intimate that every ten year old cannot "tune in" and enjoy the novelty of radio speech and music. Nor is it our intention to deter the progressive man or boy from amusing and instructing himself in this greatest invention of the twentieth century, for only by so doing will he be in a position to get the fullest benefit from the forthcoming advances in the radio art. But we do want to warn the average man that radio reproduction is not yet as undistorted as the natural voice or musical instrument, that only the best of the present equipment will survive, and that his breakfast newspaper page should be as liberally sprinkled with salt as are his eggs.

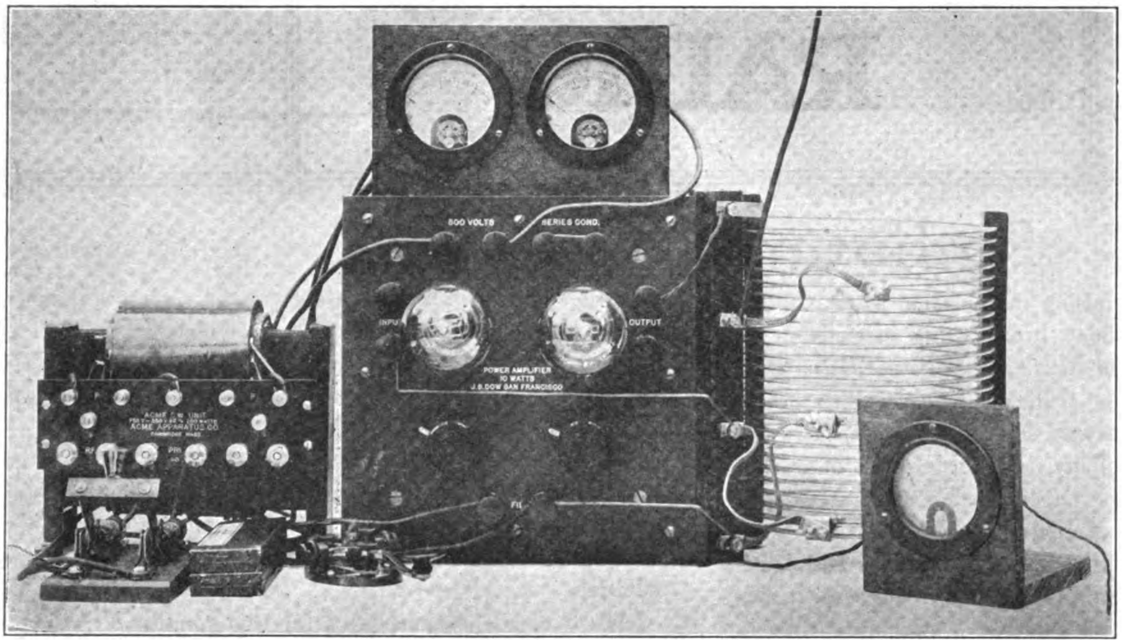


Fig. 42
Complete 10 Watt C. W. Transmitter Operating on Pre-rectified A. C.

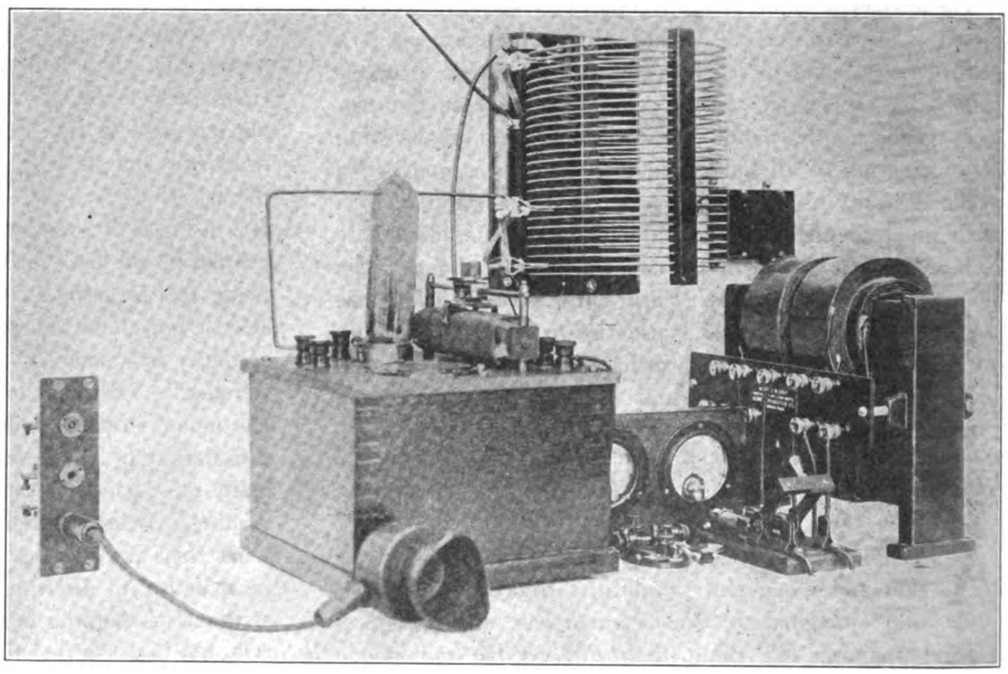


Fig. 44.
50 Watt C. W. Transmitter Using 50 Watt Combination Amplifier as an Oscillator.

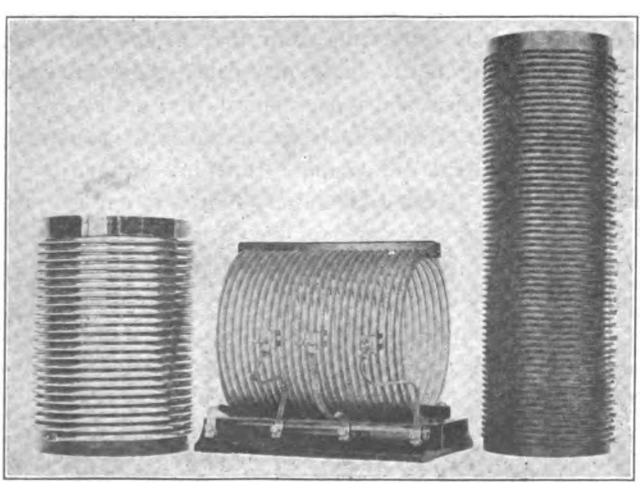


Fig. 45
Well designed Types of Output Inductances

Design and Construction of 10 Watt C. W. Transmitter for Use on A. C.

Fifth Installment of "The C. W. Manual"

By J. B. Dow, Ensign U. S. N.

THE rating of ten watts is conservative for the apparatus that we shall consider in the present chapter. It might more appropriately be defined as a combination operating on alternating current and employing two 5 watt tubes when both sides of the cycle are utilized by pre-rectification and four 5 watt tubes when self rectification is used. Indeed, such combinations, when using the very rugged transmitting tubes of today, often put three times their rated output energy into the radiating system.

The chapter will be devoted to such apparatus as will be used for the transmission of telegraphic signals only; it being understood, however, that with slight modification the arrangement may be converted into one for transmitting voice signals as well.

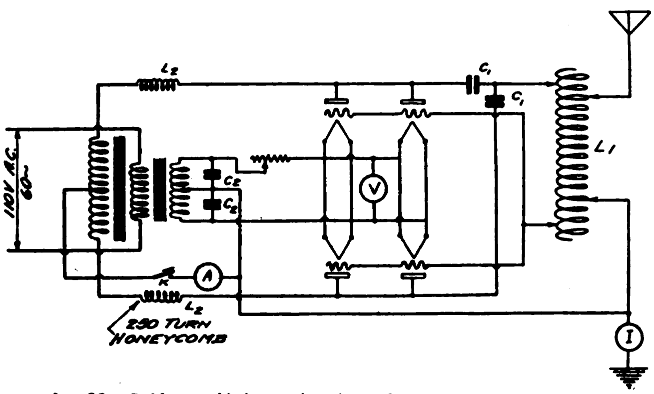


Fig. 39. Self Rectifying Circuit Using Four 5 Watt Tubes

Three circuits present themselves: one in which self-rectification is resorted to (see Fig. 39); one in which the high voltage alternating current is previously rectified by means of two rectifier tubes; and another in which the inexpensive electrolytic rectifier supplants the tubes of the second circuit. The latter circuits are illustrated in Fig. 40.

Fig. 15 represents a circuit in which one tube only is employed on alternating current, and in view of the unilateral conductivity which is an inherent factor in the physics of the thermionic valve, the tube is idle during the portion of the cycle when the plate is negative. In other words, the same effect is produced insofar as the operation of the circuit is concerned as would be produced by substituting a pulsating direct current supply to the plate in lieu of the alternating supply. The emitted signals consist, therefore, of trains of radio frequency oscillations, the train frequency corresponding to that of the alternating supply to the plate. In Fig. 16, two tubes are employed and both halves of the cycle supply a useful current to the plates of the respective tubes. Fig. 41 shows the oscillating output current graphs of the two circuits. As will be seen, Fig. 39 is merely a modification of Fig. 16. (Figs. 15 and 16 appear on page 17, February RADIO.)

The transformer for supplying the high voltage to the plates and the filament heating current will be considered first, and in developing this piece of apparatus we shall go somewhat beyond a device for this circuit alone, in that it will be designed with the idea of using it for furnishing a filament current for rectifier tubes also. This additional winding is quite easily provided and the possibility of a future use for it warrants the small amount of additional labor required to make same.

Upon one of the long legs of a laminated silicon steel core having a 1½ by 1½ in. section and a 1½ by 4 in. window wind a primary for 116 volts of 220 turns of No. 14 D.C.C. magnet wire in four layers, insulating same from the core with six wraps of 5 mil fish paper and each layer from the next with one wrap of the same material. Bring out three additional taps at 193, 200 and 210 turns for supplementary voltage control. Over this coil place six wraps of the 5 mil fish paper and wind a secondary consisting of 3000 turns of No. 28 enamel insulated magnet wire, insulating each layer from the adjacent one with a single wrap of thin paraffin paper. Tap the secondary at the center and at 1100 turns on each side of the center. This will provide a 700 and a 500 volt winding on each side of the midtap, allowing

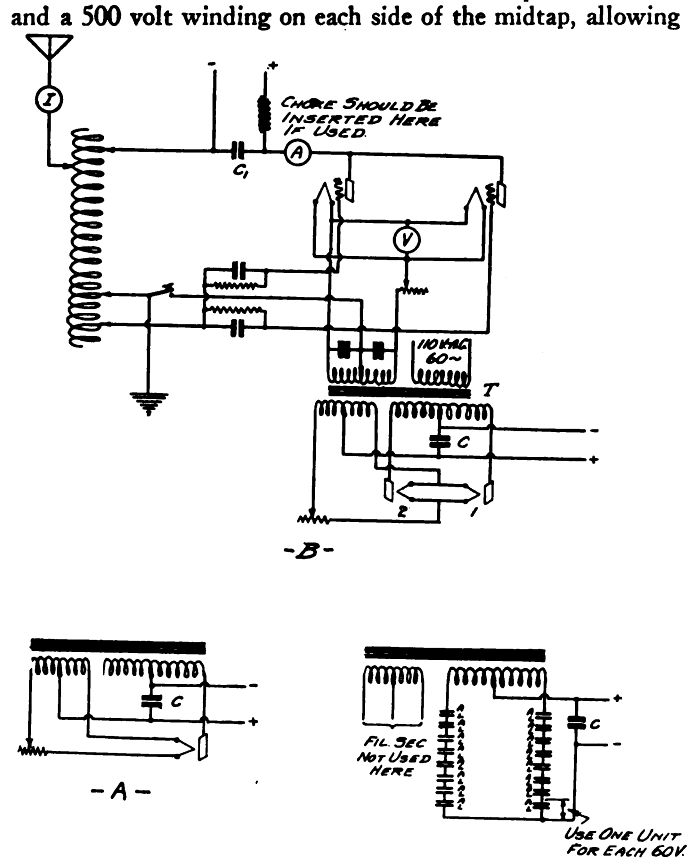


Fig. 40. Pre-rectification Circuits

for a conservative magnetic leakage factor and a nominal voltage drop at the rated output.

On the other long leg of the core wind two coils of 24 turns each of No. 14 D.C.C. magnet wire tapping each coil at the center, thus providing a midtap for the return filament to grid connection to eliminate the hum which would otherwise be present in the received signal because of a grid to filament connection to either end of this winding. To facilitate the matter of making connections to the various taps a suitable panel and arrangement of binding posts should be provided for this transformer.

The variable inductance, L_1, Fig. 39, should consist of approximately 35 turns of 1/16 by ¼ in. edgewise wound copper tape or the equivalent in 3/16 in. outside diameter copper tubing. Solid copper wire (about No. 6) may be used instead of the above with a slightly appreciable increase in resistance for the total coil. Four clips should be provided with this inductance for making connections. Two blocking condensers, C_1, having a capacity not less than 0.002 microfarad each or a multiple condenser having a total capacity of 0.004 microfarad with a midtap must be used in the plate to inductance leads to prevent the short circuiting of the high voltage transformer secondary by the inductance, L_1.

The radio frequency chokes, L_2, consist of 250 turn honeycomb coils. The bypass condensers, C_2, for the filament secondary may conveniently consist of ½ microfarad telephone condensers.

The transmitting key should be placed at K, in series with the plate milliammeter which should have a scale reading to 300.

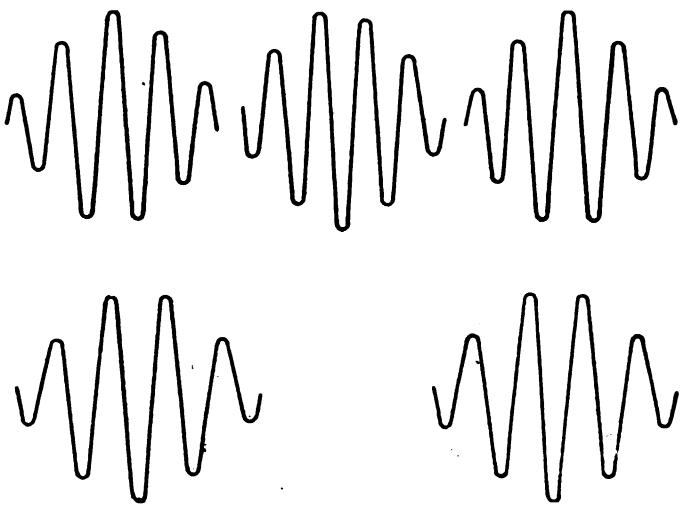


Fig. 41. Upper Drawing Shows Oscillating Current Output from Circuit of Fig. 15, and Lower from Circuit of Fig. 16. Only a few Oscillations per Train Are Shown.

The most recent practice in transmitting tube circuits requires a voltmeter in the filament circuit to secure proper filament adjustment in place of the much used filament ammeter, and accordingly one is shown at V in Fig. 39. This instrument should have a scale reading to 12 volts.

The radiation ammeter in the ground lead may be of the hot wire or thermo element type with a 2.5 ampere scale.

In connection with the adjustment of this circuit, attention is invited to Chapter III wherein the required procedure and caution are considered in detail.

As previously mentioned, Fig. 40 illustrates a circuit in which pre-rectification of the alternating current source is employed. Let us first discuss pre-rectification by means of thermionic valves.

The simplest form of rectifier circuit is shown in Fig. 40-A. Here, a single tube allows a plate to filament current (inside the tube) to flow when the plate is positive and permits of no flow when the plate is negative. It is of course positive during one-half of the cycle and negative during the other, and phenomena mentioned above results in a pulsating direct current supply to the capacity C of Fig. 40-A, charging one side of the condenser dielectric with positive charges and the other with negative changes. If the drain on the condenser C, resulting from a withdrawal of energy by the oscillator tubes is such as to completely discharge same during each cycle, the oscillating output of the radio energy circuit will be pulsating and an audio note corresponding in frequency to the supply to the rectifier tube will be in evidence at the receiving station. This low frequency note will be found objectionable. Notwithstanding this feature, the oscillator tubes cannot be worked at maximum output for they are idle during a large portion of the time.

Fig. 40-B shows a circuit in which two rectifier tubes are used. During the portion of the cycle when the plate of the first tube is positive, this tube supplies useful energy to the condenser C, and the second tube is idle because the plate is negative. During the other portion of the cycle, the plate of the second tube is positive and it supplies the useful energy to the capacity or *storage tank C*.

A moment's thought to what has been said will convince the reader that it is very desirable, then, to have as large a capacity as possible at C.

A two microfarad paper dielectric condenser, designed to withstand the impressed e.m.f. is ideal for this purpose, although one having as little as 0.25 microfarad capacity will suffice.

It should be observed here that the midtap of the high voltage secondary winding of the transformer in Fig. 40-B is the negative side of the direct current supply to the oscillating tube circuit and the center tap of the filament secondary is the positive side.

To further smooth out the pulsations it is recommended, though unnecessary for telegraph work, that a 2 or 3 henry choke be inserted in the positive leg of the rectifier output circuit. The necessary details for the construction of such a choke coil will be found in Chapter III.

The capacity C_1 of Fig. 40, is unnecessary if the above mentioned choke coil is not used in the rectifier output leads, but it must be inserted in the circuit in case the choke coil is used.

In case it is desired to use electrolytic rectification the circuit shown in Fig. 40-C may be used. Observe here, however, that the midtap of the high voltage secondary is the positive lead rather than the negative one as found in the case of the thermionic rectifiers above. Suitable electrolytic rectifier units may be constructed by placing one aluminum and one lead plate, each 1 in. by 1/16 in. by 5 in. in length (allowing for connection) in pint Mason fruit jars three-quarters full of a saturated solution of sodium borate (borax) or ammonium phosphate. The plates should be immersed for about 3 in. of their length and should be separated from one another a distance of approximately 2 in. One of these units is required for each 60 volts to be rectified and if it is desired to rectify both sides of the cycle as shown in Fig. 40-C, twice this number of units are necessary. The plates of each unit must be *formed* before the device is operative as a rectifier. This consists in depositing a white crystaline formation upon them. To do this, connect a 500 volt alternating current source to the plates of one unit, first immersing the jar for about two-thirds of its height in cool running water to maintain a constant temperature. One side of the high voltage secondary may be used for supplying the necessary 500 volts, although the transformer may get hot and may have to be operated intermittently to prevent overheating. The process of forming the plates requires approximately two hours and is complete when the aluminum plate sparks profusely over its surface. A condition may come about in the formation of the plates wherein the aluminum plate fails to spark after a reasonable time, in which case it will generally be found that the plate has become dark and covered with scabs. If this condition exists, begin the process all over again with a new plate, for it is a difficult task to clean such plates.

As was found to be the case with other systems of rectification, a choke coil inserted in the positive lead from the condenser, C, assists materially in smoothing the output for telephonic purposes.

In the circuit of Fig. 40 individual grid leaks and grid condensers should be used to bring about the required negative grid potential. A capacity of 0.002 microfarad shunted with a resistance of 5000 to 10,000 ohms will be found satisfactory.

Compensation for radio artists is to be required by the Actors' Equity Association of New York, which has adopted a ruling that the radiophone is competing with the theater, and that those who talk or sing in the transmitting apparatus must be paid.

Construction of 100-Watt I. C. W. Transmitter for C. J. Dow, Hawaii

By Gerald M. Best and Ralph Heintz

THE consistent reception of 200 and 375 meter signals, both spark and C. W., in the Hawaiian Islands, at the station of Clifford J. Dow (6ZAC), has created a great deal of interest along the Pacific Coast, where, as would be expected, most of the stations Mr. Dow has heard are located. Many thought this record reception to be freaky and were inclined to be skeptical, but with the latest reports from Mr. Dow, showing continued reception night after night of stations such as XFI, which is 5000 miles distant, on the Atlantic Coast, and numerous intermediate fives, eights and nines, ample proof is furnished that Mr. Dow has set a record for short wave reception second to none. All his work has been done with a loose coupler, detector and one-step amplifier, connected to a 50-foot antenna suspended to a neighboring palm tree.

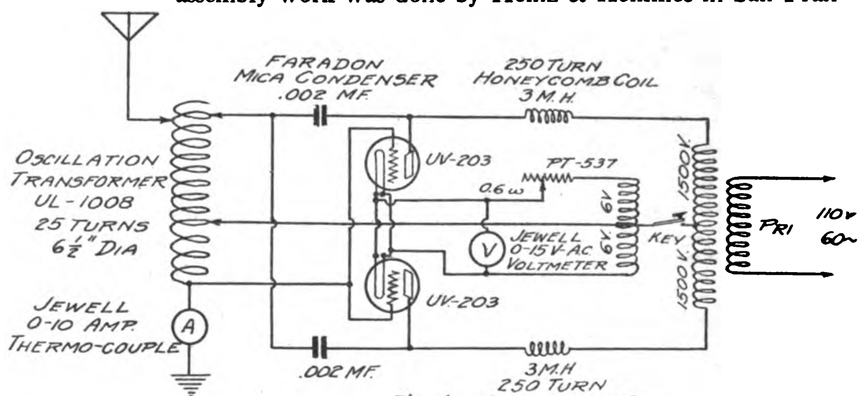
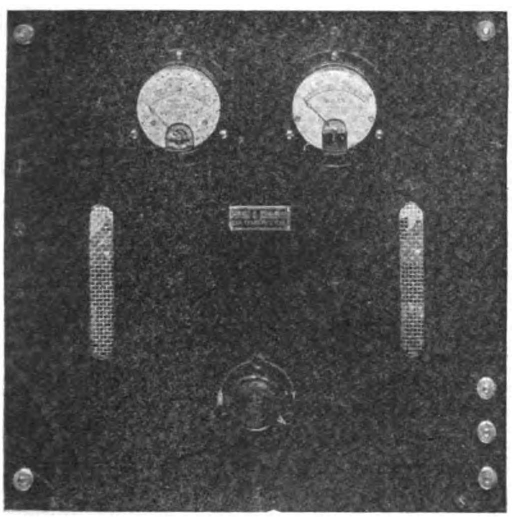
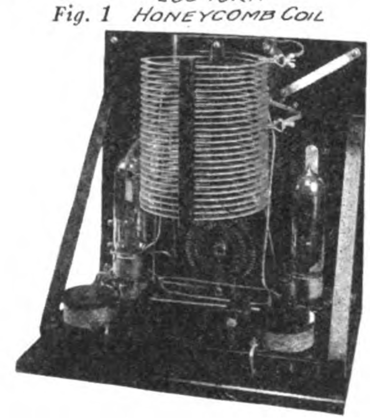


Fig. 1



Front View of Set



Rear View of Set

Mr. Dow has, for some time, had a very healthy ambition to be able to reply to those he hears, not by letter, but with a transmitter of his own. However, since he does not boast of being the sugar king of Hawaii, and hence is not desirous of installing either a thousand dollar antenna system or a miniature radio central, it remained for some of his C. W. friends in the States to get together some sort of a transmitter for him, which would be reasonably priced, simple and economical to run, and capable of covering the 2200 mile stretch of water between Wailuku and the nearest point on the California coast, as well as packing an extra kick to travel still greater distances over land.

We could think of no better type of transmitter to meet these needs than two 50-watt tubes in a Hartley self-rectifying I. C. W. circuit, as shown in Fig. 1. There are no expensive pieces of apparatus such as generators, etc., to buy and no great outlay would be necessary in its construction. Some may object to the single coil circuit used in the oscillator, saying that such a circuit does not have such a sharp decrement, and is subject to swinging. Since Mr. Dow's signals are expected to be heard on the ordinary regenerative receivers, and not on special and very delicate super-heterodyne apparatus, it would appear that a slightly broader wave is to be desired. The decrement of a transmitter of this sort is around .03 to .04, or about twice the decrement of a very sharply tuned two coil C. W. transmitter, and tests on Mr. Dow's completed set, when connected to a small amateur antenna, showed a decrement of .032, which is all that can be desired for sharpness. If Mr. Dow follows the usual precautions of thoroughly guying and securely fastening his new antenna, he will not have much trouble from swinging signals.

Accordingly, the apparatus indicated in the diagram was assembled and the completed transmitter is shown in the illustrations. Not a single item of material was used that could not be purchased readily in the stores. The panel is of 3/8" Formica and all the wiring is No. 12 B. & S. solid copper with varnished cambric sleeving for insulation. The power transformer and key are separate from the main transmitter, for the purpose of convenience in shipping. The assembly work was done by Heinz & Kohlmos in San Francisco, and the character of their work is shown in the fact that not one case of trouble was found when the transmitter was tested on an antenna, and a radiation of 5 amperes on 200 meters was obtained within 10 minutes after the set was put on test. The power supply at Wailuku is 60 cycle 110 volt a.c., so that no special transformer had to be constructed to meet unusual conditions.

After the transmitter had been thoroughly gone over, and everything found O. K., DX work was commenced in earnest and such stations as 5ZA in Roswell, N. M., a distance of 1000 miles, and many others, were worked with ease. Finally, a cablegram was sent to Mr. Dow, making an appointment with him to listen in on the night of Wednesday, February 22nd, for his own transmitter, and test messages were directed to him over a period of about an hour. The following morning we received the joyful news by cable from Dow, "Signals QSA throughout transmission," showing that the transmitter has certainly lived up to expectations.

Having thus proved its worth, the complete outfit was packed up and sent on its long journey to Wailuku, and before many weeks we shall have the pleasure of working Hawaii, not to speak of the pleasure on Mr. Dow's part of working the good old U. S. A.

It is as simple a set as can be built without sacrifice of efficiency. Many expensive pieces of apparatus common to most sets of this class are entirely eliminated. No grid leak or grid condenser is employed, and only two condensers of fixed value are necessary.

Since a balanced circuit is employed every effort was made to carry this balance into the arrangement of the various elements. The result was a pleasing symmetry of appearance, simplicity in wiring and general accessibility. All the parts and wiring belonging to each tube are thus divided along a center line and such elements as the inductance, filament rheostat, etc., which are common to both tubes, are bisected by this center-line.

In order to make the connections between the various parts of the circuit as short and as direct as possible the condensers and radio-frequency choke coils are mounted on a bakelite bridge. This bridge also serves to support the binding posts for the high tension input, thus minimizing the operator's chance of coming in contact with the 1000 volt supply. The absence of switches, knobs, dials and other pieces of like paraphernalia will no doubt discourage some amateur of the genus knobtwister, who would have to content himself with running the filament rheostat up and down. However, the amateur who is seeking results, who wants the greatest efficiency with the least cash outlay and fewest number of parts is content with only those controls which are necessary to proper tuning. In the following description the element of uncertainty is entirely removed. The question of efficiency is best answered in that the set worked the Hawaiian Islands from Oakland, California, on its first attempt and the question of cost can be answered by the definite statement that by buying all of the materials in the open market at retail prices the complete set will cost $187.94.

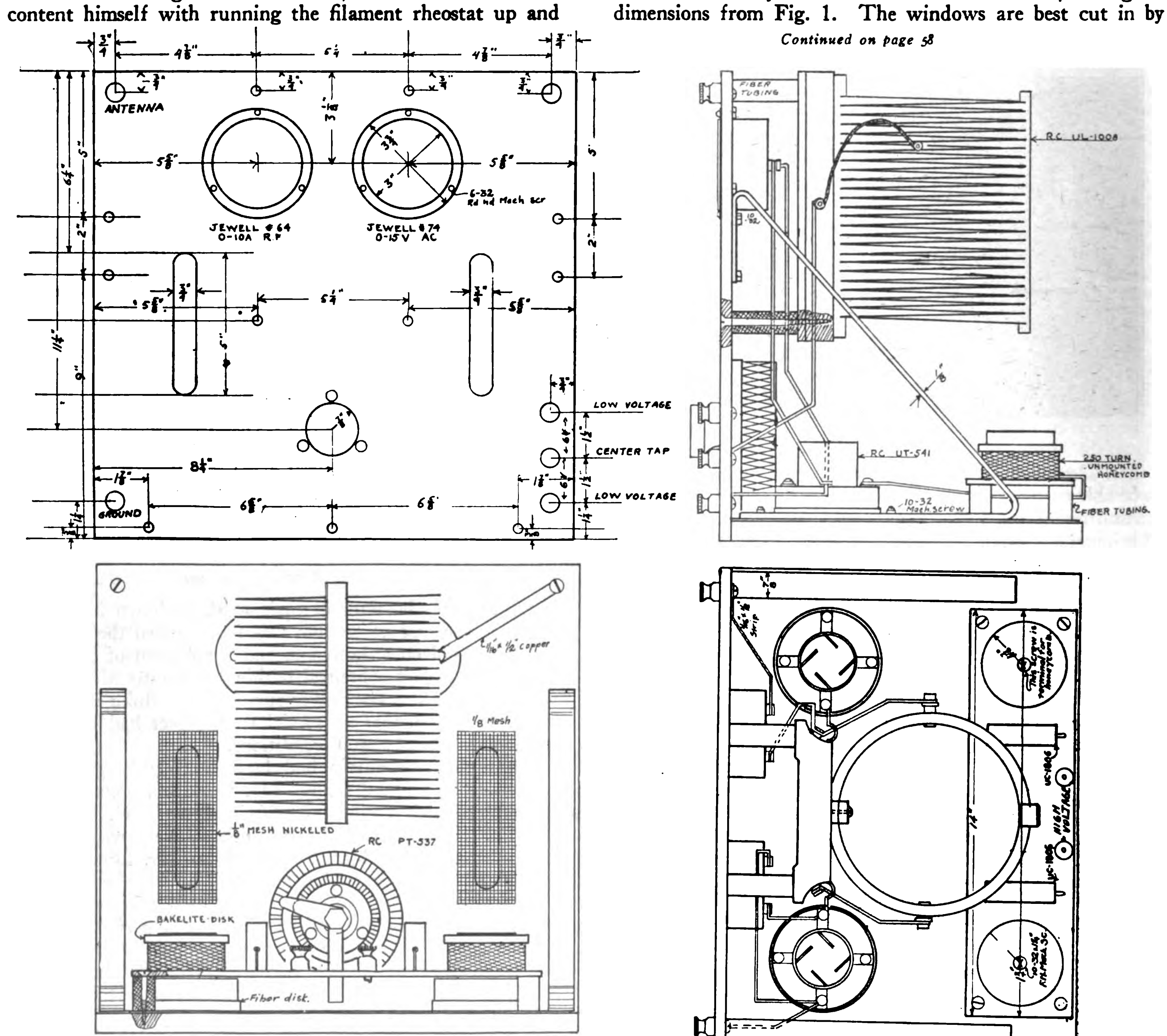
The panel is made of 3/8 in. bakelite, formica or condensite 16 in. by 16½ in. If a polished panel cannot be obtained it may be finished by sanding with No. 1 sand paper wrapped around a block of wood. A block of cork or hard felt is better (or a black-board eraser if one is at hand) than wood, as backing for the sand paper.

When the surface presents an even dull appearance it should be rubbed with pumice and kerosene, a felt pad being used. After washing with gasoline the final polish is obtained by rubbing with rotten stone and raw linseed oil.

This process is rather laborious and should be resorted to only in case a finished panel cannot be had. A pleasing satin finish may be obtained by having the panel sand-blasted at any glass beveling works at a cost of fifty cents.

The holes may next be laid out and drilled, taking all dimensions from Fig. 1. The windows are best cut in by

Continued on page 58



Panel Layout and Construction Details for C. J. Dow's 100 Watt I. C. W. Transmitter

How to Make a Two-Step Amplifier

By D. B. McGown, Assistant Radio Inspector

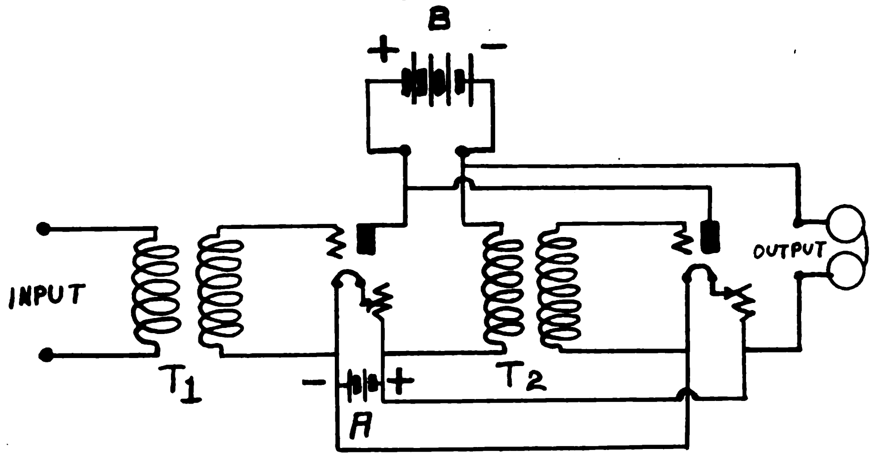
WHEN the receiver which was described by the writer in March RADIO has been completed, tested, and found to work satisfactorily, the owner thereof will find that it will not be sufficient to get all the radio telephone concerts and broadcast matter as loud as he would like to have them. The need for an amplifier becomes apparent at once, and is the only solution to the problem.

The exact design of the amplifier, as well as the detailed circuit used, is given herewith, and is shown in the accompanying cuts. It is not possible to construct as much of the amplifier as it was with the tuner, so the work becomes largely a job of standard parts. Some of these parts, such as sockets, rheostats and binding posts, could be easily made if one had a complete machine shop, but usually such tools as are required are not available, and furthermore, the time expended on the actual manufacture would be so great that it would be a better plan to buy the parts anyway, if the builder's time is worth anything at all.

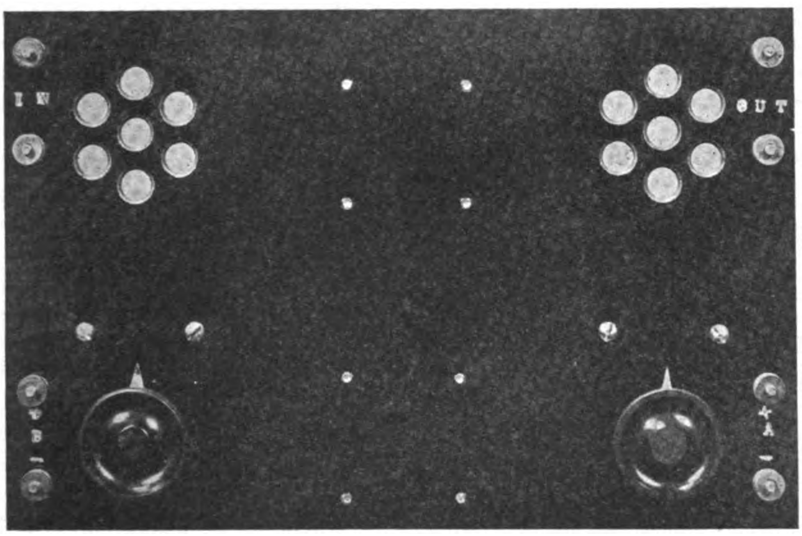
For most purposes a "two-step" amplifier will be found to be satisfactory and capable of giving loud enough signals to render the music audible to all. For this instrument, we will need the following:

1 panel of convenient size and thickness.
2 amplifying transformers (audio frequency).
2 tube sockets.
2 vacuum tubes (amplifier tubes).
2 rheostats.
8 binding posts.
Wire for connections.

The circuit diagram for an amplifier of this type is shown herewith. The posts marked "input" are connected to the primary of the amplifying transformer on one side, and the current from the pair of binding posts marked "telephones" on the detector panel forms the external circuit, in this case. The two binding posts at the upper left are the ones used for this purpose. There is then a current induced in the secondary of the transformer, T_1, whenever a signal passes thru the primary. This in turn affects the grid of the first amplifier tube, whose output goes to the primary of the second amplifying transformer, T_2, and from the secondary of the secondary of this, to the grid of the second tube. The telephones are then connected to the output circuit of this tube, as shown. Binding posts for use for this class of work are mounted on the upper right side of the panel, opposite the posts marked "input," but the telephones connect to the "output" posts. Two lower sets of binding posts are also shown, one pair on each side. One pair is used for the A battery, and the other for the B battery.

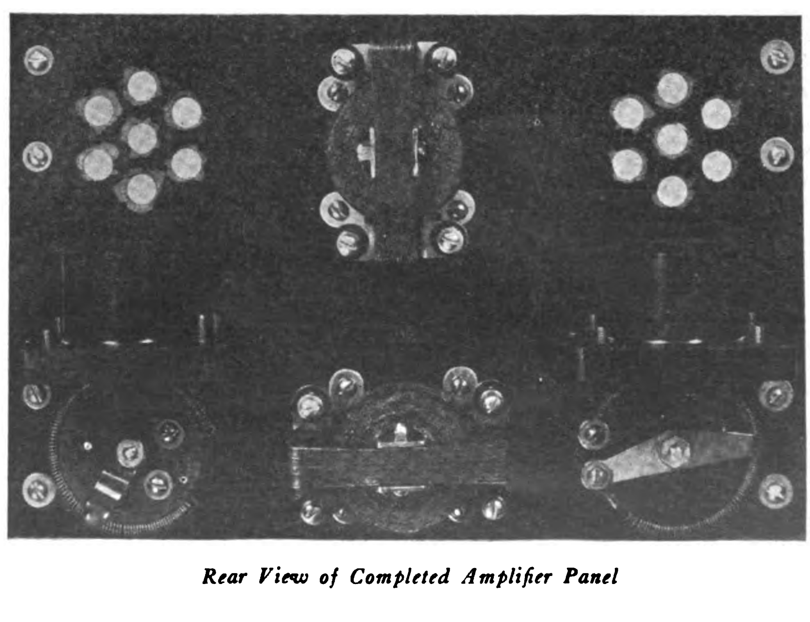


Amplifier Circuit Diagram



Front View of Completed Amplifier Panel

The same batteries may be used for the amplifier as are used for the detector tube, but they should be taken care of, and not allowed to run down, which they will do very easily if abused as the amplifier takes considerable more current than the single detector tube. When making the connections, it will be found that there is one post of the filament circuit which need not be connected with the A battery. This, if everything is



Rear View of Completed Amplifier Panel connected right, is the negative lead, and this post may be left open. This circuit is already made within the detector set itself, and if connected thru the amplifier as well, simply means extra work for nothing. This only holds true when a common battery is used for the filaments and plates, of course.

The common method of using "jack" and "plugs" to switch into the detector, and various different steps on the amplifier have been abandoned in this particular type of amplifier. In most cases persons listening in to concerts will never use less than two steps, and the extra expense and trouble of installing jacks is scarcely worth while.

Instead of the output of the last stage of the amplifier being connected to a pair of telephones, a "loud speaker" may be substituted, which, with a horn, will allow the music or telephone or other received conversation to be heard without difficulty. If this is too weak, it may be necessary to add a third "step" to the amplifier. This may be done by adding another transformer and tube and rheostat, etc. The input of this transformer will then go to the point where the telephones are now connected, and these, or the loudspeaker, may be connected in the output of the third tube. It is not advisable to carry the amplification farther than this, in most cases, as the extraneous noises usually introduced are magnified by each succeeding amplifier until more "noise" is heard than signal.

The loudspeaker used may be some one of the more elaborate instruments on the market, or a Baldwin receiver attached to a phonograph horn may also be used. Some types of ordinary metallic diaphragm telephones may be used in place of the Baldwin, and almost as good results obtained. The horn may be attached to the receiver in any convenient way. A horn may be procured and taken to a machine shop and carefully and permanently fitted to the receiver, or simpler means may be used. The writer has seen one such loudspeaker made up by taking a telephone and binding the horn onto the telephone with ordinary tape. Not a very fancy looking job resulted, but one that was "workable" was certainly obtained.

RADIOBILITY

The Word You Have Been Wishing For

RADIOBILITY—The quality of the etheric atmosphere for the propagation of radio telegraph or radio telephone signals.

The RADIOBILITY is good when there is no interference from atmospherics or fading.

Originated by W. Harold Warren, 2AVO, 605 Munroe Avenue, Asbury Park, New Jersey.

How to Operate a Receiving Set

By Malcolm P. Hanson, Chief Radio Operator University of Wisconsin

OWING to the sharply tuned waves of radio telephone signals, their reception at a distance usually requires careful adjustments of the receiving circuits, and is not accomplished as readily by the novice as is the reception of spark telegraph signals. In view of the differences of manipulation of the various types and makes of receiving sets, it is possible here to give only a general outline of the procedure to be followed. For complete operating instructions, the receiving operator should consult the manufacturer of his apparatus.

Before signals can be received, the detector must be in proper adjustment. Mineral detectors are adjusted by varying the pressure and spot of contact on the crystal until the note of the test buzzer is heard most clearly through the phones.

Gas-content (soft) detector tubes are adjusted by raising the filament current gradually, until a slight hiss is heard in the phones, and then reducing this current until the hiss just stops. Care should be taken during this adjustment to set the regenerative inductance or tickler coil at its minimum value. The plate (B battery) voltage at the same time should be so adjusted, by means of variable battery taps, or preferably by means of an A battery potentiometer, that this hiss commences at as low a filament current as possible. Most gas-content detector tubes require a critical plate voltage somewhere between 18 and 22 volts. The adjustment is most easily made by the use of an A battery potentiometer, which connects the negative end of the detector plate battery to any desired point between the positive and the negative terminal voltage of the filament A battery, thus providing a continuous 6 volt variation.

Many operators who wish to avoid the critical adjustments necessary for operation of a gas-content detector tube, find it convenient to employ a hard amplifier tube in its place, at a slight loss of sensitivity. These highly evacuated tubes are not critical in adjustment, and have no "hissing point." The best plate voltage for these tubes when used as detectors is best found by trial, but is not critical.

Amplifier tube filaments are burned at just sufficient brilliancy to give maximum signal strength. Any plate voltage from 45 to 90 volts or even higher may be used on amplifiers, the higher values of plate voltage generally giving somewhat increased amplification.

After the detector and amplifiers are adjusted, the signals desired are "tuned in" by varying the inductance and the capacity of the receiving circuits. Where a separate primary and secondary circuit is employed, the beginner frequently makes the mistake of using too tight a degree of coupling, which increases the condenser.

Signals received are greatly strengthened by use of a regenerative circuit, properly adjusted. To obtain regenerative action, carefully increase the plate inductance or tickler coupling until a slight hissing or hollow sound is heard in the phones, then move the adjustment back slightly until the hissing just stops. If the circuit is functioning properly, it will be found that phone and spark signals can thus be regenerated and their intensity increased many times. The slight hiss just mentioned indicated that the detector circuit is in a state of oscillation; this adjustment should be used for receiving continuous wave telegraph signals, and will also be found advantageous initially to "locate" radio telephone signals from distant stations.

"Locating" radiophone signals is accomplished by careful variation of the tuning while using an excessive value of tickler coupling or plate inductance, i. e., just within the "hissing" region. Continuous wave telegraph signals will now be heard, and phone signals can be recognized by the steady whistle-like beat likelihood of interference from other stations. To pick up a signal, a moderate degree of coupling should be used, and the tuning of both primary and secondary circuits varied until the signal is heard; the coupling should now gradually be loosened, and at the same time the tuning of primary and secondary be slightly readjusted for maximum signal strength. It will generally be found that, with a proper degree of loose coupling, interfering signals and strays may be diminished, without reduction in the strength of the signals to which the apparatus is tuned. Because of their sharp wave, radiophone signals may be received with much looser coupling than spark telegraph signals.

Where a single circuit tuner is employed, the tuning of the desired signals is greatly simplified by the absence of coupling and secondary circuit adjustments. In one well-known make of single circuit tuner, both the inductance and the capacity of the tuning circuit are varied simultaneously, by means of a single adjustment; other makes of single-circuit tuners are adjusted to the desired wave by varying the inductance by steps, by means of a tap switch, and then by careful variation of the tuning note which their carrier wave produces.

The Radio Wave

By Charles K. Fulghum

IT IS certain that the transference of energy which makes possible radio communication, takes place in the form of a wave. What this wave is, and some of the fundamental phenomena associated with its propagation, are presented to the amateur in this article.

Texts usually treat the subject in this light: The amateur is told that radio communication is possible thru the agency of certain waves, these waves being similar to those formed by a drop of water falling into a still pool; that these waves spread out thru the ether; that they are absorbed by the sunlight; *et cetera, ad infinitum.* On the other hand, original papers explaining these waves lead the bewildered amateur thru a devious route of differential calculus and trigonometry, and as far as he is concerned, gets him nowhere. After several years of this is it to be wondered at that the amateur's conception of a "radio wave" is about as clear as mud?

It is true that the knowledge of these waves is very slight and that at the best, we can but advance theories as to what they are. This explanation, of one of those theories, was adopted because to the writer it seems the most plausible and would be best understood by the average reader. The writer sincerely hopes that, after reading this article the amateur will at least dispute the validity of this theory.

Wave motion may be defined as a periodic, undulating motion which takes place in an elastic medium, due to energy being periodically supplied to some portion of that medium. For illustration we may fall back on that given in texts. Thus, if a stone is dropped into a still pool of water, waves will be formed and these will spread from the point of disturbance in all directions. If a point is chosen beneath the surface of the water, and a careful study made under the conditions which take place in this medium during such a disturbance as cited above, we find that the water is not moved along, but is merely compressed and rarefied, corresponding with the wave motion which takes place on the surface. One such period of rarefaction and compression, which may take place in any medium, is known as a "wave." Wave length is measured from any point in one such "compression" to a like point in the next.

From waves in water to waves in air is but a short step and we find that waves which are formed in this medium are similar in many respects to those formed in the water. Characteristic of these "air waves" are the waves which cause sound. A disturbance which will cause sound "breaks" up the atmosphere into a series of rarefactions alternating with points of compression which move outward from the point of disturbance thru the atmosphere until the energy of the wave train is dissipated, probably due to molecular friction. Thru the work of a number of scientists we are able to photograph these sound waves and study their formation and determine the fundamental phenomena associated with their propagation. Notable among these men is Professor Foley of the University of Indiana. A study of sound wave photographs made by his method was undertaken by the writer a short time before this article was prepared and some of the conclusions arrived at in the explanation of radio waves which follows are based on the characteristics of sound waves, methods of formation and their propagation thru various media.

THOSE familiar with electro-statics know that, when two plates forming a simple condenser are charged, the dielectric separating these charged surfaces is in a strained condition. This can easily be proved by examining a dielectric of glass with a polariscope when the dielectric is between two highly charged surfaces. It is evident that if the dielectric separating the conducting surfaces is a medium such as air, this stressed condition will not confine itself to that portion of the medium which lays between the plates, but will extend for a considerable distance beyond them. If we increase the area of one of the plates and keep other conditions the same we find that the stressed condition is more apparent near the surface of the enlarged conductor. If the larger conducting surface is formed of a variety of materials whose coefficients of conductivity vary widely, the "field of stress" over these different materials varies proportionally.

It is now evident that the surface of the earth can be considered as the plate of a huge condenser and the antenna of any radio station as the other conducting surface. When the antenna is charged a stress will be produced which theoretically can be detected at any place on the earth's surface.

Were the earth's surface of uniform conductivity, the amount of this stress would be diminished as the square of the distance from the radiating antenna, equally in all directions. It is also evident that the velocity with which this stress spreads over the surface of the earth will equal the velocity of electricity.

It can be shown that if an electroscope is introduced into the "field of stress" between the two charged plates previously mentioned. a displacement of the indicator will be caused, showing that a charge has appeared on the metallic portion of that instrument. The same is true of the earth forming the plate of a huge condenser. If we erect an antenna in such a "field of stress" a charge will appear on it. Why we are able to differentiate between the "field of stress" that various transmitting stations create necessitates an explanation of wavelength.

If the velocity of waves passing a point is uniform, the number of waves that pass that point in a given length of time will depend on the length of the waves. Thus, supposing the waves to be of uniform length and their frequency is lowered; i. e., the number of waves formed per unit of time, the wavelength must be increased and vice versa.

Since the current which flows in the antenna system of a transmitting station is an alternating current of radio frequency, a similar variation will be caused in the charge which is induced in the antennae of receiving stations which lay in the "field of stress" created by the transmitting station. If this charge is to cause a current to flow in the antenna of the receiving station (which it must do if we are to detect it), the impedance of this circuit must be reduced to zero for currents of a frequency equal to that of the transmitting station. This is what is done when a station is "tuned in." It is apparent that if a transmitting station varies in frequency while "working" another station, it will cause much trouble at the receiving station. This is the case with certain types of arc and spark transmitters where the current is constantly varying slightly. Such stations cannot be sharply "tuned in," and they cause any amount of trouble for all receiving stations that lie in their vicinity. Mention of these types of transmitters will be made later in connection with the distances covered when dealing with various methods of producing the radio frequency currents for the transmission of intelligence.

PRACTICALLY all of the phenomena of radio communication have to do with the distances covered by the transmitting station. These phenomena have been divided into two classes. The first deals with the radiation system; the types and directive properties of various antennae, and the sources of radio frequency currents and their qualifications.

The second class has to do with cosmographical influences and their effects on the "field of stress."

Continued on page 46

Grid Leaks

TRUE STORIES OF THE WIRELESS

By EARL ENNIS

John S—— dropped in on a friend one night, and for the first time, heard a radiophone concert. From that night on he was a changed man. He haunted wireless shops. He priced instruments. He studied catalogues. Finally, one day, even as you and I, he fell. Walking boldly into a store, he bought a complete set and marched jubilantly home with it under his arm.

That night he placed the set on the table in his living room while his family collected around him and marveled. He fastened the phones just where the man had shown him. He turned on the lamps. He heard a sound in the receivers like mother frying a steak, or a wet sock broiling in front of the fireplace. That was all he heard, no matter how hard he turned the knobs.

In despair John crossed the street and hunted up a boy who owned a home-made set worth about eighty-five cents, Mexican money. The boy came over. John asked him technical questions.

"Ain't my battery all right?"

"Sure," said the youth.

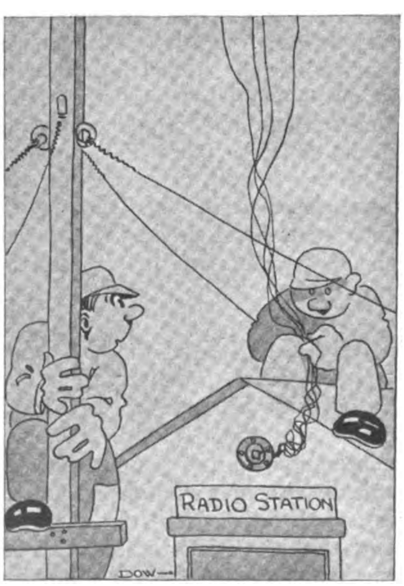
"Ain't I got enough lamps?"

"I reckon."

"Then what's the matter with the set?" demanded John.

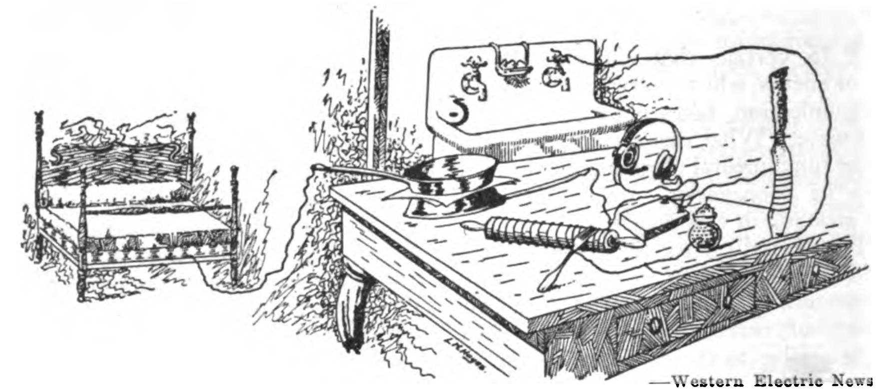
The boy scratched his nose with a reflective finger.

"Well," he said, "I don't know how it is with your set. But mine works better when I got an antenna connected to it. . . ."



Why don't you put up an "Umbrella" aerial?

Ah! I hear they leak too much!



—Western Electric News

The Home-Brew Set

BROADCASTING OPERATOR: "That last piece was 'Sweet and Low' by Al. McGluck, the Irish tenor, a victorious record. Just a moment, please . . . We'll have a two minute intermission. . . . . I'm glad you're all enjoying the concerts. The next will be a prayer. Let's go!"

SOME RADIO VERSE

By EARL ENNIS

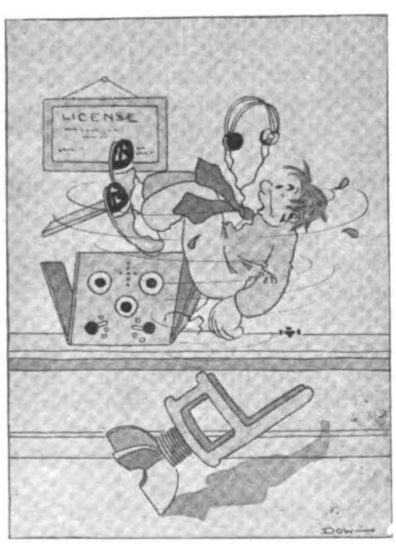
ROUGH STUFF

There was a funny little guy,
Who took up radio;
He bought a fancy tube set
But he couldn't make it go;
He clamped a piece of crystal
Beneath an old bent pin,
And made his own detector, and
B'gosh, it brought 'em in!

• • •

RADIO GOOSE RHYMES

Sing a song of wireless,
A table filled with junk;
Four and twenty-hook-ups,
Mostly all the bunk.
When the music's going,
And the voice comes in,
Isn't it a merry thing to realize that the blamed set is working in spite of the fact that the antenna is connected to the B battery?



When They Transmit Power via the Ether!

"Pretty maiden, chic and gay,
QRD for a swell cafe;
QRK, Oh dainty she?
Wilt thou shake a foot with me?"

"QRM," the maiden said,
As she coyly tossed her head.
"QRW—I cannot go;
QRZ—my answer—no!"

"Pretty maiden, how you vex!
QRV? And QRX?"
"Stand aside!" the maid's decree.
"QRU—don't fool with me."

• • •

GIMME

Maid of Athens,
E'er we part—
Give, Oh give me,
Back my heart;
Gimme back my honeycombs
Gimme back my diamond ring;
Gimme back my two-step too,
My Baldy phones and everything.
Maid of Athens,
You're tuned out;
I liked 'em lean,
And you got stout.

• • •

THE AERIAL

The wires I've strung for thee, dear set
Are like a shoe-string gambler's bet—
Each strand a sob, each sob a pain,
No sooner up than down again.
I cinched you like a fiddle string
And in the house the lead I'd bring,
And every time a high wind blew
And something snapped, I knew 'twas you,
My aerial! My aerial!

• • •

Abbreviations are used in radio communication to save time. The same abbreviation is used for answer or notice as for the question. Thus as a question QRM means "are you being interferred with," and as an answer means "I am being interferred with." It is regularly used to denote interference just as QRN denotes atmospherics or statics. QST means "will you forward the radiogram"; QRD, "where are you bound for"; QRK, "how do you receive me"; QRW, "are you busy," or "I am busy"; QRZ, "are my signals weak"; QRV, "are you ready"; QRX, "shall I stand by"; QRU, "have you anything for me," or conversely, "I have nothing for you."

A Phony Freeze-Out

By Volney G. Mathison—*A Samuel Jones Story*

"WIRELESS operators are a thing of the past," breezily proclaims Mr. Aloysius Bean. "Thanks to our wonderful new Hellkum wireless telephone, the time has come for the telegrapher-tourist to fold up his license and go to work."

Hell-Fire, Old Judge, an' myself, sittin' at our interrupted poker game in the Unga wireless-shack, receive this calamitous news in wonderin' silence. From our window overlooking the bay, we had seen th' mail-boat come in to dump off this tortoise-spectacled bird along with a lot of boxes an' crates; an' while we had been sort of wonderin' who an' what he was, th' cards had been runnin' too good to allow our attention to get deflected off th' jack-pot into any idle speculations.

"Well, personally, I ain't much concerned, mister," I remarks, calm-like. "I'm now livin' as a gentleman 'a leisure —that is as long as th' codfish-snailers' cash an' my poker-luck hangs out—but I'm kind'a sorry fer Old Judge an' Hell-Fire, here, an' all th' rest of th' brass-pounders scattered along this Alaska Peninsula. There must be twenty or thirty of 'em."

"Twenty-eight," rejoins Mr. Aloysius Bean, complacent-like; "there are twenty-eight radio stations in this Bering-Sea region owned by the various salmon and codfishing concerns; and we are going to install one of our latest model radiophone sets in every one of them. The apparatus is already here, and also five installation experts, including myself, to put it in. In three months there won't be a wireless operator left on the Alaska Peninsula."

"Zat so!" barks Hell-Fire, jumpin' up, with one hand under his mackinaw an' a bad look in his eye. "Say, you better vamoose, you——"

"I don't know if I got you straight, mister," I says, landin' Hell-Fire a hard kick on th' shin, meanin' for him to keep his shirt on. "Th' idea is that all these cannery companies are goin' to use wireless phones an' do away with th' operators?"

"Exactly," replies Mr. Aloysius Bean, still wearin' his irritating smirk, but watchin' Hell-Fire pretty uneasy-like out of the corner of his eye. "On account of it being such an isolated region, the owners have been given permission to run their own phone sets, without operators' licenses."

"But how are they goin' to handle all the business to an' from th' States?" exclaims Old Judge, who I can see is badly worried about his berth at K-V-I. "That is our main traffic, an' it all has to be sent to th' naval stations for relaying, either way."

"That night Fat tries to make a get-away, but he stumbles over a wash-tub full of dirty dishes."

"That has all been taken care of," replies Mr. Aloysius Bean, smoothly. "We have made arrangements with the navy department to install one of our radiophone sets in the naval station upon the Pribiloff Islands, which all the fishing companies will jointly pay for. This will make it a simple matter to handle business that has to make the Alaskan navy relay to outside points."

"I HAD a hunch that guy was gonna mean trouble, th' minute I lamped him," glooms Hell-Fire, when Mr. Aloysius Bean has departed in company with the Brainless Swede, the fish-boss for the codfish company who own K-V-I. "Some people got a crust, sayin' Alaska still has a touch 'a th' western days 'a forty-nine, when a google-eyed combination of a two-by-four wireless pole an' a fizzled B-battery like that can land on these shores, an' live. I tell ya, this country's goin' to th' dogs; th' time is comin' for all us real westerners to shove on to Siberia——"

"He'll prob-bly come out to th' dance Saturday night; an' you kin frame it up to start a fight with him fer dancin' with your best girl, an' knock his block off," suggests Old Judge, hopeful-like. "Soapy Komedal was grumblin' th' other day that he hasn't sold a tombstone for three weeks—an' if th' marshal brings you in, I'll throw it out 'a court as bein' a case 'a *dux femina facti*—which means, Th' Cause of it was a Woman."

While Hell-Fire an' Old Judge are plottin' the legalized extermination of Mr. Aloysius Bean, personified black plague on brasspounders' meal-tickets, I am doin' some complicated thinkin'.

"You're too previous with all that six-shooter talk," I informs 'em. "This vacuum-tube stuff is bound to come—an' it's a good thing. Here we've got a bunch 'a out-'a-date stations, made up with all kinds 'a rotten old junk scrambled together, some of it workin' bum, an' th' rest of it worse. Now we get brand-new sets, all uniform, an' th' latest thing in radio. We want them tube sets to go in—we need 'em."

"Where do ya get that *we* stuff—are ya tryin' t' double-cross us!" flares Hell-Fire. "Once them talk-to-hellenbak wireless phones are in, *we* are out—out like a bunch of old battle-ships hit by a shower of advance spring fashions in airplane bombs!"

"Your mental perambulations are about as graceful as a Missouri rube runnin' to a fire with his feet caught in a barrel-hoop," I retorts, coldly. "There's several things about this scheme which I can see haven't been figured on. Th' key-punchers may be ostracized from th' payroll an' th' ol' grub-shack fer a while —but not long. We been strugglin' here long enough with shot-up condensers an' ear-splittin' interference. Let th' tube sets go in!"

"All right, Mr. Conqueror 'a Ouglamuck," growls Hell-Fire, sour-like. "Wel'l let 'em—I s'pose we can't do nothin' about it, nohow."

THEY were dazzlin' sets. A heavy bakelite panel carrying the controls an' meters, a rack full of the finest C. W. apparatus ever built—an' four glistening 250-watt power-tubes. Using the latest thing in power-amplifier circuits, they are built to work on three-phase alternating current, without rectifiers, an' use no big modulator tubes.

On a separate base, designed to be belted to the gasoline-engine of the old spark outfit, is a triple-generator set, which furnishes filament currents, a thousand volt current for the small master-tube circuits, and a three-phase alternating current, stepped up through a transformer to 2500 volts, for the big power-tube plates.

A light handled microphone-transmitter is hooked up to the panel with a long cord; and a desk push-button operates an automatic aerial-switch and also controls a special circuit to ease the voltage-shock when the big tubes are set to work. After the apparatus is adjusted, there seems to be nothing to do but push this button to talk or to listen in on the snappy three-step amplifier receivin' set.

They look like fool-proof outfits, and we hear that after they are all installed, Mr. Aloysius Bean is goin' to stay an' travel around from station to station as a maintainence expert, to keep 'em perkin'.

Continued on page 60

A GOOD OPERATOR!

Thinks twice before he starts up.

He listens to what is going on on the wave he is going to call on, and also on the wave of the station he is going to call, if different from his own, before he calls.

He stops to think whether the station he is about to call is on schedule with someone else, or listening to QST on another wave, or for any reason may not be on his regular listening wave, or may not be on watch. (Ships should be furnished with working schedules of all stations for this purpose.)

He never answers hams who he knows want to chew the rag or do unnecessary communicating.

Never makes unnecessary signals.

Doesn't indulge in the ham practice of making dozens of meaningless signals, i. e., attention signals, Vs Ks GAs, finish signals, etc. A transmitter is for carrying on communication with, not for making a noise.

Knows and uses the international abbreviations, and when it is necessary to use plain language, doesn't spell everything out in full, but uses Phillip's code abbrevations.

Never calls a station who has just finished calling some other station, until the calling station has a chance to listen and see whether the station called answers him.

Doesn't call continually with no appreciable interval between calls. If a station doesn't answer, there isn't much use calling again in half a minute. Wait at least five minutes unless you are sure you are well within range and that the operator you are calling is on watch and not QRW.

Always uses lowest power.

Reduce your power while you are working a station till he says QRZ, then increase a little.

Decreasing your voltage is not sufficient to decrease the distance you are heard, and the consequent QRM you cause. Cut down the gaps simultaneously with the reduction of voltage. You may be surprised how far you can work with a third the number of gaps you have been using.

If you call someone on medium power and QRM comes in or you begin to fade to him, you can then increase power if you don't keep your set crowded to the limit all the time. It's better not to raise a station quite so far and be able to have some power when he calls for more, than it is to raise him with the limit of power at the limit of range and cause twice as much QRM trying to work him QRZ, and then stand a chance of not getting the biz off.

Always shifts wavelengths when possible.

Never tries to pound through QRM on 600 meters and cause still more by doing so, when he has other waves at his disposal. A lot more work can be done on 300 and 450 than many operators think.

Uses QSY waves whether there happens to be anyone else in on 600 or not. Someone else may be waiting for the air to clear up, and you never can tell who you are interfering with, even though you may not be able to hear them.

Considers 600 meters more as a calling than a working wave. The ship calling wave should be reduced to about 450 or 500 meters so that a station could QSY to longer waves when his calling wave signals were weak, and to shorter, more inefficient waves (for the average ship antenna) when his calling wave signals were loud. This would insure a station always being able to clear a station which he could raise on his calling wave. Ships should also be equipped with more waves, say every 50 meters from 300 to 650, tuned sharp and exact. There is too much work being crowded onto 600 meters.

Never sends faster than the man he is working.

The speed at which an operator works you is the speed at which he would probably prefer you to work him.

Doesn't ask for unnecessary QSRs.

QSR is a common cause of QRM. Why put a message on the air two or three times with its attendant repeats, fills, etc., and cause correspondingly more QRM when you can probably get it off yourself by waiting a little.

With a high power set has consideration for small stations.

The fellow with a small voice may be just as good an operator or better than you are. Anyway, he's human and trying to hold down a job and get his business through just like yourself.

He never tries to work through someone else because he knows he can. He waits his turn.

Keeps his set tuned sharp and with a good note.

Get your power on one wave and work twice as far with less QRM for the rest of the stations.

A good note gets more answers, does more work, and bespeaks a good operator.

Never gets personal over the air.

It doesn't do any good.

Is always on the job for calls on whatever wave he is supposed to be on.

Doesn't stand his radio watch in the galley.

Listens in with his bulb oscillating.

And picks up five times as many calls.

Doesn't pass the buck.

When he is "called down" for something, doesn't begin to blame it on the "navy operators," "Japs" or the fellow on the other end. BE sure your failure is not due to your own work first.

Sends good stuff.

Some operators do. A few can't. Most can, but don't.

Keeps up to the radio times and the advancements in the art.

And all the little kinks and tricks that make the other fellow's work easier or improves his own service.

WHERE DOES HE LIVE? Show him to me!

TRANSMITTING ON GALENA

By L. F. SEEFRED, Radio 6EB

I presume most of the fellows interested in radio know by now that one can transmit on their own receiver by making the bulb oscillate. Tune the set until you get on the "beat note" or "carrier wave" of another amateur station, and then insert a key in the ground or antenna lead and work with him. Here in Los Angeles when this system was first used by just three or four stations, the fellows used to have quite a system of secret communication. But so many know it now that if one tries to talk by these means, it causes QRM! However, this could be done in a smaller city with ease, but be sure your wave does not exceed *200* as it will result in some *other* kind of fun.

Now as for transmitting on galena, is something that everyone does not know. It is just as simple. One day while I was having my storage battery charged, I decided to "dig" out the old galena set to see what could be done on such a set these days. I tuned around and finally succeeded in picking up the "beat note" of some fellow's receiving set. Later I heard him sending to another one on the same wave. I immediately inserted a telegraph key in the ground lead and made several dots and dashes to see if I could break them. Sure enough, one of the fellows said to the other, "QRX, some one else is on our wave." They both immediately stopped and I gave one of them a call. He answered, and when I told him I was sending on galena, he began to have the —what you would call "250 wattitus." After that, we three talked together on this system most every night. The whole idea is that their receiving tubes would have to be heterodyning on each other before I could talk to them on galena. But just as soon as one of them would turn off the bulb, my transmitter would be dead!

An electron is the smallest known quantity of negative electricity. A negatively charged body is one having more than its normal number of electrons, and a positively charged body is one having less. An electron in motion constitutes an electric current. This motion is always from a place of high to a place of low pressure, the difference in pressure being known as voltage.

A Radio Primer

By H. A. Eveleth

AERIALS

THE functions of the aerial, or antenna as it is often called, are twofold: when used with transmitting apparatus it radiates energy in the form of ether electromagnetic waves and when used with receiving apparatus it absorbs energy from ether electromagnetic waves.

We say electromagnetic waves because these waves have electric and magnetic fields, at right angles to each other, similar to the electric and magnetic fields set up by a current flowing through a wire. Electric currents are set up in the windings of a dynamo or generator when the windings are made to cut magnetic lines of force by the rotation of the armature on which they are wound. The effect would be the same if the armature were stationary and the electro-magnets which form the pole pieces were revolved about the armature. It is therefore apparent that we may generate an electric current by either moving a conductor in a stationary magnetic field or by moving a magnetic field about a stationary conductor. The receiving aerial is a stationary conductor placed in the path of a moving magnetic field, this magnetic field being one component of the advancing ether electro-magnetic wave radiated by a transmitting aerial. A current will therefore be set up in the receiving aerial and suitable instruments will change this energy to sound waves which can be heard.

The material of which an aerial is composed should be a good conductor of electricity and of good mechanical strength, especially in country where it would be subjected to an accumulation of sleet. No. 14 stranded phospher bronze wire is perhaps considered the best, but stranded copper wire of the same size will answer every purpose. Stranded wire has a larger surface area than plain wire and is a better conductor of currents of high frequency. It has already been explained that radio frequencies vary approximately from 2,000,000 to 15,000 cycles per second. Now a peculiar thing about high frequency currents is that they tend to flow near the surface of a wire and the higher the frequency the nearer they stick to the surface. Hence we use a stranded wire in aerials to give this high frequency current more surface or area over which to flow.

Aerials used for transmitting purposes should be carefully designed and on account of the high voltages to which they are subjected must be thoroughly insulated from the ground or from grounded objects.

Receiving aerials require much less insulation because they carry currents of very low potential and as much care need not be put into their design. In fact messages can be received, with suitable apparatus, on almost any nongrounded metallic conductor from a bed spring to a fire-escape or even the metallic frame of a spread umbrella. Seriously speaking, it is now possible to enjoy radio music while you lie in bed, hang out clothes or walk or ride about the streets.

The wavelength at which a sending station operates depends in part on the size and form of the transmitting aerial. Hence a station, desiring to use a certain wavelength, must design its sending aerial to approximate that wavelength and final adjustments can be made in the sending apparatus. We will explain later just how the wavelength can be varied, that is, how a given wavelength can be obtained.

Amateur stations are limited by law to a transmitting wavelength of 200 meters, hence an amateur's sending aerial must necessarily be comparatively small. Commercial ship stations operate on about 600 to 800 meters, using a larger aerial than amateurs, one stretching between the masts. Shore stations have room for much larger aerials and operate on wavelengths from 1000 to 1500 meters, while the transoceanic stations, using aerials often a mile in length and 400 to 600 feet high, operate on 5,000 to 20,000 meters wavelength. While a short aerial radiates more efficiently than a very large one, there is less absorption on long waves than on short waves and the longer waves are therefore used to cover great distances. The wavelength is not the range of the station as some people believe. A station on 1000 meters wavelength will transmit many times 1000 meters in distance.

The small aerial which the amateur uses for sending will receive practically all wavelengths when used with suitable apparatus, but to receive the higher wavelengths efficiently he should use a longer aerial. Hence some amateurs use two aerials; a short one for sending to and receiving from other amateurs and a long one for receiving long wavelengths.

A transmitting aerial should have both height and capacity. The higher the aerial the more efficiently it will radiate energy in the form of electromagnetic waves, and the greater the current in the vertical part of the aerial the greater will be the amount of energy radiated. Height is secured by placing the aerial as high above the ground as possible. Capacity is obtained by stringing a number of wires in parallel and connecting them together at one or both ends. A conductor having capacity can store electrical energy, hence the parallel wires of an aerial have electrical capacity, that is, they will receive a charge of electrical energy. The effect of capacity at the end of the vertical part of the aerial is to increase the current in the vertical section which, as stated above, results in a greater amount of energy being radiated.

The "T" aerial is often used. This consists of one or more horizontal wires with the vertical part or "lead in," as it is called, attached at the center. This type of aerial gives good capacity for the amount of wire used, but it sags in the center, decreasing its effective height, and it is subjected to high potentials at both ends.

The inverted "L" aerial is very popular. It consists of one or more horizontal wires with the "lead in" taken off at one end. The farther end is subjected to high potentials. When the horizontal part is much longer than the vertical part it transmits more strongly in a direction opposite to the free end and receives better from the direction in which it sends best.

The umbrella aerial consists of wires running from the top of a mast like the ribs of an umbrella. It is a good type to use where space permits and is often used with portable outfits.

The loop aerial is so arranged that two "lead ins" are brought to the receiving apparatus instead of one. It is used principally for receiving in connection with portable sets, in places where larger aerials cannot be erected and in cases where it is desired to eliminate atmospheric disturbances and other sources of interference.

The aerial must be connected to another capacity through the sending or receiving apparatus so that the high frequency currents can flow or oscillate back and forth between the aerial and the second capacity. This second capacity is usually the earth, but when a good "ground" cannot be had a net of wires called a counterpoise is spread on or buried in the earth. A water pipe is the usual ground connection.

In the case of an aeroplane the aerial may be a wire trailing or a loop aerial placed between the wings or a "skidfin" aerial placed above and insulated from one of the wings. The second capacity or ground consists of the metallic work of the plane connected together electrically. The trailing wire is the best, but it has to be reeled in rapidly before the plane lands.

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Radio Storage Batteries

By D. B. McGown, Assistant Radio Inspector

This article is different from the usual kind of catolog information about storage batteries. It gives information in simple terms that will enable anyone to take proper care of either lead or nickel-iron batteries. It also tells the why of what is done so that the radio operator need not "work in the dark."

ONE of the most important classes of apparatus used in a radio station, outside of the actual transmitting and receiving instruments, is the storage battery equipment, both for auxiliary power supply to the main transmitter and for various other purposes. One of the largest single uses of storage batteries is on shipboard stations for "emergency" purposes.

There are two broad classes of storage batteries, the lead plate and the Edison "nickel iron" battery. Both types possess their individual advantages, and some may be better adapted to given conditions than others, and these conditions, as well as the cost, are usually the determining factor in the purchase of batteries by a ship owner, coupled, of course, with the ability of the salesman who is trying to sell the batteries.

All ships which carry 50 or more persons are required to have some source of power independent of the vessel's main power supply, which will be capable of operating the set for a four hour period, in case of emergency. Storage batteries are employed almost universally on all vessels, as until recently there was nothing else that would function with such ease and certainty. A gas engine driven dynamo, which may be easily started from a storage battery, has recently been developed, and may prove to be equally as efficient. The law requires that the power be available a few minutes after the need for it becomes urgent in the radio room, which prevents the use of an auxiliary "donkey" boiler, which could possibly be used, if unlimited time was allowed in getting the power. Thus, even with the gas engine driven equipment, we are not free from the use of storage batteries.

Lead batteries of modern type are always made with the so-called "pasted" plates. These plates are castings of lead, sometimes with a small amount of alloy added, made in the form of "grids," i. e., they are made up in the form of leaden frames, which have a large available surface, which surfaces are so designed that a "paste" made up of lead compounds, may be applied to the grids, and this paste is then held in firm contact with the lead grid by their peculiar mechanical construction. There are two plates in the battery, the positive and negative. The paste applied to the positive plate is made of chemically pure red lead, mixed with dilute sulphuric acid, while litharge, also chemically pure, is applied to the negative plate. These compounds are changed in their composition by the "forming" process, which will be explained later. These pasted lead plates are then immersed in a solution made of about 20 per cent chemically pure sulphuric acid and distilled water.

When first set up, after the plates have been made as described, care should be taken to "form" the plates, by giving them several long charges and discharges, often called "forming cycles." This action turns the litharge in the negative plate into spongy lead, and the red lead on positive plate to lead peroxide. This process is reversed during the discharge of the battery, and the acid from the solution enters the plates, and causes the specific gravity of the electrolyte to fall, or in other words, for the acid to get weaker. The actual strength of the acid is measured by an instrument called a hydrometer, which is a small glass tube weighted at one end so as to float upright in the acid. The more acid present, the greater the density of the solution, the acid being heavier than water, and therefore the higher the hydrometer tube will float in the acid. By a simple method of comparison, the hydrometer is calibrated, so it may be used to measure the specific gravity of any acid. The specific gravity is, by definition, the comparison of the weight of a unit volume of water to the weight of a unit volume of the liquid in question, or in other words, if the specific gravity of a solution is 1.225, it actually means that the sample of solution weighs 1.255 times an equal volume of pure water. Pure concentrated sulphuric acid has a specific gravity of about 1.84, and the acid used in storage batteries averages from 1.220 to 1.280 (read "twelve-twenty," or "twelve-eighty"), so it is seen to be much weaker.

The actual value of the specific gravity used in a certain type of storage cell depends chiefly on the use to which the battery is to be put. The stronger the acid, the larger the current that the battery will deliver, for the same size plates, and (in effect) the stronger the acid, the greater the capacity of the battery. This can be easily seen, as the stronger the acid, the greater the amount of active material that can be acted upon per unit time, within limits. If the acid is made much stronger than 1.280, or 1.300 as maximum value, it will be found that the battery will be rapidly ruined by chemical action inside of the cell, which greatly shortens its useful life, even tho no current is drawn out of the battery. On the other hand, if the acid is not strong enough, the battery's capacity will be greatly lowered, without serving any useful purpose.

For automobile and general work batteries are made up with thin plates, and a high gravity acid. The thin plates expose a much larger surface to the solution (which determines the battery's total capacity), and the high gravity gives a large current, which is required for the proper functioning of the starter motor (this current often rises to values as high as 150 or 200 amperes on a 6 volt battery). When such a battery is used, almost all the action takes place at the surface of the plates, while very little action occurs inside of the active material itself.

In radio work almost the other extreme holds. The battery is seldom used, and even when it is, it has no sudden drain which requires every available ounce of "pep" the battery can deliver. If the battery *is* used, a low current of long duration is drawn from it. Generally, the battery stands idle, except for a few short tests, and it usually requires only a small freshening charge to keep it in the best of condition. If a high gravity acid is used in such a battery, it will be found that trouble is almost sure to occur, due to sulphation, sooner or later. The best types of batteries used in radio work, for auxiliary power, have a low maximum gravity, usually 1.220, or thereabouts. When such a battery is discharged, the acid will gradually enter the plates, and penetrate them thoroly, due to the slow action of the low current being supplied, and the full capacity of the battery will be obtained. When the specific gravity has fallen to 1.150, the battery is considered discharged. Further current drawn from the battery will result in the acid entering the lead grids, which will ruin them in time, and also allows destructive compounds to form between the active material and the acid, which prevents the full action of these materials when the cell is functioning normally.

Unfortunately, such batteries are not generally available for installation. A battery of a given capacity will be almost twice as large, and will cost almost twice as much if it is of the low gravity type than if it is of the type using the stronger liquid. This high first cost causes more high gravity batteries to be used than actually should be, altho, with some extra care the high gravity batteries hold up very well.

In order to keep the batteries in good condition continually, arrangements are sometimes made to give the batteries a continuous "trickle charge." This is

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The Vacuum Tube as a Detector

By B. F. McNamee

> **A simple account of how the vacuum tube works, written for the layman.**

THE vacuum tube has become such a commonplace in radio that a complete description is not necessary. The essential parts are a filament, grid, and plate. The filament consists of a wire which can be heated by passing a current through it, as in the ordinary electric light. The plate is generally made of thin sheet metal, usually nickel. The grid is so called because it consists of an open coil or network of wires or metal strips; it is a sort of screen, and to be effective must be placed between the filament and plate. These three elements are enclosed in a glass bulb, and the air pumped out before it is sealed up. Four wire leads are brought out through the glass, one each for the plate and grid, and two for the filament.

Two kinds of filament are in use. The first is a tungsten wire like that used in "mazda" lamps, and when heated to incandescence has the property of emitting large numbers of electrons, or exceedingly small negatively charged particles. The second kind of filament consists of a thin strip of platinum which has been coated with certain chemicals which have been found to be good emitters of electrons. This second type of filament requires only a dull red heat to produce sufficient electrons.

The output circuit of a vacuum tube refers to what is connected between the plate and the filament; it is often called the plate circuit. In Fig. 2 this circuit is seen to consist of a pair of telephone receivers and a "B" battery, the latter containing some twenty or more very small dry batteries, with the positive end connected, through the telephones, to the plate. When the filament is cold, this circuit is evidently open, since no current can flow, inside the tube, between the plate and filament. When the filament is heated, it emits negative electrons which soon fill the surrounding space. But due to the way in which the "B" battery is connected the plate has a positive charge, and in consequence a great many of the negative electrons are attracted to it. This movement of electrons from filament to plate is in reality an electric current, and flows steadily through the output circuit, once the filament is heated. But a steady flow of current through the telephones will produce no sound; to produce sound the current must vary.

The input circuit refers to what is connected to the grid; it is sometimes called the control circuit. For the grid is the control element in the vacuum tube—it corresponds to the trigger on the gun, or to the valve on the steam engine. By making slight electrical changes on the grid, we can make comparatively large changes in the plate current. The electron stream thru the tube, which constitutes the plate current, must pass thru the openings of the grid. A negative charge on the grid will repel some or all of these negative electrons back to the filament, thus reducing the current thru the telephones; while a positive charge on the grid has the effect of increasing the current thru the telephones.

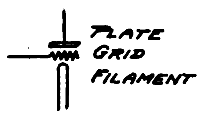


Fig. 1. Conventional Diagram of Vacuum Tube.

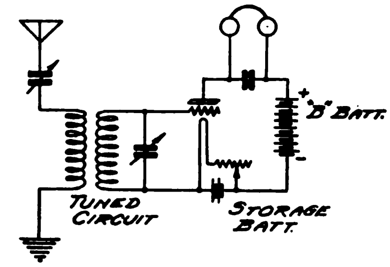


Fig. 2. Combined Input and Output Circuits.

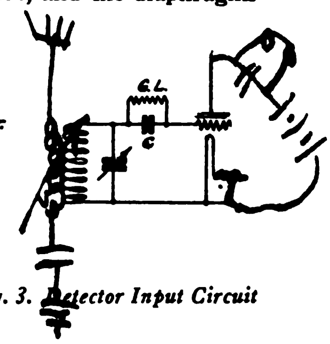


Fig. 3. Detector Input Circuit

It is thus seen that as the voltage of the grid is changed, the current in the output circuit undergoes a corresponding change. We may note, in passing, that a sufficient negative voltage on the grid will reduce the current in the output circuit to zero; this would require a voltage of about one-tenth that of the "B" battery, the exact amount depending on the kind of tube used. This point is not important as we seldom impress such a voltage on the grid.

With some adjustments of filament current and "B" battery, in the circuit shown in Fig. 2, the tube will act as an amplifier but not as a detector. With other adjustments the tube will detect. To illustrate we will suppose that an alternating voltage is impressed on the grid, this voltage changing back and forth between one volt positive and one volt negative. Further suppose that the current in the output circuit is 3 milliamperes when the grid voltage is zero, and that a change of one volt on the grid makes a change of one milliampere in the output circuit. When this alternating voltage is impressed on the grid the output current will vary between 2 and 4 milliamperes, but the average current remains 2 milliamperes as before.

If this alternating voltage is of high frequency, as would be the case in Fig. 2 the current pulsations in the output circuit will be just as rapid, and will not affect the high-inductance windings of the telephones. Since the average current remains the same, there will be no change in current thru the telephones, and no sound will result.

By changing battery values it is possible to find an operating point where the grid control characteristics are so changed that the tube will detect. This is the case when one volt negative on the grid will, just as before, cause a decrease of one milliampere in the output current, but one volt positive will cause an increase of only ½ milliampere. The plate current will now vary between 2 and 3½ milliamperes, or an average current of 2¾ milliamperes. Therefore, each time that a group of waves is received, the plate current will decrease by ¼ of a milliampere, and the diaphragms of the telephone receivers will be moved once. Just as in the crystal detector, the number of movements of the diaphragm per second depends on the number of groups of waves received in one second and not on the number of waves.

Another reason why the vacuum tube detects is as follows: When the grid is positive, it attracts some electrons which do not get through its openings to the plate. This constitutes a current in the grid circuit when the grid is positive; no current can flow when the grid is negative. This amounts to the same thing as connecting a resistance across the condenser each time that the grid is positive, and removing it when the grid is negative. If the circuit is tuned to the incoming signal, and afterwards such a resistance is shunted around the condenser, we will find that it considerably detunes the circuit. So when the grid is negative the circuit is tuned, but when positive the circuit is detuned and of course the voltage is lower. This means greater decrease than increase of output current, or a lowering of the average value, when each group of waves is being received.

The usual detector input circuit is shown in Fig. 3. C is a small condenser and GL is a very high resistance of the order of a million ohms, known as a grid leak. The amount of current flowing in the grid leak of a detector is so small that a lead pencil line on a piece of paper will suffice as a resistance.

When the grid becomes positive it will attract electrons, which can leave the hot

Continued on page 51

PROPOSED REVISION OF NATIONAL ELECTRICAL CODE RULINGS ON RADIO INSTALLATIONS

C. W. Mitchell, Board of Fire Underwriters of the Pacific, Merchants Exchange Bldg., San Francisco, as a member of the committee having in charge the revision of the 1923 National Electrical Code, requests answers to the following questions from those interested in radio installations. It is important that these answers be sent immediately to Mr. Mitchell.

RECEIVING STATIONS ONLY

1. What is the maximum height and length or other dimension of aerial that may be considered negligible as far as protective rules are concerned?
   Height from ground?
   Length of antenna or area?
2. Should aerial used exclusively inside of building be excluded from jurisdiction of rules?
   If not, why not?
3. Should relatively low aerial of moderate extent or area, but exceeding the amount excluded from the rules follow telephone practice for protection?
   (a) Should the minimum of protection include a 2500 volt fuse between arrester and interior wiring?
   If not, why not?
   (b) Should the minimum of protection include an arrester outside of building?
   If not, why not?
   (c) Should arrester be permitted to be grounded to water piping inside of building as per telephone practice?
   (d) Should all installations be provided with a switch to disconnect receiving apparatus from aerial when station is not in use?
   Will plugs and jacks be sufficient for this purpose?
4. What height, length or area of aerial should be set as a limit for the moderate protection including lightning arrester, etc?
   (a) Height ....
   (b) Length or area ....
5. Should any device be installed and accepted as proper protection in conjunction with lightning arresters where aerials are exposed to possible contact with lines carrying current at not to exceed 2500 volts to ground?
6. Vacuum arresters:
   What can be done to detect and eliminate defective devices of this character?
   (a) Tests.
   (b) Inspection.

SENDING STATIONS

1. Is there a type of sending station that can be with safety excluded from the rules?
2. Is it possible to classify sending stations on a basis of wavelength or K. W. rating making less rigid rules available for the so-called "low powered installations"?
   For example:
   (a) From 0........ to .... meters (wavelength).
   Size of aerial lead wire ....
   From 0........ to .... K. W.
   Clearance of wires from surface wired over ....".
   (b) From .... meters to .... meters (wavelength).
   Size of aerial lead wire ....
   From .... K. W. to .... K. W.
   Clearance of wires from surface wired over ....".
   (c) .... meters or over (wavelength).
   .... K. W. or over.
   Present rules to apply for size of aerial lead wires and clearance.
3. We need a clearer definition of ground switch.
   We use the word "approved."
   (a) Performance test?
   (b) Shall switch be capable of disconnecting apparatus from aerial?
   (c) Base? (design and material)
   (d) Carrying capacity? (cross section, etc.)
4. Clearance of aerial from wires in parallel with it?
5. Arrester.................... Shall this device be approved?
   (a) Performance test?
   (b) Shall base include terminals for fuses?
6. Is there any method of installing radio aerial or of equipping a sending station with devices that will reduce inductance to a point where it will not be injurious to adjacent light, power or signal lines without reducing the efficiency of the sending station?

AMATEUR RADIO IN THE EAST

By WILLIAM S. HALSTEAD, 2LH

1SD "breaks thru" fine on spark.

Old 1XE has been changed to WGI.

1BKQ, using two 5-watt tubes, has worked stations in over seventeen states.

1ZE is doing good work on C. W.

1ANQ is reaching out with C. W.

2ASO has installed a C. W. set.

2UA finally succeeded in getting his "cage" up.

2OM still gets messages thru by the dozen.

2BQH is on the air once more with a new C. W. and fone set. Four 50-watt tubes are used as modulators and four as oscillators. The set was on exhibition at the Second District Radio Show.

3ALN, Operated by H. F. Hastings, 905 B St. N. E., Washington, D. C., Who Uses One 50 Watt Tube I. C. W. and Works 6XAD.

2BAK is now WRW. What next?

Broadcasting stations are springing up like mushrooms all over the Eastern states. The following Second District stations (limited commercial) have regular broadcasting schedules:

WJZ, Newark, N. J.
WOR, Newark, N. J.
WNO, Jersey City, N. J.
WRW, Tarrytown, N. Y.
WJX, New York, N. Y.
SDT, New York, N. Y.

2VA is on again.

2EL is keeping his "meat hooks" busy.

2BSC rattles the diaphragms with his spark.

2DK is temporarily dismantled as he is moving back to White Plains. Said Scarsdale was too near Yonkers. 2BK!?

3ZY is very QSA all over the East.

3ZO is doing his usual good work.

Wonder what the President says when 3ALN goes on?

8BRL is pushing traffic thru in fine shape.

4EA handled quite a bit of traffic last month.

4BQ is very QSA on C. W.

4AS has changed from spark to C. W. 'At a boy.

4GN helps to push traffic thru to the South.

They say 4FD is on with a 5-watt C. W. set.

4AG may put in a C. W. set—sometime. Still hoping.

4GL is still racing around the ether.

AS THE NEWSPAPERS SEE US

Wuxtra, Wuxtra, Son of Prominent Citizen Installs a Wireless Station and Sends Messages all over the World.

Freddie Greenback, the fifteen year old son of Gogo Greenback, well known literary man, allows himself to be interviewed.

As the reporter knocked on the door a bright looking chap answered the call. He informed the reporter that he was Freddie, so the interview began. Little Freddie led the reporter through half of the rooms in the house and after crawling through a trap door in the ceiling of the back room they at last emerged into the radio room, which was located in a convenient corner of the back attic.

To begin with, said little Freddie, gaze out of the window and take note of those wires strung up between those two poles. They compose the oscillating circuit. They are what are used to pick messages off of the clouds. The higher the wires the greater the moistening. Now take notice of all the other wires which I have hung in the back yard. Those are called the counterweight, and their use is to balance the oscillator and keep it from falling. The counterweight must be perfectly ventilated, so there is a ground on the end of each wire to keep it aereated.

Now take notice of the instruments in the room. All those massive pieces in the corner compose the regenerator, which is the machine that is used for sending. That round box on the wall is a hot water meter, which measures how many miles per revolution my messages are traveling. To make them go faster or slower it is only necessary to change the clips on the fones and the desired result is obtained. All of those black disks mounted on that piece of cooklite are the controls that regulate the kick-back preventer and make it possible for me to hear messages. With that Freddie grabbed up the variable condensers and shoved them on his ears. Then he lit the transmitting condenser and gave the lead-in bushing a twist. Presently he removed the condensers from his head and remarked that NAJ, the broadcasting station of the Westinghouse Electric Co., was sending market reports on a dry wave. Suddenly a booming crash broke up everything, but Freddie said it was only 9BP, one of the Navy's big stations. He remarked that it was sending on a wave of 459 feet, 3 in., which was just about as high as his set would go. As soon as 9BP finished another station came on. This was POZ, one of the local stations in Evanston, Ill. Freddie jumped up and yelled excitedly, "I'm going to call him." With that he closed the grid leak and turned on the variometer. It began revolving at high speed and then he pressed the tickler. A heavy blue spark jumped from the variometer to the two telephones on either side. After doing this for about three minutes he listened again. "OH SHOOT!" he remarked, "he didn't hear me, so I have to call him again." And with that he started up the variometer and began all over again.

9BRE,
C-1 Park Apartments,
Evanston, Ill.

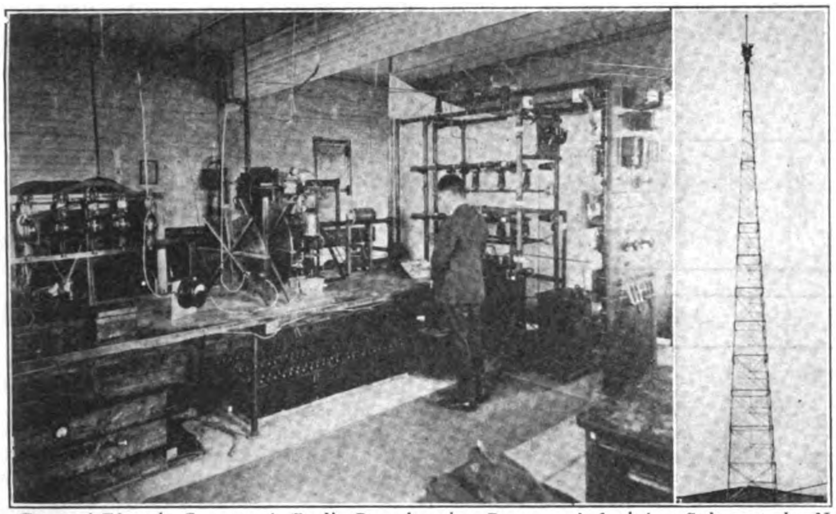
Body capacity effects, whereby closely tuned signals are lost when the operator removes his hand from the condenser dial, can be eliminated by the use of a vernier dial or by gluing a piece of tinfoil on the back of the dial and grounding it. By placing the eraser of a long pencil against the side of the dial and turning it slowly closer tuning is also possible.

News of the Broadcasting Stations

The *Oregonian,* Portland, Oregon, has installed a transmitting set employing the Heising circuit for modulation and the Colpitts circuit for oscillation, using three 50-watt tubes with 1000 volts in the plate circuit. A 60-ft. mast on the *Oregonian* tower gives the 70-ft. four-wire aerial a height of 192 ft. News, instrumental and vocal music is to be broadcasted regularly. Other radiophone stations are being operated in Portland by W. P. Hawley, Jr., and by the Northwest Radio Manufacturing Co.

New stations at San Francisco have been installed by *The Examiner* and by the Emporium.

Paul F. Johnson, proprietor of The Radio Store at Pasadena, California, has been assigned KGO as the call number for a broadcasting station that he will soon have on the air.



General Electric Company's Radio Broadcasting Room and Aerial at Schenectady, N. Y. The Tower is 183 ft. High — *International Photo*

Concert programs are sent out by radio broadcasting station WGY of the General Electric Co. at Schenectady, N. Y., on Tuesday, Thursday and Friday nights at 7:45 o'clock, Eastern time. Every night, except Saturday and Sunday, WGY broadcasts at 7 o'clock market quotations supplied by the New York State Department of Farms and Markets. All broadcasting by this station is on a wavelength of 360 meters.

The concert program which was broadcasted from WGY at 11:30 p.m., Eastern time, Friday, March 24th, for the benefit of the western territory, was heard by a number of Pacific Coast stations, including a verified reception by KZY.

Gould, The Light Man, of Stockton, California, announces that his radio broadcasting station will be employed by the Ministerial Union of Stockton for the purpose of furnishing listeners with Sunday service from station KJQ, between the hours of 10 and 11 a.m. KJQ broadcasts concerts on Wednesday and Sunday evenings from 7 to 8 p.m., and on Wednesday from 5 to 5:30 p.m.

The Missouri State Marketing Bureau market news broadcasting station—WOS—was one of the first stations, if not the first, to urge the usage of the radiophone for state programs for broadcasting market news to farmers. They have given an order to a New York manufacturer for a $10,000 broadcasting and receiving outfit, which has for its object the giving to Missouri farmers reliable government market news throughout the year. The office is on the leased telegraph wire of the U. S. Bureau of Markets, off of which they get market news information on all farm products from practically all of the important markets of the United States.

At the present time over one hundred receiving stations scattered throughout rural Missouri are co-operating in the distribution of this market news information.

TOLL BROADCASTING BY A. T. & T. CO.

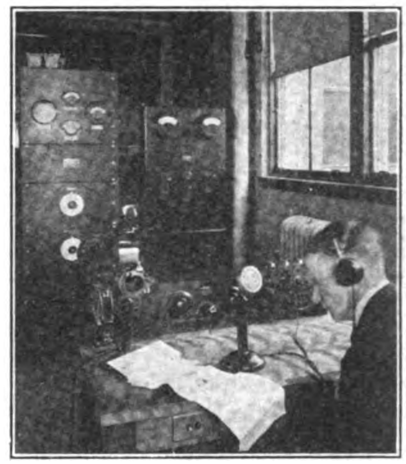
The American Telephone and Telegraph Co. has erected a wireless telephone broadcasting station on the roof of its 24-story operating building between Walker and Lispenard Streets, New York City. This building is 350 feet high and rises conspicuously above any other building in the immediate neighborhood. The steel towers supporting the antennæ will be 100 feet high. This important radio distributing station is to be equipped with the latest developments of the Bell System, including the use of electrical filters and new methods, whereby, as the business grows, several wavelengths can be sent out simultaneously from the same point, so that the receiving stations may listen at will to any one of the several services. It will be the first radio station for telephone broadcasting which will provide a means of distribution and will handle the distribution of news, music or other program on a commercial basis for such people as contract for this service.

The company will provide no program of its own, but merely the channels through which anyone with whom it makes a contract can send out their own programs. Just as the company leases its long distance wire facilities for the use of newspapers, banks and other concerns, so it will lease its radio telephone facilities and will not provide the matter which is sent out from this station. If there appears a real field for such service and it can be furnished sufficiently free from interference in the ether from other radio services, it will be followed as circumstances warrant by similar stations erected at important centers throughout the United States by the Bell System. As these additional stations are erected, they can be connected by the toll and long distance wires of the Bell System so that from any central point the same news, music or other program can be sent out simultaneously through all these stations by wire and wireless with the greatest possible economy and without interference.

While it is entirely possible, as has been demonstrated by the telephone company, to talk by wireless when all atmospheric conditions are favorable across the continent or even for much greater distances over water, such long distance radio telephone transmission is not dependable and is not to be compared from a standpoint of service or economy with the transmission which is provided over wire. However, for a broadcasting service, which involves only one-way transmission, where the same message is given simultaneously to a great number of people within reasonable distances of the transmitting station, radio telephony offers a promising field for development.

THE WIRELESS COLLEGE

Entering a field of almost limitless possibilities in the realm of education, Tufts College has announced the completion of plans for what is probably destined to be the world's first wireless college. A series of lectures will be given free twice a week, broadcasted by radio telephone to more than 35,000



Detroit News Radiophone, Employing Two 250 Watt Tubes as Oscillators, Two as Modulators, and One 50 Watt Tube as Speech Amplifier. This is Western Electric Instrument Used in Clement Test for New York, and Gives Radiation of 7 Watts.

persons scattered in a great circle whose circumference stretches from Wisconsin to northern Florida.

The broadcasting will be sent out from the Amrad Transmitting Station at Medford Hillside, Mass. In the announcement the instructors and the subjects of their lectures are listed as follows:

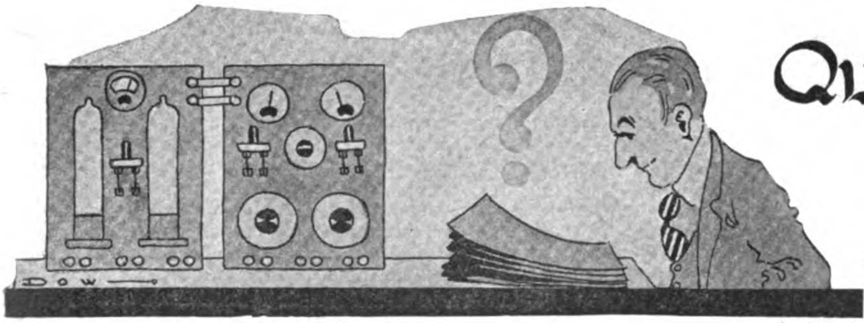
Dean Charles Earnest Fay, A. H., Litt. D. Wade, Professor of Modern Languages and Dean of the Graduate School, will give the opening and introductory address on a date next week to be announced. He will describe the lectures to be given and in general tell of the aims of the course. As a lecturer on literary and geographical subjects, Dean Fay has few equals. He has been a pioneer in the development of mountaineering in the Canadian Rockies and the Selkirks since 1900. Mount Fay in the Selkirks is named after him.

Dr. Harvey A. Wooster, Jackson Professor of Political Science and head of the Department of Economics at Tufts, will deliver the second lecture of the course on "The Story of Money."

Dean Gardner C. Anthony, A. M., Sc D. of the Engineering School, will talk on "The Story of Engineering."

The remaining speakers and the subjects which cover a wide field of human knowledge are: "Changes in Europe," by Dr. Arthur I. Andrews; "Preparedness Among Animals," by Dr. Alfred Church Lane; "The Story of Architecture," by Dr. William F. Wyatt;

Continued on page 72



Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Question: Please publish a diagram showing a receiving set with two stage amplifier, employing resistance or impedance coupling instead of transformers. Would a vernier variometer improve the operation of this set? L. L. P., Sultana, Calif.

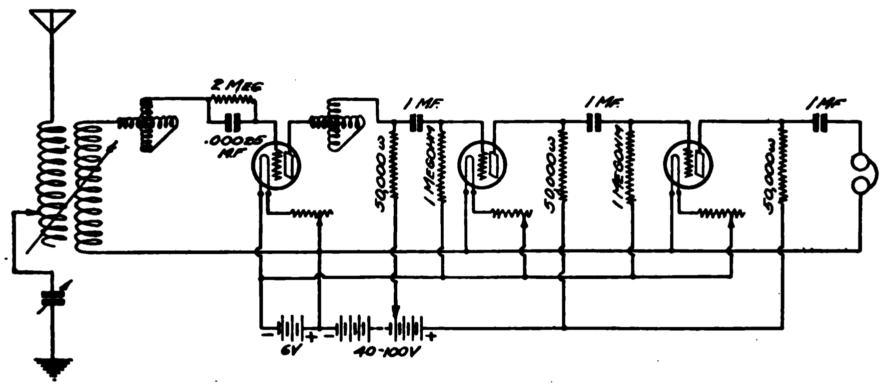


Fig. 1

Answer: The circuit requested is shown in Fig. 1. A vernier variometer would be particularly useful in tuning C. W. signals, in this sort of a receiver.

Question: Kindly give me a wiring diagram of a variometer set, 2 stages of radio fr quency amplification, and detector, all on one panel and connected so that the detector can be used alone, or with one or two amplifiers. A. L., Susanville, Calif.

Answer: The circuit requested is shown in Fig. 2.

Question: Please publish a circuit for a set using honeycombs, series parallel switch, air condensers, detector and two stage amplifier with filament control jacks. L. R., Watsonville, Calif.

Answer: With the exception of the series parallel switch, the circuit you wish was published in March RADIO on page 29. The connections to the switch are shown in Fig. 3.

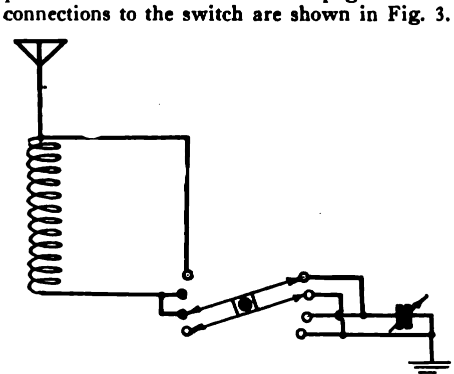


Fig. 3

Question: Can a rectifier tube or any device be used to change 110 volt 25 cycle a.c. to direct current to be used for lighting the filaments of an audion detector and amplifier tube, and how should they be used? H. S., Gilman, Wis.

Answer: Rectified a.c. for the filaments of detector or amplifier tubes is not very satisfactory, and requires the use of an expensive filter which would more than offset anything you might save by not buying a storage battery. A circuit employing a.c. for lighting the filaments of detector tubes is shown on page 52 of February RADIO.

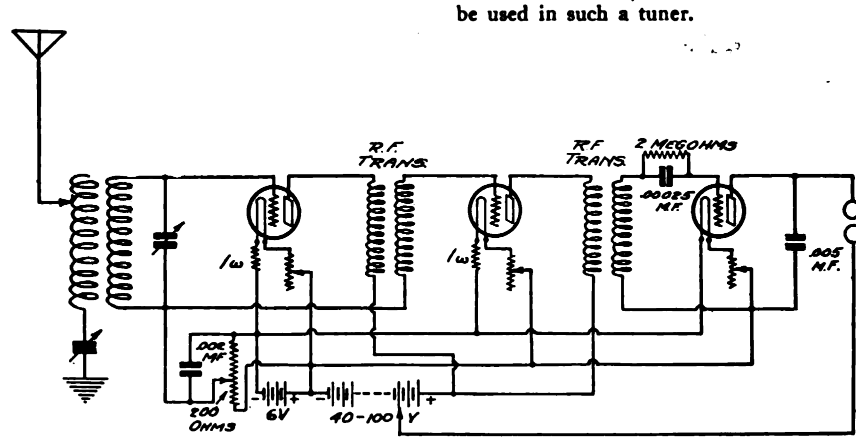


Fig. 2

Question: How do you determine the correct number of jars for rectifying a.c. for the plate of a 5 watt transmitting tube? How is the correct capacity for an antenna series condenser found? M. K., Hermosa Beach, Cal.

Answer: A 5 watt transmitting tube will not require more than 500 volts at the most; hence ten jars will be sufficient to pass that voltage without overheating. As a safe rule, use one jar for every fifty volts input. The capacity of an antenna series condenser depends entirely upon the fundamental wavelength of the antenna, and what wavelength you desire to use for transmitting. An air condenser or variable mica condenser would be the best types, as adjustments can then be made until the proper value has been obtained.

Question: Will a loading coil placed in the primary of the variocoupler of my regenerative set make the set as efficient on higher wavelengths as it is on short waves? P. C. G., Wilkinsburg, Pa.

Answer: No, not unless you can load the secondary at the same time. The most efficient circuit on any wave is one that has all of the turns in both the primary and secondary in close inductive relation to each other.

Question: Which is best for radio frequency amplification: transformer coupled or impedance coupled circuits? R. K., Palo Alto, Calif.

Answer: Both types have their good points. For a transformer coupled circuit, see Fig. 2 on this page. For an impedance coupled or resistance coupled circuit, see the recent articles on the Armstrong Super-Heterodyne, in RADIO.

Question: What is the circuit of the Remler detector panel type 330? Can this set be used with a short wave regenerative receiver? Can a variable condenser be used, and of what capacity? J. H., Menlo Park, Calif.

Answer: The circuit of the Remler No. 330 panel is given in Fig. 4. This panel can be used with any short wave regenerative set. An air condenser, or .0005 microfarads can be used in such a tuner.

Question: Please tell me how to wind the 500 and 1500 turn coils called for in I. A. Weihe's article on page 14 in February RADIO. How can a honeycomb or duolateral coil be tapped? How is the auxiliary tickler of 20 turns wound and placed in primary? B. C., San Francisco.

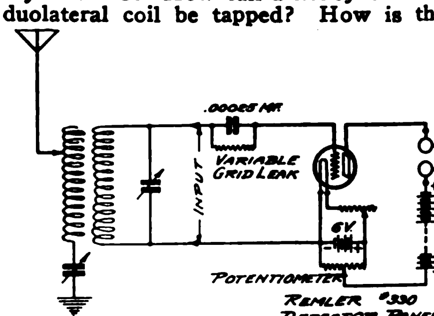


Fig. 4

Answer: Suggest that you look through the back numbers of the current radio publications,

Continued on page 78

Lawrence Mott, 6XAD, President *G. G. Griffeth, 6AA, Secretary* *H. O. de la Montanya, 6AUL, Treasurer*

The C. W. Association of America is devoted to the advancement of the theory and practice of radio communication by means of continuous waves thru the encouragement of experiment and investigation by mutual exchange of experience and assistance. It also provides a medium whereby the government can be assured a reserve personnel thoroughly trained in the radio art should national emergency require. No amateur or professional who is interested in C. W. or any other branch of radio can afford to neglect joining the club, the only organization in the United States devoted exclusively to C. W. interests.

If anyone doubts the superiority of C. W. over other methods of communication, just refer to the recent trans-Atlantic tests of the A. R. R. L., and see the large number of C. W. stations compared with the sparks that got across, and to the log of Clifford J. Dow, 6ZAC, at Wailuku, Hawaii, who is almost daily logging new mainland stations, nine-tenths of which are C. W.

The advice of the club's engineering staff is free to all members. Initiation fee is $2.50; dues, $3.00 per year. In order to start exchange of ideas and experiences with C. W., members are requested to send in a complete, detailed description of their station, including circuits and the apparatus used, together with photographs of station equipment and antenna, if they are available. Descriptions will be published in these columns for discussion only when permission is given to do so. Otherwise comments and advice will be given personally by our engineer. Address all communications to the secretary, room 22, 602 California St., San Francisco, Calif. A list of about ten DX stations worked forming a circle about your station should be included. "Worked" means two-way traffic, not just getting in to the list of calls heard. You are not getting anywhere unless you can "carry-on" with the other fellow.

For our DX test work the following members are ready to arrange a schedule with anyone who will drop them a line. Members who have a regular schedule of hours on the air, please advise the secretary.

6XAD—Lawrence Mott, Avalon, Catalina Island, Calif.
6ZAF—A. H. Babcock, Care Southern Pacific Co., San Francisco, Calif.
4JY—E. Richard Hall, St. Petersburg, Florida.
6JX—G. M. Best, 109 Greenbank Ave., Piedmont, Oakland, Calif.
6AUQ—Ralph Heintz, 653 Miramar Ave., San Francisco, Calif.
6XAQ—L. B. Benjamin, 140 South Oxford St., Los Angeles, Calif.
9ZX, 9EE—H. J. Goddard, Ellendale, North Dakota.
6ZA—Ira J. Kaar, 243 East 7th South, Salt Lake City, Utah.
6ZZ—H. L. Gooding, Box 175, Douglas, Arizona.
9ZY—Ben. A. Ott, Segelhe & Kohlhaus Mfg. Co., La Crosse, Wis.
6WZ—F. S. Wisner, 1906 Chestnut St., Berkeley, Calif.
6ZAC—Clifford J. Dow, Wailuku, Hawaii.
6AUL—R. P. MacKenzie, 1016 4th Ave., Los Angeles, Calif.
6ZE—D. B. McGown, 1247 47th Ave., San Francisco, Calif.

Mr. E. Richard Hall, 4JY, at present the most distant member for the southeast, and a prominent C. W. fan, is building a powerful C. W. set after plans of the C. W. A. A., and hopes to reach the Pacific Coast. He'll do it and we are all anxiously waiting to QSA him. Mr. Hall is president of the Wireless Club of St. Petersburg, Florida, and also City Manager for the A. R. R. L. One of the rules of the Wireless Club of St. Petersburg states: "Any member found to be operating his transmitter on a wavelength over 200 meters shall be fined $5.00 for each offense."

the C. W. Association of America is a national organization of amateurs interested in C. W. It is true that our present officers are located on the Pacific Coast, and mainly in California. This is due, however, to the fact that the C. W. A. A. is a development of the former C. W. Club of California, and that such a large majority of members were located on the Pacific Coast that the officers naturally were selected in this locality.

We sincerely hope that by the next election the membership will be equally distributed over the U. S. and the officers will naturally be chosen from the members available over the U. S. The Eastern membership is pouring in at a rate that bids fair to outnumber the West soon.

Charles Filstead, 6CU, Los Angeles, Calif., is using three 5 watters and radiates 2.4 amps on exactly 200 meters. He has handled considerable traffic, clearing 65 messages in February.

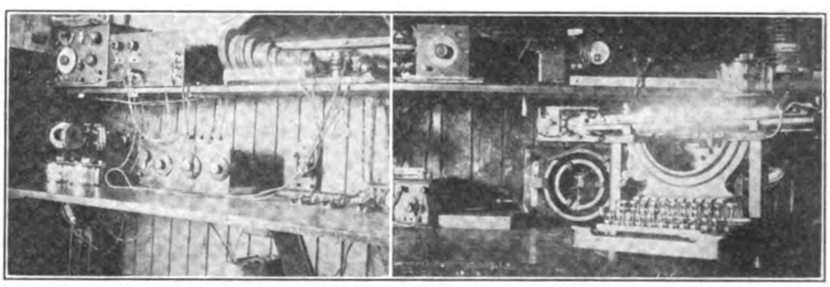
4CB—CANADIAN

Because so frequently reported in calls heard, many readers should be interested in the picture and description of 4CB, operated at Morse, Sask., Canada, by Jack E. Maynard and E. L. Maynard. With 15 watts their C. W. signals have been reported from Chicago, St. Louis, Kansas City, Tucson, Los Angeles, all along the Pacific Coast to Prince Rupert, B. C., and in all the four Western provinces of Canada. They wave worked stations in St. Paul and Minneapolis, Wichita, Kansas, Denver, San Francisco (6AWT), and Portland.

The following data are taken from their card:

My transmitter, 3 UV 202 tubes, 15 W., C. W., I. C. W. and fone, magnetic modulator. Trans. aerial 4 wire

Continued on page 78



4CB—Canadian

Charles Maass with his two 50 watters will soon be on the ether as air cop for the San Francisco Radio Club. More power to him.

O you VT'S! See the description in another column of that wonderful C. W. set of C. J. Dow, 6ZAC, soon to be on the air at Wailuku, Hawaii, designed for him by our engineers, G. M. Best and Ralph Heintz. Some of these fine nights we may expect to hear Florida and Hawaii discussing the merits of their respective rest camps for the idle rich.

The question has been brought up by a number of Eastern C. W. fans as to whether the C. W. A. A. is a national association or a California association. We wish to say most emphatically that

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

W. Wilson, Pat. No. 1,403,726; Jan. 17, 1922. Electric discharge device and operating circuits therefor.

An audion is described, having in addition to the ordinary three electrodes, a fourth one 9 which is left entirely unconnected, located between the filament 6 and the grid 8. Such an audion may be arranged by choosing the proper negative voltage impressed on grid 8, to have no space current at all; but when the potential of grid 8 is made responsive to the received signals, the space current begins and persists. This space current may be used to operate a relay 35 to ring an annunciator, while at the same time the space current carries the detected signaling current. The relay 35 is then continuously energized until a circuit is broken, for example, the input circuit.

R. W. Wilson, Pat. No. 1,403,932; Jan. 17, 1922. Electron discharge device.

In order to compensate for the contact difference of potential between the grid and filament of an ordinary audion, it has been customary prior to this invention to utilize a battery or other source of constant e.m.f. This, however, does not accurately serve its purpose because each tube may require a different value to neutralize this potential. In this patent the neutralizing potential difference is supplied by the drop across a resistance 6 in the anode circuit. The value of the space current thus determines the value of the neutralizing e.m.f. and in this way the proper regulation is effected to maintain this space current nearly constant.

Brillouin & Beauvais, Pat. No. 1,404,573; Jan. 24, 1922. Telephone installation in wireless telegraphy.

Amplification of high frequency currents is secured by a plurality of thermionic tubes. The plate circuit of each tube includes a resistance d′, d^2 etc., as well as a common plate battery b. The fluctuations of plate potential are impressed on succeeding grids, and in the last plate circuit the telephone g is substituted for the resistance. By the use of condensers f′, f^2 etc., between the plate of one tube and the grid of the succeeding tube, only the high frequency variations are transmitted to the tube. A potentiometer arrangement k-j is used for determining the mean potential of all of the grids.

L. N. Brillouin, Pat. No. 1,404,574; Jan. 24, 1922. Telephone and wireless telegraphy installation.

An arrangement similar to that of the Brillouin and Beauvais patent is described, in which resistances d′, d^2 etc., are connected in the plate circuits, the plate of each tube being connected to the grid of the succeeding tube through a condenser, such as f^2, etc. In order to produce heterodyning or at least increased amplification, the grid 100 of the first tube is in addition connected through a variable condenser 1′ with the plate of one of the succeeding tubes.

E. F. W. Alexanderson, Pat. No. 1,404,726; Jan. 31, 1922. Removing sleet from antennae.

A multiple conductor radiating antenna is described, so constructed that heating current may easily be sent through only a portion of the conductors to remove sleet; furthermore the antenna has substantially the same radiating characteristic as one in which all of the conductors are earthed at several points along the length of the antenna. Such a construction would make it difficult to supply heating currents to a part of the conductors only. However, at each grounding point, such as along the dotted line 35, only a relatively small portion of all of the conductors are earthed at 40, those not earthed being so close to those that are, that there is no loss in radiating power over the arrangement where all of them are earthed.

F. W. Dunmore, Pat. No. 1,405,905; Feb. 7, 1922. Radio receiving apparatus.

A closed coil receiving system is described, for direction finding or interference prevention. A clearer minimum point is secured by inserting a transformer 4-5-6 between the detector 7 and the coil 1, this transformer being wound with alternate secondary and primary turns on an iron core.

L. Cohen, Pat. No. 1,406,442; Feb. 14, 1922. Radio receiving system.

High selectivity in receiving is secured by providing an electrostatic coupling between the antenna coil 13, by means of condensers

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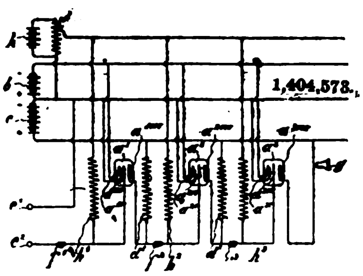
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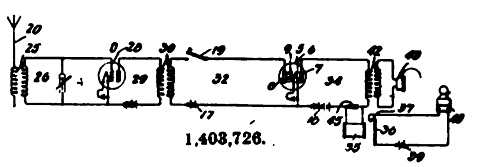
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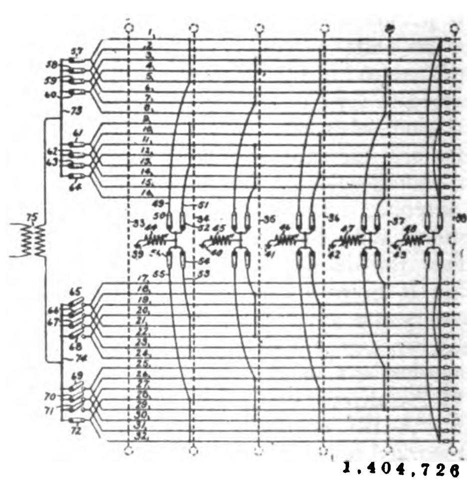
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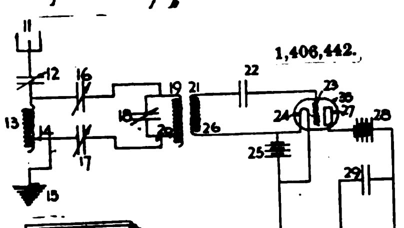
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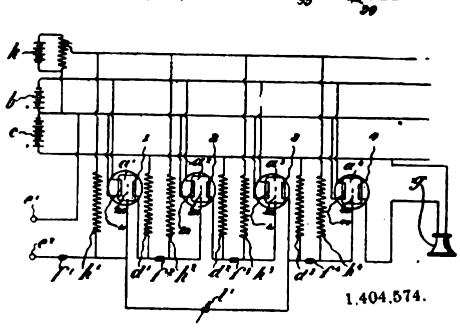
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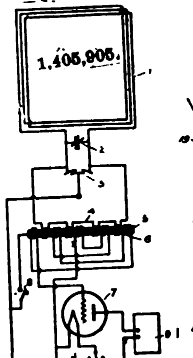
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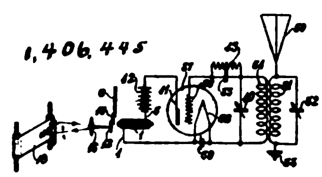
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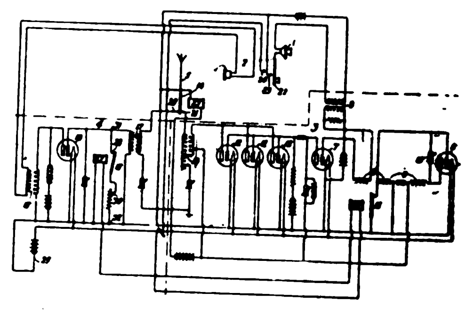
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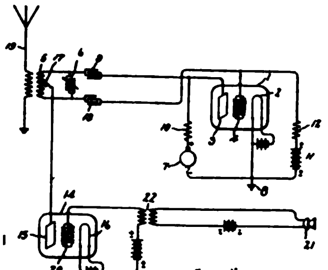
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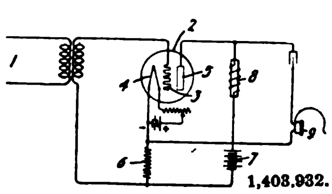
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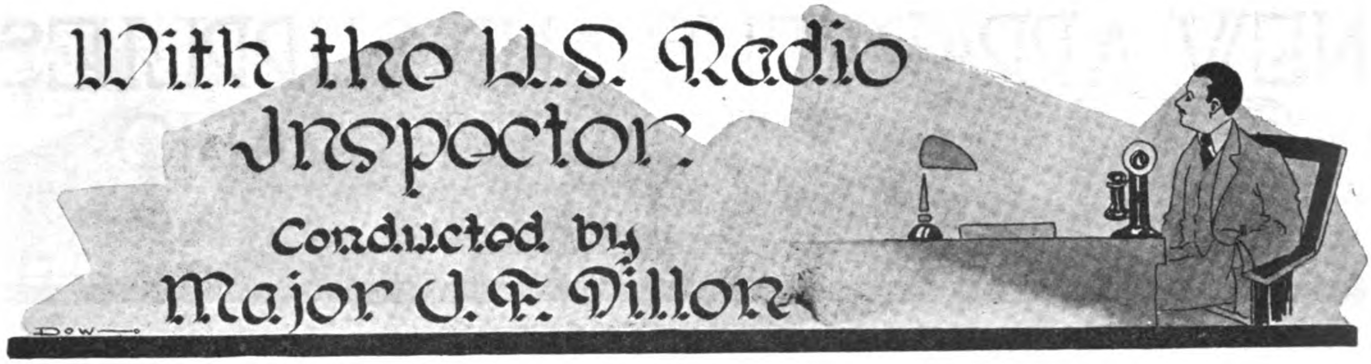


SUMMARIZED REPORT OF DEPARTMENT OF COMMERCE CONFERENCE ON RADIO TELEPHONY

Resolved, That the Conference on Radio Telephony recommend that the radio laws be amended so as to give to the Secretary of Commerce adequate legal authority for the effective control of the establishment of all radio transmitting stations except amateur, experimental and Government stations and of the operation of non-governmental radio transmitting stations. It is the sense of the Conference that radio communication is a public utility and as such should be regulated and controlled by the Federal Government in the public interest. Resolved, That the types of radio apparatus most effective in reducing interference should be made freely available to the public without restriction.

A. It is recommended that waves for radio telephony be allocated in bands according to the class of service, as follows:

Use	Wave Length, Meters	Frequency, Kilocycles per Sec.
(1) Transoceanic radio telephone experiments, non-exclusive	6,000-5,000	50. - 60.
(2) Fixed service radio telephony, non-exclusive	3,300-2,850	90.9-105.2
(3) Mobile service radio telephony, non-exclusive	2,650-2,500	113.2-120.
(4) Government broadcasting, non-exclusive	2,050-1,850	146.- 162.
(5) Fixed station radio telephony, non-exclusive	1,650-1,550	181.8-193.5
(6) Aircraft radio telephony and telegraphy, exclusive	1,550-1,500	193.5-200.
(7) Government and public broadcasting	1,500-1,050	200. -285.7
(8) Radio beacons, exclusive	1,050- 950	285.7-316.
(9) Aircraft radio telephony and telegraphy, exclusive	950- 850	316. -353.
(10) Radio compass, exclusive	850- 750	353. -400.
(11) Government and public broadcasting, 700 miles inland	750- 700	400. -428.
(12) Mobile radio telephony, non-exclusive	750- 650	400. -462.
(13) Mobile radio telegraphy, exclusive	650- 525	462. -572.
(14) Aircraft radio telephony and telegraphy, exclusive	525- 500	572. -600.
(15) Private and toll broadcasting exclusive	435- 310	690. -968.
(16) Restricted special amateur radio telegraphy, non-exclusive	310	968.
(17) City and state public safety broadcasting, exclusive	285- 275	1,052-1,091
(18) Technical and training schools (shared with amateur)	275- 200	1,091-1,500
(19) Amateur (exclusive, 150 to 200 meters) (shared with technical and training schools, 200 to 275 meters)	275- 150	1,091-2,000
(20) Reserved	below 150	above 2,000

NOTE 1. The terms used in the above schedule are defined as follows: "BROADCASTING" signifies transmission to an unlimited number of receiving stations without charge at the receiving end. It includes:

(1) *Government broadcasting* signifying broadcasting by departments of the Federal Government.

(2) *Public broadcasting* signifying broadcasting from public institutions, including state governments, political subdivisions thereof, and universities and such others as may be licensed for the purpose of disseminating informational and educational service.

(3) *Private broadcasting* signifying broadcasting by the owner of a station, as a communication company, a store, a newspaper, or such other private or public organization or person as may be licensed for the purpose of disseminating news, entertainment and other service. And

(4) *Toll broadcasting* signifying broadcasting by a public service radio telephone company as a paid service.

B. It is recommended that the Secretary of Commerce assign a specific wavelength to each radio telephone broadcasting station (except Government and amateur stations), this of course being within the band pertaining to the particular service of that station.

C. It is recommended that the wave band assigned to amateurs, 150 to 275 meters, be divided into bands according to the method of transmission, damped wave stations being assigned the band of lowest wavelengths, interrupted or modulated continuous wave radio telegraph stations the next band, radio telephone stations the next band, and finally unmodulated continuous wave radio telegraph stations the band of highest wavelengths. It is recommended that amateurs be permitted to carry on broadcasting within the wavelength band assigned by the Secretary of Commerce to amateur radio telephony.

D. It is recommended that the present regulations governing experimental stations remain in effect.

E. It is recommended that the establishment at any later date of any commercial transmitting stations having more than 1 kw. input to the antenna may, at the discretion of the Secretary of Commerce, be prohibited within 25 land miles of a Government or commercial station or in regions where congestion of radio traffic shall warrant such prohibition.

It is recommended that the Secretary of Commerce assign to each radio telephone broadcasting station a permissible power based on the normal range of the station. Government broadcasting stations, 600 (land) miles. Public broadcasting stations, 250 miles. Private and toll broadcasting stations, 50 miles.

That the same wave (or overlapping wave bands) not be assigned to stations within the following distances from one another, except that these distances may be lowered if the normal ranges of the stations are correspondingly lowered: For Government broadcasting stations, 1,500 miles. For public broadcasting stations, 750 miles. For private and toll broadcasting stations, 150 miles.

That the Secretary of Commerce cause an immediate study to be made of the best geographical distribution of broadcasting stations with the view of attaining the best service with a minimum of interference. A chart has been prepared showing an ideal distribution of broadcasting stations under various assumed conditions as to number of available wave bands and ratio of distance between stations having the same wavelength to normal range of the stations.

That in cases where congestion of radio telephone broadcasting traffic exists, or threatens to exist, the Secretary of Commerce assign suitable hours of operation to existing or proposed private and toll broadcasting stations.

That the degree of public interest attaching to a private or toll broadcasting service be considered in determining its priority in the granting of licenses, in the assignment of waves, and in the assignment of permissible power, within the general regulations for these classes of service.

That direct advertising in radio broadcasting service be not permitted and that indirect advertising be limited to a statement of the call letters of the station and of the name of the concern responsible for the matter broadcasted, subject to such regulations as the Secretary of Commerce may impose.

That the Secretary of Commerce at his discretion prohibit at any time the use of existing radio transmitting apparatus and methods which result in unnecessary interference, provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time interval is allowed for the substitution of the more satisfactory apparatus.

That the Secretary of Commerce at his discretion prohibit at any time the use of existing radio receiving apparatus which causes the radiation of energy.

1. That the status of the amateur be established in the law.

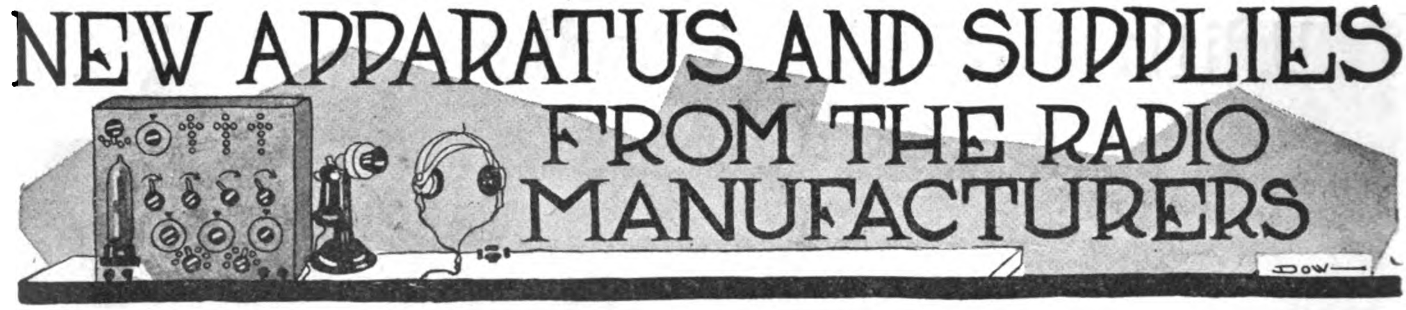
2. That the limits of the wavelength band allocated to the amateur be specified in the law.

3. That the wavelength band allocated to the amateur be from 150 to 275 meters.

4. That the Secretary of Commerce subdivide the amateur allocation into small or wavelength bands for the various classes of amateur transmitting apparatus, at his discretion, but in the following order of wavelengths, starting at the shortest wave: spark, interrupted or modulated continuous wave telegraphy, telephony, continuous wave telegraphy.

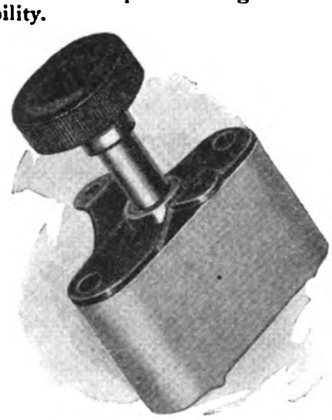
5. That the amateur continue to be under the jurisdiction of the Department of Commerce.

6. It is recommended that for the purpose of self-policing among the amateurs, amateur Deputy Radio Inspectors be created, elected from their number of the amateurs of each locality; that upon receipt of notice of such election the Radio Inspector in charge of the district in which such amateurs are located shall appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year if compensation is legally required; that the duty of such amateur Deputy Inspector shall be to endeavor to the best of his ability to accomplish, under the direction of the District Radio Inspector, observance of the Radio Communication Laws and Regulations of the United States and the observance of such local co-operative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such amateur Deputy Radio Inspectors be clothed with whatever authority may be necessary in the opinion of the District Radio Inspector.



BRADLEYSTAT FILAMENT CONTROL

For "soft" vacuum tubes the regulation of filament current must be very fine, even to the point of providing for a smooth control of the filament current without any "steps" or "jumps" when varying the current. The ordinary wire-wound coil with a slider contact has limitations because there is a decided change in resistance when the slider moves from one turn of wire to the next. This has been overcome to a degree with the vernier attachments, but the latter usually require either two adjusting knobs or a special operation in one knob that slows up the action and interferes with quick tuning for the best audibility.



Bradleystat Filament Control

The ideal rheostat is one that will give smooth variation in current with a simple one way adjustment. One way to accomplish this is by the use of a compression type rheostat. A rheostat of this nature, especially designed to meet the requirements of ½ and 1 ampere receiving detector and amplifier tubes and 5-watt power tubes, has just been placed on the market by the Allen-Bradley Company, Milwaukee, Wisconsin. It is known as the Bradleystat. A column of specially treated graphite discs, assembled in a porcelain container, form the resistance element in this new device. The resistance of the graphite discs varies with the pressure applied by an adjusting knob and pressure screw. The resistance depends only on the pressure applied to the column of discs and since the pressure can be regulated to any desired degree, the voltage on the filament and the corresponding current can be adjusted to the smallest fraction without any jumps and without any disturbing noises in the head set. There is no sudden change in the current nor no point just a little too high or a little too low. The graphite discs are assembled in two small columns in the porcelain, the pressure screw acting on the disc through a cross piece or equalizer. A small spring lifts this pressure equalizer from the discs when the pressure is relieved so that the circuit is opened and the A battery disconnected when not in use.

Since no two vacuum tubes are likely to be the same in sensibility, owing to variation in the degree of vacuum, the Bradleystat is intended for use with a single tube only. Synchronizing of several tubes is best accomplished with one rheostat for each filament circuit. Owing to the wide range in resistance obtained in a compression type rheostat, a standard Bradleystat can be used universally in receiving tube circuits or in 5-watt power tube circuits, without any change in connections or insertion of different resistance.

The enclosed graphite compression type of rheostat has been made under a patented construction by the Allen-Bradley Company for twenty years and applied to motor starting, battery charging and other current control requirements.

NEW RADIO CATALOGS

Electrose Mfg. Co. have published a broadside sheet illustrating the large line of radio parts and insulators made by them. This also gives dimensions and prices.

Standard Metal Mfg. Co., Newark, N. J., has issued a folder on their radio horns designed to fit all makes of receivers.

Essex Wireless Specialty Co., Newark, N. J., are distributing a folder showing how to use their attachment for attaching a radio receiving set to any make of phonograph and thereby receiving the benefit of the talking machine tone chamber for speech amplification.

Manhattan Electrical Supply Co. of New York City have a new folder on their No. 2500 headset.

Thordarson Electric Mfg. Co., Chicago, Ill., have issued a folder giving valuable information on C. W. transformers for filament and plate supply and on their amplifying transformer for receiving sets.

American Radio and Research Corporation's latest folder, "Wireless Telephone for the Family," attractively describes the Amrad crystal receiving set, which is designed for eventual combination with added vacuum units.

Radio Frequency Amplification is the subject of Bulletin No. 102 from the Radio Service Laboratories, Inc., Asbury Park, N. J. It gives a number of schematic circuit diagrams, with brief explanation, illustrating all desirable combinations of tubes and transformers.

Elwood Electric Co., Inc., is the new corporate name of the former Liddell Electric Mfg. Co., which has been reorganized with Clarence E. Bilton president and treasurer, and C. Edgar Bilton secretary. The plant and office of the company are at 2-4 Randall Ave., Bridgeport, Conn. The company has been manufacturing telephone equipment, binding posts, push buttons and other electrical items for seventeen years and is now producing radio head receivers and other radio apparatus.

RADIO CORPORATION ANNOUNCEMENT

By E. E. BUCHER

The Radio Corporation of America is endeavoring in every way possible to meet the unprecedented demand for radio devices. The factories of the General Electric Company and of the Westinghouse Electric & Manufacturing Company which are manufacturing such devices for the Radio Corporation of America, are now operating on a greatly expanded production program and it is expected that within the next few weeks considerable quantities of material will be shipped on orders already placed with the factories by the Radio Corporation. These will be delivered to customers as rapidly as received in the warehouse.

Distributors are requested to communicate the above information to dealers and to inform them that orders will be filled just as promptly as possible. This applies to all classes of radio apparatus for which we are accepting orders, including Radiotrons, vacuum tubes, etc., which are employed for reception.

We believe that radio broadcasting is here to stay. The great opportunities for the sale of radio devices can, in our judgment, only be properly taken advantage of if all those who are interested in distributing and selling this apparatus, properly equip themselves to handle this class of merchandise in a satisfactory way. This means that the dealer or whoever is effecting the sale to the consumer, must familiarize himself with the product, explain its capabilities as well as its limitations and lend assistance in every way toward the proper installation and maintenance of radio sets.

Those who desire radio equipment and cannot for the moment obtain it, should be informed that the present shortage is but temporary and due entirely to the great demand which suddenly came as a result of broadcasting, and that the Radio Corporation and its associates, the General Electric Company and the Westinghouse Electric & Mfg. Company, are doing everything in their power to produce the necessary apparatus with maximum speed; that normal production is expected to begin within the next few weeks and that deliveries will then be promptly made.

A new catalog covering all of the radio devices being manufactured for the Radio Corporation of America by the General Electric Company and the Westinghouse Electric & Mfg. Company, is now in course of preparation. This catalog will contain information of value to the wholesale distributor, the retail dealer, and the ultimate user of radio apparatus.

ANTENNA WIRE INFORMATION

Radio frequency currents, when conducted by wires at the sending and receiving stations, travel through a thin layer of metal along the exterior of the wires because of the phenomena known as "skin effect." The loss of radio energy in the wires depends on the electrical conducting properties of this exterior layer of metal.

Pure copper is the most efficient commercial metal, insofar as electrical conducting properties are concerned, but lack sufficient strength for a great many purposes. The objection to bronze is because of its poor electrical conductivity—approximately two-fifths as much as copper. Much more radio energy is lost in bronze wire than in copper of equal size.

LET US KNOW What you want to Know about Radio

Do you want—

	Yes	No
Radiotorial Comment on General Conditions?		
Illustrated descriptions of noteworthy installations?		
Latest news on radio development?		
Design and construction of C. W. transmitters?		
Practical construction of tested equipment?		
Simple explanation of radio phenomena?		
Technical articles with mathematics?		
Imaginative fiction of improbable facts?		
Radio fiction with a kick?		
Radio humor, cartoons and verse?		
Queries and Replies on C. W. Practice?		
Pictures and descriptions of receiving stations?		
Digest of Recent Radio Patents?		
The Radio Inspector's Department?		
List of Calls Heard?		
A study course in the elements of electricity?		
News of the broadcasting stations?		
Who's Who in Radio?		
News from the radio manufacturers?		
News of the radio clubs?		

What other kind of information do you want?______________________

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Help yourself and your fellow readers by checking the above and mailing it to us. Every reader of "RADIO" is invited to send us the questionnaire.

Special Announcement!

The Next Issue of "RADIO" WILL CONTAIN—

100 PAGES

The June issue of RADIO will be the banner number in the history of the publication. It will contain one hundred pages of the best radio material that has ever been brought to you through the printed page. Future issues will contain one hundred pages or more. Through your co-operation by filling in and sending us the questionnaire that appears on this page we will know just what kind of radio information you are looking for *and we will give you that information.* It makes no difference whether you are a subscriber or buy your copy on the news-stand. Send in the questionnaire in order that the future policy of RADIO may be guided by your action.

The cost of publishing a magazine of one hundred pages is far in excess of the cost of the publication in its present form. Due to the high quality of material that will be published, the extra cost of paper, printing, mailing, etc., the price of single copies will be increased to 25 cents, effective with the June issue. Subscription rates will be increased to $2.50 per year.

You can still subscribe at the $2.00 per year rate—provided that your subscription reaches us by June 30th. We want to give our readers a chance to subscribe at the prevailing rate. News-stand buyers will save one dollar a year on this offer. This is a worth-while saving and it gives you the guarantee of monthly receipt of the magazine. News-stand sales have been unusually heavy of late and many have been unable to secure copies one day after the supply was received by the stands.

Save a dollar!

Take no chance of missing a single issue of the new, big RADIO. Subscribe today at the $2.00 rate. We will start your subscription with the June number, which will be ready for the mails on May 23rd.

Remember that RADIO leads all others in giving you first-hand information. You will find its constructional material to be the best available and nothing misleading appears between the four covers of RADIO. Clip the coupon—drop it in the mail box today.

Do it NOW

COUPON

RADIO,
465 Pacific Bldg.,
San Francisco, Cal.

Herewith is $2.00 for which you will send "RADIO" for one year to:

Name ....

Address ....

....

BROADCASTING OVER ELECTRIC LIGHT CIRCUITS

By CARL H. BUTMAN

Local radio telephone broadcasting by means of "wired-wireless" on an ordinary electric light circuit was demonstrated in the office of the chief signal officer of the army on Friday, March 24, for the first time before officers of the corps, scientists and representatives of the press.

As the air is left clear for long distance communications, this new development in radio is believed by experts to promise great utility by relieving the congestion in the ether due to the great number of broadcasting stations. By purchasing an ordinary short wave radio receiving set anyone who is fortunate enough to have a direct current electric lighting system in his house, is within reach of entertainment, locally at least.

The demonstration included the receiving of news, music, and talks from a distant room in the Munitions Building, where a radio telephone transmitter (S.C.R. 67) was connected through an ordinary light socket to the lighting circuit of the building. Music from a phonograph was transmitted to the 110 volt d.c. electric line through a standard microphone such as was developed during the war for aviators.

In General Squier's office a standard Westinghouse short wave radio receiver was connected with the lamp socket on his desk, and by pulling the cord, he started and stopped the music. No head pieces and no extra wiring or antenna were used, the sound coming from a loud-speaker near the set on the wall.

With receiving sets of similar type the entertainment could have been heard in any room of the great building, but not outside, as the wire was a private lighting circuit for the building. In a small town, or a large city with a single lighting system, anyone with a receiver could plug in and get the news of the town, the entertainment, etc., sent out by a central station.

All the work necessary to install the apparatus was to bring in the receiving apparatus, connect to ground, hang up the horn, and screw an ordinary plug into the light fixture, much the same as an electrical flat iron or toaster is connected. "Every home or every room in a hotel where there is an electric lamp can now keep in touch with the world," General Squier said. "The main feature about it is the fact that it permits local broadcasting without paying the penalty of broadcasting in space from the usual antenna, which has resulted already in so much confusion," he continued. There is no interference, no fading, and weather does not affect the broadcasting by the new method.

The process is based upon General Squier's invention of "line radio" or "wired-wireless," perfected some time ago, which permits the use of a wire as a guide, but the messages are transmitted on radio waves which follow the wire. The turning of the switch breaks the circuit and the sound ceases.

Future uses for the new invention which the General has made public, suggest that a hotel can supply all its guests with music, from a sending station in the basement, a phonograph salesman can demonstrate his new records to everyone in town by putting them on the light circuit, one orchestra can furnish music for the local playhouses and movies, invalids at home or in hospitals can get the news and such entertainment as is furnished locally, even advertising could be sent out to every citizen in town by agents and stores.

THE NAVY'S NEW RADIO REPAIR SHIP "GOLD STAR"

To supply, repair and keep in touch with its eight radio traffic and two compass stations in Alaska, the Navy Department has just designed and commissioned a special vessel as a radio repair ship. Its name is the *"Gold Star,"* in commemoration of the "Gold Star" mothers of the World War, and she is equipped with all kinds of radio equipment, spare parts and a crew of expert repair men and artificers capable of erecting a large radio station or repairing a small receiving set.

A former Shipping Board vessel of the "B" type, the *Gold Star* has just been remodeled at the Philadelphia yard and equipped for her work which will carry her north in the Pacific nearly to the Arctic Circle. She is an 11 knot vessel of 7420 tons, 377 feet long, and will carry a complement of 300 officers and men, under command of Lt. Commander J. C. Katterfield, who commanded the *Saturn,* an old ship which the *Gold Star* will relieve. On March 18, the *Gold Star* started on her cruise to Hampton Roads, from which port she will leave April 10 for the Pacific Coast.

At present the traffic stations operated by the Navy in Alaska comprise St. George, St. Paul, Dutch Harbor, Kodiak, Seward, Cordova, Juneau and Ketchikan, but compass stations are also maintained at Cape Hinchinbrook and Soapstone Point. During the war these stations intercepted enemy messages, communicated with our forces, and formed part of the chain of communication in Alaska and adjacent waters. The Transpacific circuit via Cordova and St. Paul formed an important line of naval communication service during the recent Arms Conference, and aided in the furtherance of governmental and commercial interests in Alaska, besides serving as a relief in the event of a break in the army cable.

As these stations are most difficult to reach, but few commercial vessels touch there, especially from October to April, and because of the need for supplies and frequent change in personnel, the Navy has decided to have its own radio station tender and repair ship. The failure of radio equipment and material must be replaced immediately and kept in condition for constant use through the long winter months, necessitating frequent trips of a supply ship. Having tried commercial means of transportation with unsatisfactory results and with great expense the Navy has now assigned a ship to this special duty to succeed the old *Saturn,* built in 1898 and listed as a fleet tender.

The radio garter is an invention of Walter P. Miller of the Seattle Post-Intelligencer, whereby the girl reporter can listen in to the radiophone broadcasting at any time. With an aerial concealed in her hat, a "ground" attached to her shoe and a receiver hooked on her hat over her ear milady need never be at a loss for radio entertainment. This crystal set is made by winding wire on a piece of stiff cardboard covered with silk to give the appearance of a garter. Attached to this are two ordinary eyeglass snap chains, one of which held under the foot makes a ground for the current, the other fastened to the coil of wire arranged in the hat forms the aerial. A small bottle with the crystal in it and a telephone receiver complete the novel invention.

NEW YORK RADIO SHOW

As a spectacular exhibit of public interest in radio, the show held in the Hotel Pennsylvania, New York City, during the week ending March 11th, was a success. It is estimated that 38,000 people attended the show and thousands more were unable to gain admittance.

Public interest centered on a miniature torpedo whose movements were controlled by radio, this being exhibited by E. F. Glavin. Another attraction was the Lyraudion concert grande, which poured forth from its husky throat an appalling volume of sound amplified from the feeble, music-laden currents received from the broadcasting stations.

The fifty exhibitors showed radio receiving equipment of all kinds from the tiniest of crystal receivers to the elaborately housed and finished tube sets. The new "batteryless," "grid-leakless" vacuum tubes excited great interest, as did also a small attachment enabling any phonograph to be used instead of the usual type of loud speaking horn.

The Signal Corps of the U. S. Army had an exhibit which attracted many visitors. Various loud speaking devices were much in evidence, but in the words of one observer, "if the show proved one thing, it certainly proved the need for better instruments of this sort."

A number of lectures were given during the show, including a paper on "Vacuum Tubes and Their Operation," by W. C. White of the General Electric Co., and on account of the A. A. R. L. Trans-atlantic test by Paul F. Godley. A very unique and remarkably enlightening moving picture produced at great expense by the Western Electric Company made plain to all who saw it just exactly "what happens in a vacuum tube."

The show was held under the direction of the Executive Radio Council, Second District, made up of two delegates from each of the clubs in and around New York, being the second annual convention and exhibit of the Council. A radio ball and banquet was a part of the program.

Radio waves are merely a very long form of light waves. The difference in length of radio waves corresponds to the difference in color of light rays. But whereas light waves vary from about one-two-millionth of an inch for violet up to one-millionth of an inch in length for red, the other colors of the rainbow each being of an intermediate length, radio waves vary from 200 meters or less in length for the amateur station up to 30,000 meters for the long-distance commercial or government stations. The observer's eye might be said to be "tuned" to green light if he wore a pair of spectacles allowing only green light to pass, much as a receiving aerial is "tuned" to 360 meter radio waves.

Communication with moving trains has been successfully demonstrated in France. From a compartment equipped with radio transmitting and receiving equipment radio telephone conversation has been maintained with a fixed station 34 miles distant.

Roswell, N. Mex., April 5, 1922.

Editor RADIO—Dear Sir:

On March 28 the Pecos Valley Radio Society was organized with eleven radio fans present. Mr. Louis Falconi was elected president of the society. (Mr. Falconi is owner and operator of 5ZA.) L. F. Woodhead was elected treasurer, C. L. Sanders elected secretary. Arden Boellner and Capt. C. A. Flannery were elected to serve on the executive committee with the president, secretary and treasurer. L. B. Merchant appointed publicity committee.

The society meets the second and fourth Tuesdays in every month, and has made application for affiliation with the A. R. R. L. and hopes to be affiliated with other radio clubs, etc.

Code practice will be a feature during the summer when static prevents ether activities, and by fall we hope to have a number of stations capable of doing good work.

In one week we have taken in fifteen new members and from the interest shown we will have a goodly number and we are endeavoring to be the pioneers in this territory.

Yours very truly for the advancement of radio,

PECOS VALLEY RADIO SOCIETY,
Box 16, Roswell, N. M.
C. L. SANDERS, Sec.,

CALLS HEARD

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY KENNETH PATON, CASHMERE, WASHINGTON

6abw, 6qr, 6cv, 6zx, 6abx, 6zr, 6atj, 6qt, 6xm, 6jd, 6qg, 6amk, 6aru, 6arf, 6aid, 6di, 6agf, 6aix, 6re, 6ix, 6aji, 6sj, 6agr, 6atq, 6ird, 7bk, 7zm, 7kj, 7ck, 7mu, 7ca, 7hf, 7bj, 7zt, 7ya, 7ys, 7cd, 7zu, 7gt, 7yg, 7yl, 7nn, 7bc, 7zu, 7tj, 7mp, 7ly, 7bh, 7mf, 7bx, 7vo, 7zk, 7zj, 7jd, 7cn, 7id, 7iw, 7rt, 7bj, 7xc, 7nz, 7wg, 7hm, 7zv, 7nw, 7cu, 7vz, 7by, 7ot, 7hw, 7it, 7zp, cl8.

Canadian—9ax, 9bd.

C. W., phone and I. C. W.—6xad, 6xg, 6afi, 6aat, 6aif, 6xaf, 6aru, 6atq, 7aag, 7ma, 7ya, 7xf, 7yn, 7cf, 7nf, 7ln, cl8, 9dth, 9aua, 9wd, 9dtm. 9db, 9awp, 9zaf, 9zl, 9bbf, 9pd, 9wu, 9bji, 9zcl, cv5, klp, kfc, kwg, kvq, kdn.

BY A. E. WOOD, WATSONVILLE, CALIF., BETWEEN JAN. 1 AND FEB. 1, ON A ONE WIRE AERIAL, ONE BULB, AND HONEYCOMBS

Spark—5if, 6ar, 6ak, 6ag, 6cp, 6ea, 6ec, 6lr, 6od, 6oh, 6pq, 6pr, 6qr, 6qx, 6sj, 6zb, 6zr, 6zx, 6aah, 6aau, 6abm, 6acr, 6adm, 6adv, 6aix, 6agf, 6ald, 6amk, 6amn, 6akl, 6asf, 6atg, 6aws, 6bak, 6bar, 6xaf, 7bj, 7kk, 7mf, 7ot, 7qr, 9nr.

C. W.—6cf, 6en, 6zq, 6za, 6aif, 6xac, 6xg, 6wv. 6xw, kzm, kzy, kwz, jjj (Radio Shop), 6xak, 7xf, 9nx, 9zl, 9bd, 9bj, 9dva.

AT 6AMZ, SAN MATEO, CAL.

Spark—5hk, 6cf, 6da, 6ea, 6eb, 6eh, 6en, 6fh, 6fk, 6gf, 6gk, 6gt, 6gx, 6ii, 6is, 6iv, 6ji, 6jy, 6ka, 6kc, 6km, 6ks, 6lc, 6mh, 6od, 6ol, 6ot, 6st, 6tf, 6to, 6wc, 6wg, 6zr, 6zz, 6zal, 6zam, 6aah, 6aak, 6aau, 6abm, 6abw, 6abx, 6acr, 6acy, 6adl, 6aei, 6afn, 6agf, 6agp, 6ahp, 6ahq, 6aib, 6aif, 6aio, 6aix, 6aiy, 6ajh, 6ajr, 6akl, 6ald, 6alp, 6alr, 6alu, 6amn, 6aoe, 6aoz, 6ark, 6ath, 6atz, 6auc, 6avr, 6awh, 6bcj, 6bgu, 6biu, 7bc, 7bh, 7bj, 7bk, 7cn, 7cp, 7fi, 7gt, 7hf, 7in, 7jd, 7jw, 7kb, 7jk, 7mf, 7mp, 7myk, 7nf, 7nn, 7nz, 7tj, 7to, 7wg, 7zj, 7zm, 7zn, 7zp, 7zt, 7zu, 7zv, 7yg, 7ya, 7yj, 7yl, 7ys, 8yn, 9yae-Can., 9ax, 9bd, cl8.

C. W.—Can. 4cb, 9bd, 5fv, 5za, 6cu, 6en, 6gd, 6jd, 6jj, 6ka, 6rr, 6wv, 6xd, 6xad, 6xaq, 6aat, 6aif, 6alu, 6atg, 6za, 6zb, 6zf, 6zz, 6zad, 6asv, 6bir, 7ln, 7nn, 7qt, 8box, 9kp, 9nx, 9wd, 9wu, 9amb, 9dva, 9zaf, cl3, cl8.

Heard on one tube and short wave set; January and February. Anyone hearing 6amz C. W., pse qsl.

AT 7KP, SEATTLE, ONE TUBE

Spark—5hk, 6agf, 6ain, 6aix, 6ajh, 6ajr, 6amk, 6ark, 6avr, 6bip, 6bm, 6cp, 6dm, 6ex, 6fh, 6gr, 6km, 6le, 6mh, 6qr, 6to, 6tu, 6vw, 6vx, 6wm, 6zam, 6zx, 7abp, 7cn, 7ed, 7mp, 7tj, 7vz, 7zt, 7zu; Can. 9bd.

C. W.—2fp, 4bq, 5fo, 5qa, 5za, 6aat, 6aau, 6aif, 6alu, 6awt, 6dr, 6en, 6gy, 6hc, 6ka, 6ky, 6rr, 6xad, 6za, 6zad, 6zf, 6zs, 7aav, 7hw, 7ln, 7nf, 7ot, 7tq, 7we, 8agz, 8bk, 8xv, 9ays, 9bsg, 9kp, 9ps, 9wd, 9zac, bf2, cl8; Can. 4bt, 4cb, 5bi, 9bd.

BY 7TT, PORTLAND, OREGON

Canadian—4cb(cw), 9ax. Spark—6ex, 6hc, 6km, 6lc, 6pj, 6qr, 6tu, 6tv, 6vx, 6aad, 6abx, 6agf, 6aix, 6ark, 6zk, 6zm, 6zr, 6zx, 6zaj, 6zam, 7bh, 7ce, 7dg, 7go, 7hh, 7iu, 7ku, 7jd, 7mp, 7nn, 7ot, 7qi, 7rg, 7wt, 7xa, 7xd, 7ya, 7vh, 7yj, 7zm.

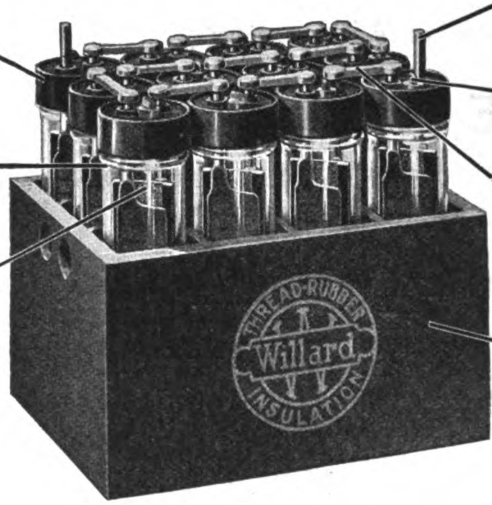
C. W.—5za, 6ad, 6gy, 6jj, 6aat, 6aif, 6xad, 6zaf, 7ad, 7uz, 9amb, 9zaf.

BY 9EA, DULUTH, MINNESOTA

C. W.—3aqr, 3bec, 3fs, 4bq, 4ft, 5uu, 8agz, (8aim), 8ajv, 8aqf, 8axk, 8bcx, 8bk, 8box, 8bxh, 8caz, 8ea, (8lv), 8jl, 8js, 8ju, 8ni, 8vy, 9ark, 9aja, (9ajp), 9akb, (9akr), 9als, 9anf, 9as, 9aua, 9awm, 9ayh, 9ays, 9bca, 9bbf, 9bcd, 9bi, 9bji, 9bjv, 9bsg, 9dfg, 9dv, 9dyn, 9fm, 9hk, 9io, 9kp, 9nx, 9ps, (9qe), 9sj, 9wk, 9xaq, 9xi, 9zac, 9ze, 9zl.

Spark—5hk, 8axy, 8eb, 8xh, 9aaw, 9aeg, (9aig), 9aka, 9ama, 9aou, 9arx, 9asn, 9avz, 9axu, 9ayn, 9ayw, 9da, 9dfx, 9ka, 9dpb, 9hi, 9hm, 9hr, 9jaa, 9jn, 9lw, 9me, 9nr, 9am, 9at, 9ze, 9zx.

A Real Radio "B"
24-Volt
Storage Battery



Built especially for radio reception—to bring in voice, music and signals, louder, clearer and with greatest reliability. Rechargeable—will last for years. Made up of 12 individual 2-volt cells in tubular glass jars. Separate cells are easily added to increase voltage. Threaded Rubber Insulation and leak-proof glass jars eliminate all frying and hissing noises.

Ask about the Radio "A" Battery of the special Willard All-Rubber Radio Type. Eliminates all ground noises. One piece rubber case. Threaded Rubber Insulation. Absolutely leak-proof.

WILLARD STORAGE BATTERY COMPANY, CLEVELAND, OHIO

Made in Canada by the Willard Storage Battery Company of Canada, Limited, Toronto, Ontario

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Willard

THREADED RUBBER BATTERY

CALLS HEARD

BY 3GG (CANADIAN), M. J. CAVENEY, TIMMINS, NORTHERN ONTARIO, CANADA

1awb, 1ary, 1ayw, 1bdi, 1bua, 1bwy, 1io, 1mx, 1ts, 1xm, 2aab, 2bak, 2bej, 2btj, 2bfx, 2cbg, 2fp, 2ql, 2ts, 2va, 4id, 4ft, 5uu, 5fv, 8asb, 8aim, 8awy, 8axk, 8aqh, 8apt, 8alv, 8auo, 8aiz, 8bu, 8bfx, 8bbk, 8bef, 8buq, 8bzy, 8bdo, 8box, 8bk, 8cp, 8cbr, 8cgm, 8ea, 8fa, 8hj, 8kp, 8ni, 8px, 8rh, 8sp, 8tk, 8uk, 8uc, 8vy, 8yv, 8zg, 9aiv, 9af, 9akf, 9agr, 9ajb, 9aav, 9atm, 9ay, 9bed, 9bjv, 9dbq, 9dfx, 9dv, 9dzq, 9dnt, 9dzy, 9dwp, 9dkv, 9dxt, 9ea, 9gk, 9io, 9iv, 9kp, 9lw, 9le, 9ol, 9qe, 9tv, 9ul, 9vl, 9wk, 9yq, 9yak, 9yo, 9yb, 9yc,

Phones—kdka, kyw, wjz, wdy, nsf, 2xj.

BY 6CU, CHARLES F. FILSTEAD, 2010 6TH AVE., LOS ANGELES, CALIF.

Spark—5mj, 5xd, 5xu, 6aah, 6aau, 6abh, 6abw, 6abx, 6acl, 6acr, 6ada, 6aeh, 6afn, 6afp, 6afr, 6ag, (6agf), 6agk, 6ah, (6ahf), 6ain, 6ajf, 6ajh, 6ajr, 6alv, 6amk, 6ang, 6anh, 6aor, 6app, 6ark, 6as, 6ask, 6asv, 6ath, 6atq, 6auc, 6aud, 6avb, 6awx, 6bca, 6ben, 6bft, 6bhq, 6biu, (6cp), 6ex, 6fh, 6gr, 6gt, 6gx, (6hc), 6km, 6mz, 6ng, 6oh, 6ot, 6po, 6pr, 6qk, 6qr, 6sj, 6to, 6tu, 6tv, 6uo, 6vk, 6vx, 6vz, 6wz, 6zam, 6zb, 6zk, 6zu, (6zx), 6zz, 7bh, 7bj, 7bk, 7ck, 7hf, 7in, 7jd, 7ly, 7mf, 7mp, 7oh, 7ot, 7tj, 7vo, 7ya, 7yg, 7yj, 7za, 7zj, 7zm, 7zq, 7zt, 7zu, 7zv, 9dsd, cl8.

C. W.—4ft 5ak, 5za, (6aat), 6ak, 6ale, 6aoz, (6asj), (6asv), (6awt), 6awv, (6gy), (6hc), 6jj, 6lr, (6oo), (6pt), 6to, 6vm, 6xaf, 6xh, 6za, (6zb), 6zf, (6zz), 7nf, 7qt, 7tq, 7we, 7xf, 8agz, 8xv, 8zp, 9aja, 9amb, 9ays, 9bji, 9db, 9dth, 9dtm, 9dva, 9ji, 9nx, 9ps, 9wd, 9wu, 9xaq, 9zac, (9zaf), kzy, nof, cl8, Can. 9bd.

These stations were worked on three 5 watt tubes radiating 2.4 on exactly 200 meters. Jan. 28th when radiating .8 amp. on one 5 watter was heard by 9aig, Sioux Falls, S. D., on detector alone. Distance is 1330 miles. Cards will be appreciated and promptly answered.

HEARD AT 7CV, VANCOUVER, WASH., S. HOBERT, 815 COLUMBIA ST.

Spark—Can. 5ak, 9ax, 9bd, 5za, 6cp, 6ec, 6ex, 6gi, 6gr, 6hc, 6ol, 6tu, 6vx, 6zu, 6asv, 6aei, 6agf, 6ajh, 6ajr, 6amf, 6amk, 6aph, 6ark, 6atu, 6avd, 6zam, 6awi, 7at, 7bc, 7ej, 7ju, 7ly, 7mp, 7mu, 7nw, 7om, 7ot, 7ub, 7ut, 7vx, 7vz, 7wm, 7ya, 7zu, 7aad.

C. W.—Can. 4cb, 6en, 6gy, 6ka, 6rr, 6zf, 6afi, 6aif, 6alu, 6bcd, 6xad, 7il, 7rn, 9wu.

HEARD BY 6EA, H. C. SEEFRED, 343 SOUTH FREMONT AVE., LOS ANGELES, CAL.

C. W and I. C. W.—2fp, 5za, (6ak) (voice), (6ax), (6gy), (6jx), 6nx, 6pk, 6vm, 6aat, 6arb, (6asx) (buzzer and voice), 6aul, 6awt, 6bcd, 6za, 6ze, 6zx, 6zz, 6xaf, 6zad, 6zaf, 7dp, (7ln), (7xf) (chopper and voice), (7xg) (chopper and voice), 8xv, 9amb, 9bji, 9dtm, (9dva), 9wd, 9xm, (9zaf) (voice), cl8, wv6 (voice). Best 5 watt I. C. W. "QSO" was with 7xg and 9dva (850 miles).

Spark—5xd, (5xu), 5za, (6ah), (6ak), (6as), 6cp, (6ex), 6fh, (6gf), (6gr), 6gx, 6hc, 6ib, 6ic, 6im, 6km, (6lu), 6oc, 6oh, 6pj, (6pr), (6qr), (6qs), 6st, 6tu, (6tv, Ariz.), 6vk, (6vx), 6wg, 6wz, 6aaa, 6aau, 6abk, 6abw, 6abx, 6acr, 6aei, 6afd, 6afp, (6agf), 6ain, 6ajf, 6ajr, 6ala, (6alv), 6amk, 6ang, 6aor, (6ark), (6avb), 6xh, 6zd, 6ze, 6zk, (6zx), (6zz), (6zam), 7bk, 7gj, 7iw, 7jd, 7jw, 7kb, 7mf, (7tj), 7ya, 7yg, 7zj, 7zm, 7zp, 7zt, 7zu, (cl8). Best spark "QSO" was with 5xu (1,230 miles). Best spark reported heard was by Mr. W. D. Van Dyke at Chattanooga, Tenn. (1,915 miles).

BY 6AHR, 659 CLAYTON ST., SAN FRANCISCO, CALIF., ON ONE TUBE

6cj, 6cu, 6cw, 6da, 6eb, 6gt, 6hy, 6jy, 6kc, 6kp, 6nl, 6ol, 6uw, 6zu, 6zz, 6aak, 6aau, 6aic, 6aif, 6aio, 6aiv, 6ajh, 6ale, 6alu, 6ame, 6ano, 6ape, 6asr, 6asv, 6aud, 6aug, 7in, 7yg, 7zt. Would like to hear from anyone who has heard my C. W.

BY 6EB, L. F. SEEFRED, 343 SO FREMONT AVE., LOS ANGELES, CALIF.

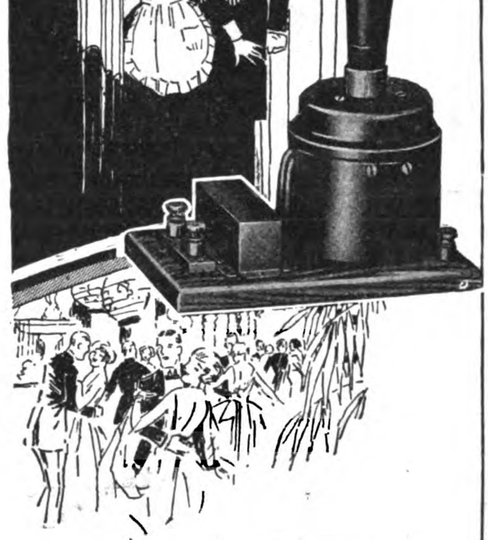
C. W.—4bq, 5za, 6gy, 6jq, 6km, 6nx, 6za, 6zf, 6zx, 6zz, 6aat, (6asx, voice and buzzer), 6awt, (6bcd), 6xaf, 6zad, 6zaf, 7dp, 7nf, 7xf, 8xv, 9ayu, 9bex, 9dth, 9nx, 9wd, 9zac, 9zaf voice also, wv6 music.

Spark—5xd, 5xu, 6aaa, 6aah, 6aau, 6abm, 6abw, 6abx, 6aei, 6afn, 6afy, (6agf), 6ain, 6ajr, 6ala, 6alv, 6amk, 6ark, 6aou, 6ape, 6bak, 6bip, 6zae, 6as, 6bb, 6co, 6cp, (6ex), 6fh, 6gf, (6gr), 6gx, 6hc, 6hp, 6ib, (6ic), 6ik, 6km, 6oc, 6op, 6po, 6qr, (6rs Ariz. now), 6tu, 6tv Ariz. now., 6vk, 6vx, 6wg, 6wz, (6xh), (6zi), 6ze, 6zk, 6zx, 7gj, 7iw, 7jd, 7kb, 7ot, (7tj), 7to, 7ya, 7zj, 7zm, 7zp, 7zt, 7zu.

My 5 watt I. C. W. using 550 v. on anode was reported heard by 9bd, Vancouver, B. C., approximately 1200 miles.

Radio brings it
MAGNAVOX tells it

The Magnavox Radio, constructed on the *electro-dynamic* principle (with movable coil)—the most sensitive and also powerful converter of electrical energy into sound waves.



TO enjoy the fullest possible service and value from your receiving set, equip it with a Magnavox Radio—the *scientifically correct* reproducer. Comparative tests by experts and amateurs alike have established Magnavox Radio as the world's standard loud-speaker.

Concert and dance music, speeches, songs—Magnavox Radio amplifies them all in volume and marvelous clarity, multiplying many times the use you now get from your wireless. The hookup is simple, and no extras or adjustments are required.

No wireless receiving set is complete without the Magnavox Radio. Any dealer will demonstrate for you, or write us for descriptive booklet and name of nearest dealer.

THE MAGNAVOX COMPANY
Oakland, California
New York Office: 370 Seventh Avenue, Penn Terminal Bldg.

The Magnavox Power Amplifiers insure getting the largest possible power input for your Magnavox Radio. Can be used with any "B" battery voltage up to 1,000.

2 and 3 stage

MAGNAVOX Radio

CALLS HEARD

8AGZ, EAST CLEVELAND, OHIO

Has been in operation since Jan. 11, 1922, and has been reported by the following:

6aoi, 6rr, 6aif, 6atg, 6abw, 6alp, 6agh, 6aqp, 7kp, 6xaq, 6xad, 6iv, 6ajr, 6agf, 6ak, 6cu, 6arf, 7yj, 6awp, 6zz, 6ky, 6en, 6oh, 6aj, 6are, 6hy, 7mp, 6bcr, 6awt, 6aju, 6ka, 6gy, 6ame, 6atf, 6lc, 7zu, 9bd and 5cn, Vancouver, British Columbia; Mr. Riople, Hollywood, California; Mr. Bridges, Loleta, California; U. S. S. Kanawha; Mr. Wheatstone, Long Beach, California.

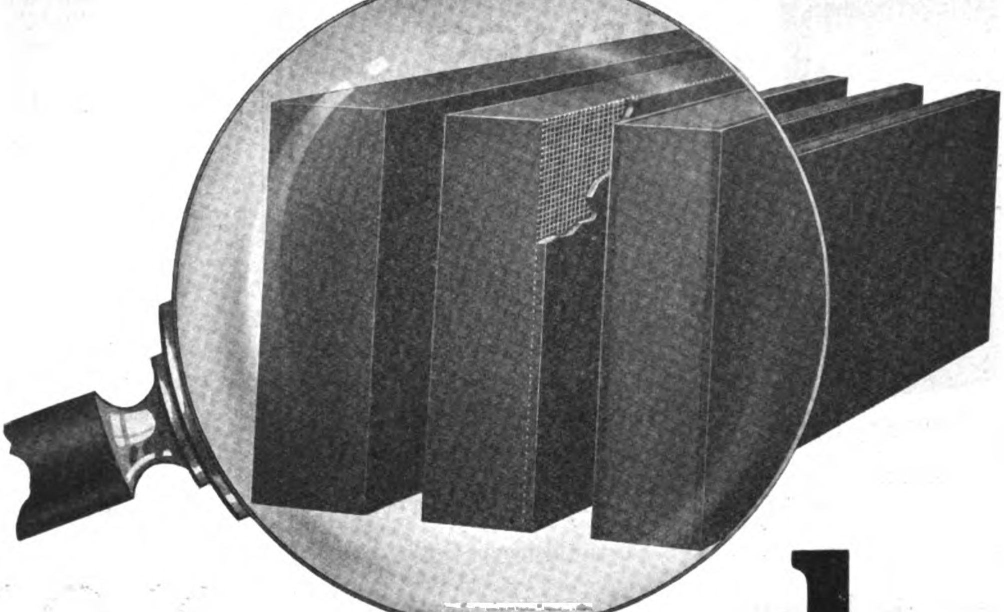
The record made by this radio 'fone set is about 1000 miles, made in tests to several stations such as 9nx, 9ps, 9nk, 4ii, and 4co.

One thousand volts direct current generator and rectified a.c. for plates. Hartley oscillation circuit, radiation 6 amperes. Radio 'fone uses Heising modulation 2 50-watt oscillators and 4 5-watt modulator tubes. Radio 'fone radiation is three amperes. The antenna is of four wires on 16 foot spreader, T type 60 foot lead-in, and is located on top of a concrete building 50 feet high. Two steel towers on this building support the antenna approximately 100 feet above the ground.

The following Pacific Coast stations have been logged at this station:

6awp, 6zg, 6awt, 6xaq, 6aj, 6xad, 6ka, (6zz).

The latter station is very consistent here and often worked; on a one step 6zz can often be copied 15 feet from Baldwin 'fones. Henceforth, station 8agz will be known at 8yd on 375 meters.



Panels

Three distinct and exclusive types

CHOOSE the panel best suited to your needs and made to your own individual specifications. Any size or shape you desire—any quantities, one or a thousand—engraved or plain—polished or dull mat surface—plain blank or fully machined and ready for mounting. Diamond F Radio Panel Service gives you the choice of three distinct types of panels, each a leader in its field.

CONDENSITE CELORON

Grade 10 is the highest type radio insulation made. Extremely high in surface and volume resistivity, high in dielectric strength and low in dielectric losses. It is handsome in appearance, extremely water resistant, machines easily, engraves with clean cut characters, and will give long lasting, satisfactory service.

VULCANIZED FIBRE VENEER

(patent applied for) is made of a hard grey fibre core veneered on both sides with a phenolic condensation product. It meets the demand for quality plus low cost. We recommend it for use in receiving sets and other apparatus where very high voltages at radio frequencies are not involved. It has a smooth jet black surface, machines readily and engraves nicely.

CELORON SHIELDED PLATES

(patent applied for) are made with a concealed copper wire mesh imbedded directly under the back surface of the plate. This wire shield, when properly grounded, very effectively neutralizes all detuning effect and "howl" caused by body capacities. Made in both Condensite Celoron Grade 10 and in Celoron Fibre Veneer.

Send for our Radio Panel Guide

Write today for our special "Radio Panel Guide," giving complete details regarding all Celoron Radio Panels. This guide quotes prices and enables you to determine just how much any type of Celoron panel will cost in either standard or special size—plain or fully machined, and engraved to your own specifications. Don't fail to get your copy of this important Guide by return mail. Write us immediately.

Dealers: Our Radio Panel Service enables you to sell panels completely machined and finished to the buyer's specifications. Write for our Special Dealers Proposition.

DIAMOND STATE FIBRE COMPANY
BRIDGEPORT (near Philadelphia) PENNA.
Branch Factory and Warehouse, CHICAGO
Offices in Principal Cities
In Canada: Diamond State Fibre Co. of Canada, Ltd. Toronto

CALLS HEARD

BY CHAS. C. WHYSALL, 8CMI (EX 6TV), MARION, OHIO

1bqa, 1xad fone, 2aje, 2aqi, 2bm, 2bml, 2el, 2fp, 2jz, 2kg, 2oo, 2sz, 2wb, 2xj, 3aev, 3ajd, 3agt, 3ge, 3gm, 3gn, 3hj, 3qw, 3zo, 4bi, 4bq, 4cx, 4gl, 4gn, 5fv, 5hk, 5jd, 5kc, 5rz, 5xa, 5xb, 5xu, 5ye, 5za, 8awu, 8aoe, 8ajx, 8aiq, 8aet, 8aqz, 8avo, 8ars, 8amq, 8ahe, 8axn, 8afd, 8ax, 8ait, 8alo, 8atu, 8aje, 8bco, 9bbu, 8bss, 8bib, 8bis, 8bxx 8bk, 8bun, 8bep, 8bow, 8bfh 8brl, (8cbe), 8cld, 8cmf, 8ew, 8ft, 8iu, 8jm, 8jj, 8kg, 8lb, 8no, 8qe, 8rq, 8tl, 8wz, 8wu, 8wc, 8wo, 8xe, 8yu, 8zaa, 8zo, 8zn, 8zp, 8zz, 9aja, 9arp, 9ayw, 9aas, 9ap, 9arr, 9acn, 9ava, 9aou, 9aeg, 9abv, 9aqm, 9aaw, 9asj, 9awz, 9aul, 9amq, 9aza, 9anp, 9acb, 9aig, 9aua, 9bhd, 9bk, 9dqq, 9deu, 9dev, 9ddz, 9dyy, 9dzy, 9dsd, 9dxk, 9dso, 9del, 9gx, 9hr, 9hi, 9lf, 9lz, 9ox, 9pf, 9qe, 9tv, 9vl, 9wi, 9xt, 9yae, 9yak, 9yq, 9zj, 9zl.

Fone stations—kdka, kzh, kyw, wbl, whk, wwj, wlw, wjz, wgy, wha, wfo.

BY RULON BIDDULPH, PROVO, UTAH

5xd, 5zj, 6bk, 6ea, 6es, 6eu, 6gi, 6gp, 6hy, 6kc, 6nq, 6nx, 6ol, 6qr, 6tu, 6xh, 6za, 6zd, 6zz, 6aag, 6aah, 6aak, 6aei, 6aid, 6aru, 6ath, 6atq, 6awh, 6awt, 6bdg, 6bhg, 6bii, 6xad, 7ad, 7ex, 7fg, 7hm, 7jd, 7ln, 7mp, 7mv, 7nz, 7ot, 7qn, 7tz, 7aav, 7ya, 7yl, 7zm, 7zo, 7ap, 7zu, 7zv, 9nr, 9ps, 9za, 9amb, 9zaf, dd5.

BY 9IF, GILTNER, NEBR.

C. W.—1xm, xfi, wubc, nmw, wl2, 2fp, 2xq, 8aln, 8aqr, 3ca, 3bp(c), 8zy, 4el, (4cb-c), 4bf. 4by, 4bq, 4co, 4xf, 4xc, 4ft, 5's too numerous. 6en, 6ef, 6ka, 6ky, 6jd, 6xwi, (6xad), 6za, 7sm, 8ajp, 8agl, 8aqh, 8apt, 8aog, (8axk), 8awz, 8ain. 8awm, 8aid, 8atu, 8bx, 8bfx, 8box, 8bo, 8bum, 8bk, 8brl, 8bow, 8bnj, 8bzj, 8bex, 8bet, (8bbk). 8bxx, 8bzc, 8bfx, 8cw, 8ci, 8dr, 8fo, (8ii), 8ib, 8iv, 8iq, 8gl, (8jl), 8ji, 8mp, 8oc, 8oh, 8sp, 8uk, 8uj, 8vj, 8wi, 8wr, 8wk, 8xk, 8xv, 8zz, 8zv, 9's too numerous.

Spark—8bp(c), 5's too numerous. 6ot, 6zz, 6zm, 6za, (7mp), 7ly, 7xb, 7mo, 7zv, 7zu, 7zo, 8ft, 8zn, 8jj, (8bbu), 8zp, 8eb, 8ade, 8ml, 8zac. 8bep, 8brl, 8ars, 8zy, 8xx, 8yn, (8rq), 9's too numerous.

Fones—5zak, 5xp, 5za, 8ajp, 9xm, 9zaf, dd5, kdka, Los Angeles Exchange, Catalina Islands, wrr, wvl.

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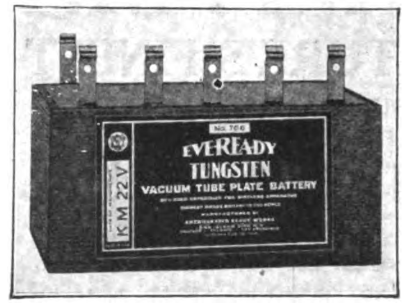

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RECENT PATENTS

Continued from page 28

16 and 17, and a closed circuit consisting of coil 19 and condenser 18. This closed circuit is tuned to the received waves. A closely coupled coil 21 supplies the input circuit of an audion 35.

C. A. Culver, Pat. No. 1,406,445; Feb. 14, 1922. Photographic receiving apparatus.

A photographic record of the received oscillations is made on a sensitive strip 18 moving at a uniform rate, by means of a mirror 12 mounted on the free end of a flexible reed 8. The reed has very small inertia, while the mirror has comparatively large inertia. The coil 1 acts electro-magnetically to vibrate the reed, the natural period of which may be adjusted for the best effect by the clamp 24-25. A highly flexible connection 13 is placed between the mirror and the reed to increase the angular movement of the mirror when signals are received.

A. N. Goldsmith, Pat. No. 1,404,756; Jan. 31, 1922. Signaling system.

A scheme is disclosed for modulating the oscillations of a high frequency source, such as a pliotron 1. Such a device when causing oscillations to be impressed on a closed circuit 5-6 cannot have its current flow materially varied by a mere variation in the resistance of this circuit. To overcome this difficulty a second pliotron tube 14 is used, having its anode 15 connected to the mid-point 17 of the coil 5, and its cathode 16 by grounds 18 and 8 to the cathode of the first pliotron. Then by varying the potential of the grid 20 of the second pliotron, as by the telephone transmitter 21 coupled to the grid circuit, the oscillations are modulated.

R. A. Heising, Pat. No. 1,406,857; Feb. 14, 1922. Wireless signaling.

An antenna system is described, arranged so that it may either receive or send signals. The scheme here disclosed is for facilitating the change from transmission to reception, or vice versa. This is accomplished by a key 22, controlling contacts 23, and 24, which in turn control relays 25, 26 and 27. The relay 25 causes the antenna 5 to be connected either to the receiving coil 17 or to the secondary of a transmitting coil 13. The relay 26 controls the oscillator 6. The relay 27 controls the detector 18 which when short-circuited by the elements 28, 15 and 30, is rendered inoperative. However, by making resistance 30 variable, it is possible to obtain a side tone when the station is transmitting, and in this way the operator can tell whether the oscillator is working properly.

A vacuum tube, whether used as a detector, amplifier, generator or modulator, consists of three elements inclosed in an evacuated glass receptacle. These elements are known as the filament, the plate and the grid. When the filament is heated by the passage of an electric current from a battery minute negative electrical charges are given off from it and attracted to the plate, which is maintained at a higher voltage than the filament. This flow of electrons constitutes an electric current which may be varied or controlled by another current passing through the grid or screen interposed between the filament and the plate.

A. C. for filament lighting is not satisfactory for a receiving set, as the hum of the usual 60-cycle current is too pronounced without the use of expensive filtering condensers. It is possible, however, to light the filaments from a large storage cell, say of 150-ampere hour capacity, while charging the battery with a vacuum tube rectifier.

THE RADIO WAVE

Continued from page 17

All attempts to produce an antenna or radiation system that would radiate in one direction only, have met with decided failure. The reader can easily see why this is true if the "stress theory" is considered valid. Several types have been produced that have a more or less directive effect and of these the "condenser aerial," lately tested out by the Bureau of Standards, seems to have the most marked directive properties. For amateur installations, however, the T type will be found the best, this type radiating more energy in the directions of its free ends. The L type also has a directive effect; radiating the most energy at the end from which the lead-in is taken. In all types, the directive effect becomes greater when the length of the antenna is increased, and also when it is placed near the ground.

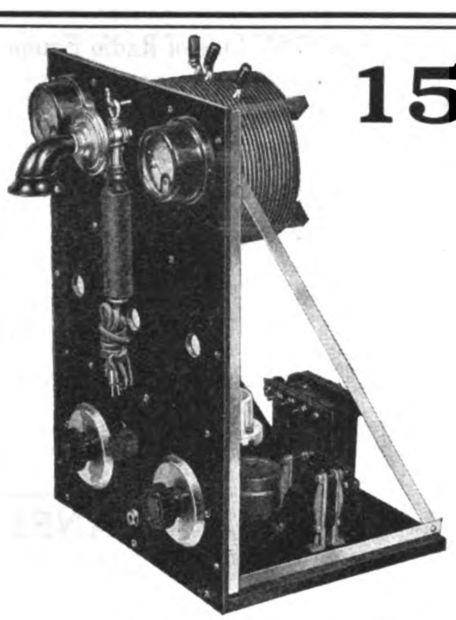
Why these various types show this directive effect is easily explained, for the charge on them is distributed in accordance with the law of electro-statics for the distribution of charges on irregularly shaped bodies.

In connection with the directive properties of various antennae when used for reception, little need be said except of the "loop aerial." When the "loop" is presented to the "field of stress" so that the plane of its windings lies in the direction of the transmitting station, the difference in potential of the opposite sides will cause a current to flow thru the "loop." If the coil is rotated so that its two sides are equidistant from the transmitting station, they will be at very nearly the same potential and no current will flow thru the "loop." Of the other types of directive antennae for reception purposes nothing will be said; all of them owe their directive properties to the way they are constructed in the "field of stress."

The vacuum tube has fully demonstrated its superiority to all other methods of producing undamped oscillations for radio work. We are at present, however, limited to comparatively low power in the ratings of these tubes, due to constructional difficulties, but the writer believes that the course of time will bring about unique improvements which will overcome these difficulties.

The spark and arc oscillation circuits have a tendency to vary constantly in frequency. As these variations are comparatively small, but very rapid and irregular, they have a pronounced effect on the "sharpness" to which stations may be tuned that are trying to receive from such transmitters. This naturally would have a limiting effect on their range.

Another point of superiority of the vacuum tube transmitter is the small amount of power they require to cover extreme distances. An explanation of



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Specifications **(*Cont.*)**

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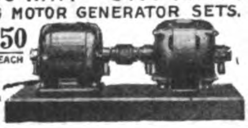

this may be found in the following illustration:

Suppose a pendulum is at rest. If we set it in motion we find that it has a natural period of oscillation. If energy is supplied at regular intervals corresponding with its period of oscillation we find that it takes but very little power to keep it in vibration, but if the energy is supplied at irregular intervals, the power expended in keeping the pendulum in motion will be comparatively great.

The same is true of the "field of stress." If we supply energy periodically it will require but very little to keep it in "vibration," but if the supply of energy is erratic, as with spark and arc transmitters, it will be necessary to use a great deal of power to keep the "field of stress" in "vibration."

With C. W. and radiophone transmitters, there are two common annoyances with which every operator is familiar: "swinging" and "fading." "Swinging" is especially noticeable when using the heterodyne method of reception. It is caused either by a change of wavelength of the transmitting station or perhaps more often by the variation of wavelength of the oscillations that are being produced at the receiving station. A swinging antenna is often the cause of the trouble and amateurs will do well to see that the displacement of their antennae during a wind storm is as small as possible. The lead-in, too, should be kept from swaying. At transmitting stations "swinging" is often caused by the variations in the load on the high voltage generator. If possible compensation should be made for this in some way because "swinging" caused by this is often attended with a "fading" of the signals.

"Fading" may also be caused by external conditions and due reference will be made of it later in connection with cosmographical influences which are probably the cause of the greater part of it.

TURNING now to phenomena dependent on cosmographical influences: the effect of the seasons upon the distances covered by transmitting stations will be dealt with first.

If a curve is plotted of the range of a transmitting station during the year, we find that in the months of December, January, and February, a maximum range is obtained. This range falls off abruptly during April, and in the summer months, especially July and August, a minimum is reached. This effect is not so noticeable in the tropics, but in the temperate zones there is a wide range of variation. Probably a great deal of the diminished range during the summer months is due to disturbances caused by static. One investigator considers the range of transmission

TURN TO PAGE 31

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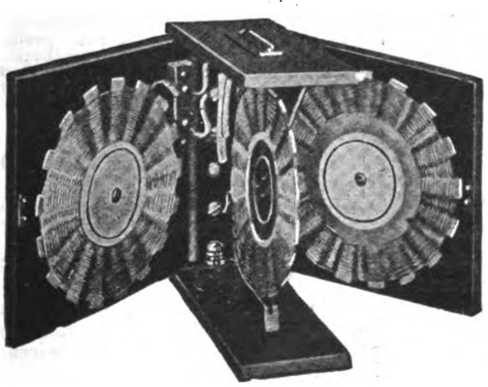

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as being inversely proportional to the amount of static in the air. Another claims that the diminished range is due to the leafing out of the trees. Undoubtedly this would have the effect of presenting more surface to the "stress" which would act in a measure to absorb some of its energy. Any of these theories do not violate the principles of the "stress theory," and the writer leaves the amateur to accept or disregard them as he wishes.

Another noticeable phenomenon is the "daylight effect." Often the range of a transmitting station will be increased a hundred times just after sunset and by three o'clock a maximum range is obtained. After this it falls off rather abruptly and with the rising of the sun the range falls off still more.

Most investigators account for this by the absorption of the radio waves due to the sun's action on the atmosphere. It is highly probable that the sunlight causes an ionization of the air which allows the energy of the "field of stress" to "leak" away. Other investigators claim that the sun affects the magnetic lines in the earth and this causes the resultant change in the transmitting range, but the writer would prefer to disregard such theories because they will not apply if the "stress theory" is held valid.

Another very common phenomenon associated with radio communication is the variation in signal strength between various portions of the earth's surface. The data on the subject are meager, but a few general deductions can be arrived at. It is evident that over large bodies of water, radio transmission is attended with little difficulty. On land there seems to be a wide variation in the strength of signals, depending on the direction from which they are received. This is undoubtedly due to the various degrees of conductivity of the earth's surface.

This same explanation will also account for the so-called "bending" and distortion of radio waves by the coast line, which so many observers claim to be true.

Several of the minor phenomena upon which little data can be obtained in connection with this work, are the so-called "magnetic shadows," the auroral displays, and sunspots. That the last two mentioned have some connection with each other is almost certain, but as to their effect on the range of radio communication little can be said. Near the polar regions certain effects might be noticed, but in the temperate zones no definite effects have been observed. "Fading" in the northern latitudes may be caused by auroral displays, but of this we are not certain.

The so-called "magnetic shadows," which spark stations are prone to contend with, are probably due to some peculiar molecular change in the atmosphere. The "fading" of C. W. and radiophone signals is perhaps due to this phenomena. Similar effects have been noticed in connection with sound waves and the explanation offered, tho not very good, seems to be the only one at hand.

The writer wishes to thank Allan R. Kenworthy, late of the U. S. N., for his aid in compiling the data given in this article.

THE V. T. AS A DETECTOR

Continued from page 23

filament but not the cold grid. With each of the rapidly recurring positive swings, in one group, the grid becomes increasingly negative. The condenser serves to transmit these potentials to the grid, but does not permit the charge which accumulates to leak off. The negative charge accumulated during the reception of one group of waves causes quite a decrease in the plate current. The time between groups of waves allows this charge to leak off through the grid leak, and the process is repeated for each group.

There are two cases in which a grid leak is not needed with a grid condenser. The first is when either the condenser or the base of the tube is not a good insulator, and allows a small current to flow. The second case is when a "soft" detector tube is used. Such tubes contain a small amount of gas, the atoms of which serve as carriers of electric charges in addition to the electrons, with this difference, that they may be either positive or negative. When positive charged atoms, or positive ions, as they are termed, come in contact with the grid they neutralize its negative charge, making a grid leak unnecessary.

In practical work all three of the above methods of detection are generally brought into play, the part each takes depending on the adjustments made and the tube used.

CALLS HEARD

BY 600, SAN FRANCISCO

5za, 5gv, 5fv, (6ak), 6ax, (6ea), 6eb, 6en, (6gy), 6ga, 6ka, 6ky, (6ni), 6nx, 6vm, 6zf, 6zi, 6zq, 6zs, (6zx), 6zz, 6rr, (6alv), 6pk, 6ti, 6ku, (6agp), 6awp, 6bak, 6baw, (6bcr), 6bir, 6bla, 7we, 7go, (7qt), 7dp, 7nx, 7zu, 9pi, 9dtm, 9bro, 9bjb, 9bsg, 9xaq, 9zaf, px, all C. W.

Spark—(7mf), (7oz), 7my, 6zam.

BY 6ZF

C. W.—4bq, 4ft, 4gl, 4zc, 4cb Can., (5za), (7qe), (7xf), (7xg), (cl8), 8jl, 8vy, 8wi, 8xv, 8zg, 8agz, 8axk, 8brl, 9fm, 9pi, 9ps, (9wd), (9wu), (9xi), 9xm, 9bd Can., 9aav, 9aeq, 9aja, 9ayu, 9bji, 9dng, 9dth, 9dtm, (9dva), 9egm, 9xaq, 9zac, (9zaf).

Spark—5ak, 5er, 5if, (5xd), 5yq, (7bc), (7bk), 7ck, (7ge), (7gj), (7il), 7jd 425 meters, (7ke), (7ln), (7ly), (7mf), (7mp), 7nw, (7oh), (7ot), (7oz), (7po), (7vo), (7wg), 7xb, 7ya, (7yl), (7zj), (7zm), (7zp), (7zt), (cl8), 9zj.

Feb. 20 (760 miles north Seattle) 7.15 p.m. cq de 6zf (cw) qsa vry; 9 p.m. Seattle P. I.; 9.30 p.m. 6zx (?) spk qsa but qva bad.

Feb. 21 (850 miles north Seattle) 8.15 p.m. kwg Stockton; 8.40 p.m. Seattle P. I.; 8.50 p.m. some other Calif. station but unable make out call or where. 9.10 p.m. 6km de 7mf spk; 9.12 p.m. 7mf de 6km spk; 9.14 p.m. 7zm de 7ed qsa vry spk; 9.18 p.m. 6eu de 6km qsa vry spk; 9.21 p.m. 6vx wrking qsa; 9.23 p.m. 6atq de 7mf; 9.57 p.m. cq de 6zf (cw); (cannot copy cw account qrm fm ships generator.)

RADIO STORAGE BATTERIES

Continued from page 20

simply a continuous charge at a very low rate, which keeps the battery in first class condition at all times, and stops the deterioration usually experienced when a battery is left without a proper charge. This trickle charge varies in quantity for different sizes of cells, but rarely exceeds a half an ampere, even for the largest types of cells.

At best, however, a lead battery is a very delicate, tricky thing to handle, and should always have the best of care. Even where the battery has not been discharged, a freshening charge is required, at least once every two weeks, and oftener if the battery does not hold up well. Distilled water should be added at regular intervals, to make up for that lost in evaporation, gassing, which occurs when the battery is charged. The terminals and tops should be kept clean, and no foreign matter allowed to get into the cells at any time, as this will almost certainly ruin them. Naked flames and lights should always be kept away from lead batteries, as the oxygen and hydrogen liberated around the battery will ignite easily, usually with a disastrous explosion which may communicate itself to the whole set of cells, and cause the loss of life and property, the explosion rivalling powder in its force.

THE Edison battery was, when it came out, heralded as "perfect." Unfortunately, those who considered it so were somewhat too hopeful in their claims and dreams. The Edison battery is unquestionably the best for some classes service, everything considered. Where a battery will have a long steady load drawn from it, as a radio set would draw, the Edison battery stands up far better than the lead, provided the battery is used, i. e., charged and discharged often enough to keep it "active." If a set of Edison cells are charged and allowed to remain charged all the time, with occasional freshening charges, they will not deliver their maximum service by any means, altho they will be in no way injured. It is almost impossible to permanently injure an Edison battery unless some foreign substance is put in the cells, or unless they are damaged mechanically.

Edison batteries are as different from the lead-acid type as it is possible to make a thing which serves the same purpose. In the first place, they have for a solution about the strongest "base," or alkaline substance known, potassium hydroxide (and in some cases sodium hydroxide). The solution is generally made of about a 20 per cent solution of potassium hydroxide (the same substance as common "lye"), in distilled water, usually with a small percentage of lithium hydroxide added. The active materials of the plates are not the plates themselves, or a "paste" applied to them, but is material securely contained inside of nickel plated sheet steel containers. This material consists of flakes of nickel in the positive plate, and iron oxide, iron rust, in the negative. Small sheet steel tubes, made up of perforated, nickel plated steel, are used to hold the nickel, while small perforated "boxes," called "pockets," are used to hold the iron oxide. These various containers are then forced into steel sheet-metal "frames," which compose the plates, which are then made up with hard rubber separators, and the whole cell, composed of positive and negative plates, is enclosed in a steel "can," which is made tight by being electrically welded at all the seams, the only opening left being a small hole, fitted with a cap and cover, which serves as a "filler" opening, and thru which the electrolyte and distilled water is inserted when the cell is in use, and where the gases escape while the cell is charged.

Edison batteries can be subjected to almost untold abuse, and still maintain their normal capacity and activity. The writer has seen the following classes of abuse heaped on the metaphorical "head" of the Edison battery, which lived to tell the tale: A set of Edison cells was stored away in a warm climate by a person ignorant of the proper method of storing batteries, and after five years it was found that all the water had evaporated from the solution, leaving the cells bone dry. Small crystals of potassium hydroxide could be seen clinging to the surface of the plates. The cells were filled with distilled water and allowed to stand over night. Next morning it was found that current could be drawn from the battery, altho it had not been charged while it was in storage. The old solution was dumped out and replaced with new, the battery was given a couple of cycles of charge and discharge at the normal rate, and as far as could be determined, it was as good as ever! Another time it was noted that at a certain radio station there was but one battery supplied for lighting of the filaments of the audions. Plenty of 110 volt dc. current was available, and the 6 volt tray of cells was placed right across the line, without resistance, and a short charge given the cells, lasting about five minutes. No ammeter was available, but the current certainly rose to 150 or 200 amperes. The limit of the charging period was determined by the time necessary to get the solution too hot to make the process safe to continue. This was done about twice a day for several weeks, until a spare battery could be procured, together with the proper charging panel. No serious effects were noted in the actions of this much abused battery, either at the time or later. In general, however, such extreme cases of misuse should be avoided, as it certainly can do the battery no good, even if there does not appear to be any harm done at the time.

The actual life of an Edison cell is not known. The makers claim they have cases of trucks and small motor driven vehicles in which the batteries operate the truck all day, are charged at night every working day of the year, and after ten years of such service the cells showed a drop of about 10 per cent from their original capacity and seemed capable of another ten years of such service.

For the lighting of filaments for audions and the like, nothing can excel these batteries. They may be left charged, uncharged, partly charged, or in any convenient condition indefinitely without seriously injuring them in any way. If they are to be left for a time, they should be carefully cleaned off, and all loose solution removed from the outside of the steel containers, as this is liable to cause rusting, which will spoil the container, and will necessitate renewal of the steel cans. They should be supplied with distilled water from time to time, when laid up.

After a couple of years' service it will be found that Edison batteries start to lose their capacity, and that they will not hold the charge. This may be remedied by renewing the solution, as follows: Take the whole cell (or tray, if not too heavy) and shake it vigorously, with the old solution inside, and vent cap closed. This should continue for at least five minutes, and more, if possible. Now open the cap, and while the solution is still stirred up, quickly invert the cell, and allow the old solution to run out into a sink, being careful to continue the shaking until the solution is all out of the battery. If the cell is filled with new solution, and charged, it will be found to be as good as new, and it will continue to serve faithfully until about two years more, when the same process should be repeated.

The Edison cell possesses some serious disadvantages, however. It is of comparatively low voltage—1.2 volts being the normal reading on load, when fully charged, as compared to the 2.0 volts of the lead cell (2.08 to be exact). The internal resistance of the Edison cell is also rather high, which effectively prevents the use of the battery in such work as automobile starting systems, where a terrific current is drawn for a short time. A dead short circuit will not injure the battery; it will only run it down. The plates cannot "buckle," like lead ones do, and, except that the solution would probably heat up, no unusual action would be noted around a battery in this condition.

Both types of batteries should always be kept clean, and should be supplied with distilled water, when the solution falls, due to the evaporation, either thru heat or due to gassing on charge. All leaky jars in a lead battery should be repaired, and all cans on the Edison type should be carefully greased to prevent rusting and the resultant leakage. Naked flames and lights should be kept away from batteries, as explained previously, as both types generate oxygen and hydrogen when charged. In general, but little care will be required to keep a set of cells in proper working order, but if they start to go bad—look out. Usually a bad cell, either sulphated or leaky in a lead battery, or one with exhausted solution, or a leaky can with Edison cells, will indicate that the rest are in nearly the same condition, and all should be gone over at once. Batteries will give excellent service, no matter what type, provided they are given half a chance, and usually their failure can be traced directly to abuse or neglect, which will ruin anything.

A RADIO PRIMER

Continued from page 20

Communication can be carried on between an aeroplane in flight and a submerged submarine. The aerial on the latter may consist of a loop aerial securely fastened on the outside of the ship and insulated or a small coil of wire placed in a compartment on the deck and insulated both from the ship and the water.

It was said that ether waves are subject to absorption and to reflection previously. Both of these effects depend more or less on the wavelength. These waves are both reflected and absorbed by the salt water, but they are able to penetrate to a sufficient depth so that the aerial of a submerged submarine can pick them up. However, the submarine must necessarily use a very short wavelength in transmitting, and inasmuch as the sending aerial is completely surrounded by an absorbing medium, the salt water, only a small part of the radiated energy goes above the surface of the water. The receiving range is therefore much greater than the transmitting range. The shell of the submarine is used as a ground.

One mistake often made is to place the horizontal wires of an aerial too near together. If two wires are placed several inches apart the capacity of the two is not much greater than one alone, but if the distance between them is several feet the capacity is then equal to the sum of two. A good distance between wires is three feet.

You may be asked to suggest a suitable aerial for receiving radio music. The wavelength is usually about 360 meters; the tentative recommendations of the Washington Radio Conference allot 310 to 435 meters for radiophone broadcasting. A single wire inverted "L" outdoor aerial from 100 to 150 feet long will do, insulated at both ends, using water pipe for ground. The higher the aerial the better. The writer would suggest two such wires, spaced about six feet apart, joined at the farther end and the free ends brought into the house through a tube.

An indoor aerial can be used, but it will necessitate the use of amplifiers to bring the signals in at good strength. An insulated wire behind the picture molding will serve.

Insulated wire may be used outside, but stranded, bare wire is better.

The Radio Conference will reconvene at Washington about May 1 to consider suggestions from private and government broadcasting interests who believe that changes should be made in the preliminary recommendations on radio telephony. There is a possibility of change in the proposed allocations of bands.

CONSTRUCTION OF 100 WATT TRANSMITTER

Continued from page 14

drilling a $\frac{3}{4}$ in. hole at the top and bottom of each slot and sawing out the material between them with a coarse hack-saw blade. The edges are rounded with a half-round file and smoothed by pulling emery cloth back and forth through the slot. The holes for the meters can be roughed out by drilling holes around the rim, the rough hole being finished with a half-round file.

The base is a piece of hardwood, preferably mahogany or walnut, although gum finishes up well. The edges are beveled and the top and edges sanded. A good dark mahogany wood dye should be applied with a cloth and rubbed until quite dry. Three coats of white shellac with light sanding between each coat are next applied. When quite dry and hard the shellac should be rubbed dull with pumice and gasoline, using a stiff brush such as a nail brush. This treatment should be followed by a brisk rubbing with the palm of the hand to remove all vestige of pumice. A flow coat of a good spar or furniture varnish will result in a high gloss that will not scratch easily.

The side brackets should be bent as illustrated, the bottom serving to strengthen the board and prevent it from warping. They can be easily formed as follows: On a piece of steel 26½ in. long a file or center punch mark is made 3 in. from one end and another 9½ in. from the opposite end. The steel is then heated to redness in the region of the mark and cooled by dipping in water for a space of ¼ in. on each side of the mark and bending to a chalk line laid out from the drawing.

The panel should now be screwed to the base and squared up. The brackets should be formed to fit both the panel and the base and the holes marked through the holes previously drilled in the panel. This insures perfect alignment so that, in the next operation, the brackets may be screwed into place.

The rheostat should be mounted next, with a piece of blotting paper between it and the panel to prevent cracking the base when it is fastened in place.

The tube sockets are mounted on bakelite rings so that additional working space is provided for the passage of wires, etc. Blotting paper is placed between the bakelite ring and the socket to prevent breakage as in the case of the rheostat. The sockets are placed so that the grid connection is nearest to the panel, the filament connections are parallel with the panel, and the plate connections are nearest the bridge.

The bridge is next assembled and screwed into place with the shorter fiber tubes as spacers, No. 6 wood screws 2 in. long being used.

The meters should come next, the antenna meter being on the left, 8/32 round head nickel screws and hex. nuts being used. The screens are fastened on by means of escutcheon pins driven tightly into drilled holes.

The inductance is spaced from the panel by fiber tubing and screwed into place, the top level with the top of the panel, No. 8 wood screws, 3 in. long being used. In order to make wiring simpler the top clip and its mounting are placed, as indicated in the drawing, on the other side of the inductance near the center.

The set is now ready for wiring. The high frequency leads are of 1/16 by ½ in. copper strip. These connect the radiation ammeter with the antenna binding post at the upper left hand corner of the panel, as well as the radiation meter with the top of the inductance. The remaining high frequency lead connects the bottom tap of the inductance with the ground binding post in the lower left hand corner of the panel. The remainder of the wiring is No. 12 hard-drawn copper wire through varnished cambric sleeving. The leads should be neatly formed to connect the various elements of the circuit by the most direct path. This is best accomplished by studying the wiring diagram, Fig. 1.

If these simple directions, as well as the data contained in the drawing, are followed the resulting apparatus cannot be other than a source of real satisfaction to the constructor.

SPECIFICATIONS AND COSTS

1	R.C. U.P. 1016 transformer	$38.50
1	R.C. P.T. 537 rheostat	10.00
2	R.C. U.R. 541 tube sockets	5.00
2	R.C. U.V. 203 tubes	60.00
2	R.C. U.C. 1806 condensers	14.00
1	key	2.50
1	0-10 radiation ammeter—Jewell 64	12.40
1	0-15 a.c. voltmeter—Jewell 74	8.00
1	RC. UL. 1008 oscillation transformer	11.00
2	D.L. 250 radio frequency chokes	2.80
1	bakelite panel ⅜x16x16½"	10.50
1	bakelite bridge 3/16x3⅜x14"	.90
2	bakelite disc. 2⅞" dia., 3/16" thick	.30
2	bakelite disc. 3¾" dia., ⅜" thick	.50
16"	fiber tubing ¾" diameter	.75
1	brass screen ⅛" mesh, 4"x6"	.50
1	brass or copper 1/16"x½"x20"	.30
8	heavy binding posts	2.00
20	ft. hard-drawn copper wire No. 12	.20
20	ft. cambric tubing for No. 12 wire	3.00
12	screws, machine, flat head 10-32x1½	.24
6	10-32x¾	.12
6	screws rd. head nickel, 6-32x⅝	.18
	Screws, rd. head brass—	
6	8-32x⅝"	.12
6	8-32x⅜"	.12
	Nuts, hex. brass—	
18	10-32	.18
12	8-32	.12
6	6-32	.06
	Washers, brass—	
24	10-32	.10
12	8-32	.05
	Wood screws, flat head iron—	
6	No. 8x3"	.05
6	No. 6x2"	.05
6	No. 6x1½"	.05
6	ft. cold rolled steel 3/16x⅞"	.60
1	base, mahogany or walnut, ¾x12x16½"	1.25
	Paint, varnish, sand paper, nickeling, etc.	1.50
	Cost of all material at retail prices	$187.94

Royalties on radio music are being demanded by music producers, it is announced by William Rossiter, music publisher. Negotiations for collection of a tax from all radio-sending stations have been started with the Westinghouse Electric Company in New Jersey by the American Association of Authors, Composers and Publishers, he said. Tremendous inroads on the sales of phonograph records and sheet music have already been made, declared Mr. Rossiter. "If the present movement is carried to its logical conclusion," he asserted, "it will wipe out the phonograph and music publishing business." People figure, he explained, that by spending $15 or $20 putting in a radio receiving set they can avoid buying expensive phonographs and constantly buying new records. The demand for royalties on radio reproduction, he said, is in line with the tax that has been collected for years by the association from theaters, dance halls, cabarets and other places where music is reproduced for profit. The royalties collected are divided three times a year, said Mr. Rossiter, and through the publishing house, the author, the composer and the artist all receive their shares.

Church chime music by wireless is the new diversion of those owning radio receiving sets within a fifty-mile radius of Rochester, N. Y. A transmitting station installed by the Lake Avenue Baptist Church sends out the music from the Deagan electrically operated chimes in the church tower. This suggestion will undoubtedly be followed by other broadcasting stations situated near chimes which are operated at regular periods. This form of music appears to be well adapted to broadcasting as it is greatly enjoyed by the listeners-in. One enterprising circus management is reported to be seeking an opportunity to broadcast the sounds of the steam calliope!

A PHONEY FREEZE-OUT

Continued from page 19

"I tell ya, we're done fer," wails Hell-Fire, as we watch the K-V-I phone go in. "Anybody can see this rig is gonna *work!* They're usin' our big four-hundred foot aerials, an' our old eighteen-hundred meter wave. An' when I look at them rows of evacuated glass cannons, I can see it ain't for nothin' that th' aerial-ammeter is calibrated to read to thirty amperes! They're gonna slam th' needle right up onto th' end of th' scale!"

"Yes," I agrees, thoughtful-like. "Yes, I s'pose they will."

"Then whadda' ya sittin' around here lookin' so d——d peaceful fer!" howls Hell-Fire. "Why don't ya git excited or somethin'! Don't ya think these rigs are gonna work! Don't ya know th' tube hounds in th' States are puttin' across weddin' invitations an' home-brew recipes from Catalina t' Chicago on twenty watts—an' here's a thousand watts to upholster th' vocal disturbances 'a th' fish-barons across just three-hundred miles—of water! Th' farthest cannery up th' peninsula ain't more'n five-hundred miles from N-P-Q. I tell ya, these things are gonna come in like a stewed six-foot Oregon lumber-jack war-hoopin' in your ear with a megaphone as big as a road-culvert!"

"Well, it's no use ravin' that way about it," I yawns. "Let's get Old Judge an' have a little game."

THE testing of the phone set at K-V-I was a grand success. Working on hardly half-power, it carried strong across the three-hundred-mile stretch to N-P-Q. After showin' the Brainless Swede how to run it, Mr. Aloysius Bean leaves him an instruction-book, an' then goes on to put in the next phone over at K-O-X-N, Hell-Fire's hang-out.

When Old Judge officially gets th' can at K-V-I, he is pretty glum.

"I know I'll never get back there again," he announces, mournful-like. "Th' phone company are takin' out all th' spark outfits as part payment on th' tube sets. An' th' phone is workin'. Th' Brainless Swede gets th' N-P-Q radiophone on a regular daily schedule; an' after he clears his business, th' navy fella reports back th' message charges, which th' Swede puts down on his abstract sheet. Nothin' to it!"

I sends word to all the brasspounders along the line to come down to Unga when they get fired, an' they soon begin driftin' in pretty steady. Old Judge, who is th' town postmaster an' everything else, has a fairly good-sized shack, of which we summarily proceed to take possession. We make a barracks out of his combined court an' post-office room, a mess-hall out of his kitchen, an' a loungin'-room out of his private smoke-den. Old Judge has a nifty ham set, a big vic-

trola, an' a lot of high-class records, all of which we put into use.

We had a nice time. Music an' song, a blindin' fog of tobacco-smoke, poker-chips, nightly rough-house initiations into a Skull-Bones Lodge, an' dances in th' Unga dance-hall. Everybody chips into a general chow fund, Old Judge an' some of th' other culinary gooneys do th' cookin', an' nobody washed th' dishes. We enjoys knotted sleepin'-blankets, shoes nailed to th' floor, sleep-walkers, an' a spark-coil shockin' rig on all th' door-knobs. In three weeks, th' joint looks like a Chink lodgin'-house struck by a typhoon.

We keep a listenin' watch on Old Judge's ham set; an' long before all the phones are installed, th' bunch begins to see the idea of stickin' around. One or two phones went fine, but when fifteen or twenty of 'em gets on the air, an' more comin' all the time, trouble begins. The boss of the King-Salmon company overhears some Alaskan Fisheries' private dope about a band of natives comin' down from Nome to fish; an' the King-Salmon outfit rush boats out an' beat the other people to 'em. Then the Pacific-American crowd spot a big run 'a fish at Herendeen; but the Great Northern gang, gettin' wind of it by eavesdropping on the phone, sneaks down an' cleans up all th' fish. A few days later some personal stuff trickles into th' receivers of a fish-hound who is bein' slandered, an' there is a fight; then some feministic scandal leaks out which causes a shootin' scrap.

Pretty soon th' whole outfit blossoms out with a bunch of secret codes. And then *real* trouble starts. Puttin' coded stuff over telegraph is bad enough—but over a phone. Try it!

While th' gob at N-P-Q was takin' straight stuff from a few phones, he got along fine, but now with twenty-eight on his over-worked neck an' everything comin' in code, he begins to get pretty savage. Listenin' in on Old Judge's set one mornin', when the Brainless Swede is tryin' to get off his business, we hears th' first powwow.

"Squeeche, trowback, Kinooschi, wiolence, vaffle—you bane hear, yes?"

"Hear what!" snarls th' gob. "A tongue-twisted Hungarian peddlin' oysters, or a moon-struck Eskimo sobbin' a funeral dirge! Is it squeejee, throwback —how do ya spell that third one?"

"K-o-n-i-u-j-i. Das Koniuji Island."

"Koniuji, violence, waffle?"

"Yus. Pulwerized, spoonfish, floosk."

Before the gob has time to digest this, another fish-magnet up Naknek way comes slammin' on th' air.

"Say, there, are you going to spend the rest of the month on that cursed message?" he fumes. "I can't stay here this way with the river full of salmon—my time is money!"

"Well, ya just gott'a wait, mister salmon-snatcher!" barks th' gob, hostile-like. "There's eight watin' their turns yet before you. Ya better get a bookkeeper to th' phone if you're so doggone busy. Now, Unga, go ahead, pulverized, spawnfish, flush."

"Listen here, I don't want any of your lip, you navy fellow," snaps th' Naknek cannery-king, before the Brainless Swede can get back in. "The bookkeepers are working fourteen hours a day now—we've got nobody to sit here all day with this thing!"

"Ach, dunnerwetter!" rumbles th' thick, mushy note of old Rudolph Krugscaller, th' codfish-kaiser at Hell-Fire's hang-out. "Blease, mister Nicknack und shut up! Did you think you iss der only one standing all der time here mit pizness fizzling by der finkers, yes! It's for fishink I'm also, und chabbering all day, not!"

"I can't stay here with you guys any more now," busts in th' gob. "It's time fer my arc schedule with Cordova. See you all at eight tonight—g'bye."

About a dozen phones come yellin' on the air at the same time, but it was no use. The gob was gone.

"I've had enough of this, dammit!" boils th' Naknek salmon-packer. "Hello, Unga, are you still there?"

"Yus—and Ay skall vait hyar even it bane vun veek, by golly!"

"I understand the operators are all down there at Unga—please tell our man we'd like him to come back up here—right away!"

"HURRAH!" whoops Fatty Gibbs, th' Naknek brasspounder, who is listenin' in with me—an' he makes a dive for his suit-case.

"You needn't be in such a rush to submerge your safety-razor under your other shirt, Fat," I advises him. "You're gonna be here with us a good while yet."

"How so!" demands Fat, a big striped necktie in one fist an' a pink undershirt in th' other—like a decorated balloon. "They said fer me to come back, didn't they?"

"Yes, sure, but you're not goin'—not right away. You've got to wait fer th' rest of th' bunch."

That night Fat tries to make a getaway, but he stumbles over a wash-tub full a' dirty dishes an' goes down with a crash that brings th' whole gang flyin' out 'a their blankets to see if it's 'a earthquake. Capturin' Fat, we confiscates his striped yellow tie an' lock it up in Old Judge's safe, which we know will keep him with us till we're ready for him to go.

In another two weeks, about half the cannery outfits have sent word they want their ether-jammers to come back.

"You gotta wait!" I declares to th' bunch, when some of 'em begin to get anxious to go. "If half you brasspound-

'ers go back on th' job now, it'll clear th' air enough so th' rest of th' fish-barons will get their business through. Let 'em yell an' rave till they *all* give up. United we stand, divided we don't eat!"

THE salmon-packers find out that runnin' a big radiophone is more than pushin' a button. A gale takes down an aerial; an' when it is put up again, the set is out of tune an' out of the game for two weeks till Mr. Aloysius Bean can get to it; another interference-smasher ran up his filament current an' burnt out his tubes; one lost his instruction-book an' forgot how to start up; another, foolin' around with the current on, got his hand on the 2500-volt plate-circuit, an' went to th' cannery hospital. When he gets out, he sends Mr. Aloysius Bean to the same place for not tellin' him th' thing was dangerous.

Things on the air got snarled up worse every day. Schedules shot to pieces; two dozen fightin'-mad fish-hounds chewin' th' corners off their desks; an' th' gob at N-P-Q on th' point of hydrophobia.

At last th' whole crowd give it up as a bad job—all but old Krugscaller an' the Brainless Swede. These two keep hangin' on, day after day, and as all the other fish-magnets are howlin' for the key-punchers to come back, I decides it's necessary to do somethin'.

Happenin' to know that the marshal has a confiscated stock of Canadian real-stuff, we pulls off a sham-battle in th' dance-hall one night an' gets him away from his shack long enough to break in an' grab a case—or two. The Naknek salmon-packer had sent his big tub-boat *"Shelikoff"* down to Unga with orders to bring back Fat; and I takes the case of glassware down to the skipper.

"If you go back home without Fat, you'll probably get killed, won't you?" I remarks, as a preliminary.

"I ain't goin' back without him!" yells th' tug-boat navigator, spittin' a shovelful 'a chewin'-tobacco over the lee rail. "If you'd 'a heard what th' boss said——"

"Well, here's a proposition," I cuts in. "Take this box up to th' navy operator at Pribiloff; then come back, an' we'll let Fat go with you."

"Yep, sure, you betcha I'll take it!" exclaims th' skipper, makin' a grab fer th' box. "Say, if you'd 'a heard what the boss said——"

"Handle it careful," I warns him. "It's full 'a delicate—wireless instruments."

TWO evenings later, we hears th' Brainless Swede an' old Krugscaller havin' their usual row about who is goin' to clear first.

"You ha' no business talking over

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Secondly we will pay all postage charges on orders exceeding $5.00. This will make our equipment even cheaper than it can be bought on the coast where prices are often higher than listed by the manufacturer. It is needless to mention that our prices are strictly list as can be seen by the following list:

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We are distributors and jobbers for the Radio Corporation of America and always carry a complete stock of their apparatus. We list below their complete line and in addition can supply you with the Radio Corporation C. W. instruction book at 25c per copy.

Item	VACUUM TUBES	List Price
1	Radiotron (detector) UV—200	$ 5.00
2	Radiotron (amplifier) UV—201	6.50
3	Radiotron (5-watt) UV—202	8.00
4	Radiotron (50-watt) UV—203	36.00
5	Radiotron (250-watt) UV—204	116.00
	POWER TRANSFORMERS FOR C.W. SETS	
12	325-watt, UP—1368	25.00
13	750-watt, UP—1016	38.50
	A—Filament heating Transformer for UV—204, UP—1633	.....
	B—Power Transformer for UV—204, UP—1636	.....
	C.W. ACCESSORIES	
14	Oscillation Transformer UL—1008	11.00
15	Magnetic Modulator (½ to 1½ amp.) UT—1643	9.50
16	Magnetic Modulator (1½ to 3½ amp.) UT—1357	12.00
17	Magnetic Modulator (3½ to 5 amp.) UT—1367	17.00
18	Filter Reactor (160 mill amp.) UP—1626	11.50
19	Filter Reactor (300 mill amp.) UP—1627	15.75
20	Plate Circuit Reactor, UP—415	5.75
21	Filter Condenser ½ mfd.—750 V., UC—1631	1.35
22	Filter Condenser, 1 mfd.—750 V., UC—1632	1.85
23	Filter Condenser, ½ mfd.—1750 V., UC—1634	1.50
24	Filter Condenser, 1 mfd.—1750 V., UC—1635	2.00
25	Transmitter Grid Leak (5-watt tubes), 5000 ohms UP—1719	1.19
26	Transmitter Grid Leak (50 and 250-watt tubes), 5000 ohms, UP—1718	1.65
27	Antenna Ammeter, 0-2.5 amp., UM—530	6.00
28	Antenna Ammeter, 0-5 amp., UM—533	6.25
29	Sending Key UQ—809	3.00
30	Microphone Transformer UP—414	7.25
31	Filament Rheostat (for UV—200, 201 and 202) PR—535	3.00
32	Filament Rheostat (for UV—203 and 204) PT—537	10.00
33	Rotary Grid Chopper PX—1638	7.25
34	Shaft Bushings for ¼″ or $\frac{5}{16}$″ motor shaft	.25

Item	KENETRON RECTIFIERS	List Price
6	20-watt Kenotron, UV—216	$ 7.50
7	150-watt Kenotron, UV—217	26.50
	VACUUM TUBE SOCKETS	
8	Porcelain Socket (for UV—200, 201, 202, 216) UR—542	1.00
9	Porcelain Socket (for UV—203 and UV—217) UT—541	2.50
10	Bakelite Socket (for UV—200, 201, 202, 216) UP—552	1.50
11	Mountings (250-watt tube) UT—501, UT—502	2.00
	SPECIAL CONDENSERS FOR C.W. SETS	
35	Antenna Series Condenser, 7500 V. .0003, .0004, .0005 mfd., UC—1015	5.40
36	Plate and Grid Condenser—3000 V. .002 mfd., UC—1014	2.00
37	Special Condenser—10,000 V. .000025 mfd., UC—1803	5.00
38	Special Condenser—.002 mfd., 6000 V., UC—1806	7.00
	VACUUM TUBE DETECTOR ACCESSORIES	
39	Intervalve Amplifying Transformer, UV—712	7.00
40	Special "A" Battery Potentiometer, PR—536	2.00
41	Tabular Grid and Plate Condenser	
	.00025 mfd. UC—567	1.25
	.0005 mfd. UC—568	1.35
	.001 mfd. UC—569	1.50
	.0025 mfd. UC—570	2.00
42	Grid Leaks	
	UP—509, .05 megohm; UP—518, .75 megohm	
	UP—510, .1 "; UP—519, 1.0 "	
	UP—511, .15 "; UP—520, 1.25 "	
	UP—512, .20 "; UP—521, 1.5 "	
	UP—513, .25 "; UP—522, 1.75 "	
	UP—514, .30 "; UP—523, 2.00 "	
	UP—515, .40 "; UP—524, 2.50 "	
	UP—516, .50 "; UP—525, 3.00 "	
	UP—517, .60 "; UP—526, 4.00 "	
	UP—527, 5.00 " ... each	$0.75
43	Grid Leak Mounting UX—543 ... "	.50

Send 15c for our complete literature

ELECTRICAL SPECIALTY COMPANY, 48-50 South Front Street, Columbus, Ohio

dar except Ay bane tru here first already!" howls th' Swede. "Das navy yentleman ha telled you before t' kip qviet ven Ay bane talkin', by golly!"

"Ach, himmel! All night you iss hollering und it's schwearing here I'm because it's talking not English you spoke, but Swede chabber. Doesn't der opberator told you already your bronunziation iss so sweet, like a funeral singing in Lapland, yes!"

Before the Brainless Swede can get back on this, th' gob comes on the air, gloriously hooked up to our case of—wireless instruments.

"Hic—hullo there Dushy an' Sweedie, ol' dears," he chirrups, lovin'-like. "Glad t' see th' battle 'a wind an' words is, hic—howlin' its merry way along this evenin'. I'm jesh enjoyin' a beaushiful preshent some darlin' angelsh shent me today, an' I'm sh' happy I'm just about ready t' climb up th' wirelesh mast an' fly away t' heaven! Say, I guessh long's we're gonna be here all night t'night, we mightsh well have a little mushik—eh, Sweedie! I got shome new records hic—here, an' I'll stick th' trans—transhmisher up to th' phonograph sh's we can all enjoy thesh pashin' idle hours—huh Dushy!"

Sure enough, we can hear the gob crankin' up his music-box; an' then over the air there comes a horrific squawkin' like a duet sung by a colicky mule an' a jealous tom-cat. At last th' thing clatters to a welcome end.

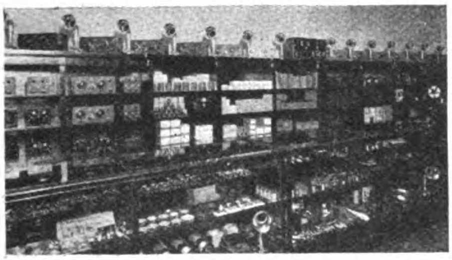
"Fellas, that wash 'Th' Moonshine's Hid in th' Cowshed,' shung by Frenzied Wheelbarrows an' Hollar Louder. I got dozensh more 'a thesh pretty shongs, an' if th' anglesh preshent holds out, I'm gonna play 'em all. Let th' benifishunt harmonies be shung to all th' world, thanksh to th' two greatest modern invenshuns shience has given to man! Just a minute an' we'll have another."

"Say, nix, mister Briploff," pleads old Krugscaller, after th' happy gob has perpetrated four or five more unmusical outrages on th' agonized ether. "Moosik iss moosik, but pizness iss greenpacks, und fishing all day iss no sleepings—pesides der pooks iss not keeped today yet to be twiddle-finkering at midnight by der tellingfoam here, und der wife says to come right aways to bed in."

"Aw, whash th' use 'a bein' so hic—huffy, when we're all havin' shush a grand celebrashun, Dushy," grumbles th' gob. "Ash codfish-snailers, you an' Sweedie ol' dear are a fine pair 'a hic—hooks, but when it comes to wirelesh concerts, you don't know th' difference between Crusho's 'Vermishelli' an' a scandal in a boiler-shop. That lash shong was 'Las Tickly Crocodillas,' shrieked by Gallopin' Curses. Jush a minute an' we'll have another."

"Dumkopf!" explodes old Krugscaller. "It's finished I'm tellyfoaming by

The CAPITAL Serves Indiana, Ohio and Kentucky



Interior of Salesroom

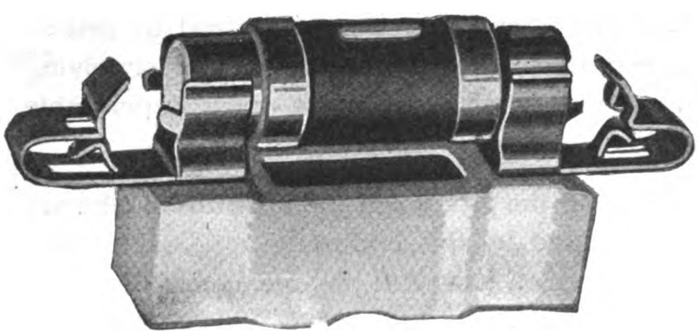
THE Capital Radio Supply Company, located at Indianapolis, was organized by prominent business men for the purpose of supplying this territory with the finest, most dependable and efficient radio equipment made.

Among the prominent manufacturers who are represented by this company are Grebe, Kennedy, Remler, King Am-pli-tone, Hipco Batteries, Western Electric, Signal and Tuska.

Because of the financial strength, the experience and efficiency of the organization and the geographical location, the Capital Radio Supply Company is logically the distributor to *successfully* handle this rich territory.

CAPITAL RADIO SUPPLY COMPANY, Inc.

Indianapolis, U. S. A.



navy slobs crazy mit phonographs und singing all der night out like nightmares und chackass deliriums! Codfish brains goes by codfishing, und wireless opberators goes by midnight electrics und lying all der night up mit hollering und loose talking-machine screws! It's under der bed already I'm in!

That settles Dutchy; but the Brainless Swede still sticks. About two o'clock in th' mornin' the gob goes to sleep with his set runnin'; an' he seems to have left his transmitter lyin' on a table or somethin' near his head, because we can hear him snorin' on th' air, like a distant rumblin' 'a autumn thunder. Th' Swede keeps yellin' away, tryin' to wake him up, until Hell-Fire slips out to the K-V-I engine-house with a bucket of water, an' dumps it in th' gasoline-tank.

Pretty soon th' old gas-mule gives a couple 'a consumptive chugs, splutters an' sucks wind, an' then dies stone-dead. An hour later, th' Swede comes dashin' over to our peacefully-sleepin' camp, wild-eyed an' cursin'.

"Yumpin snakes! After Ay bane vaiting whole night das navy stewbum vent avay before I vas speaking vun vord of fivf messages I vas writing tree days already yet, and now das gasoline engine stopped vorking, but for vy, I can't see! By golly, Ay bane qvit!"

THE next morning, I takes charge of the Swede's phone an' spreads a general call to all th' fish-barons to be on th' job at eight o'clock. That night, with all th' brasspounders that can squeeze into th' shack crowded around, I calls a roll; an' there is a hundred-percent attendance on th' air.

"Now then, we're ready to talk business," I commences. "After tryin' to be your own operators for three months, you've found out you're like a bunch 'a blacksmiths tryin' to tailor their own suits. Small phone sets can be run by anybody, even salmon-packers, but outfits the size of these take as good 'a operator to handle 'em an' keep 'em perkin' as a telegraph set does. Handlin' commercial business takes somebody's time, anyway; you can't always sit down an' clear right away, no matter how clever you are; an' if there's a heavy jam on th' air, an' you don't know th' game, you won't clear a'tall.

"Handlin' business telegrams over a phone ain't satisfactory, especially when they're full 'a names an' words hard to spell. Besides, nobody wants his private business shouted a thousand miles around with ten hundred million people stickin' up aerials to hear it; an' puttin' code an' cipher over a radiophone would turn a psalm-singer into a cursin' maniac inside of a week—even th' Brainless Swede here admits that.

"Th' tube sets are all right, an' can't be beat, but we'll have to put in circuits to handle th' business on undamped tele-

TURN TO PAGE 31

graph—not telephone. Now, to put in these circuits will cost you—wait a minute——"

I covers the transmitter-mouthpiece with my hand, an' turns to the bunch crowded around.

"How much have we spent for grub an' stuff since we been here?" I asks.

"Nearly twenty-four hundred bucks," replies Hell-Fire, who has th' figures. "About eighty-six plunks apiece."

"All right, say ninety dollars," I rejoins. "To put in key-circuits on these sets won't cost nothin' but five dollars each for th' sendin' keys."

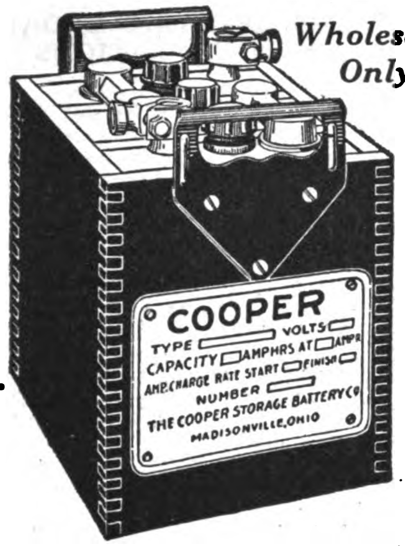
I takes my hand off the transmitter.

"To put in these circuits on your phone sets will cost five dollars apiece for telegraph keys an' ninety dollars for —for th' rest of th' apparatus an' things we have to get. Th' operators will leave tonight on th' *'Shelikoff'*; and as each one will hook up his own key-circuit, all you have to do is to each pay your own operator ninety-five simoleons for th' stuff we have to furnish. Now, is this O. K.?"

"Yes!"

Twenty-eight 1000-watt tube sets in at once knocked th' phones clean off my bean.

AND that is really the end of the story. The extra tube set that was in N-P-Q is now in Old Judge's den beside his amateur set; and on Sunday afternoons, when the Alaskan air is drowsy and peaceful, twenty-eight brass-pounders lean back in their chairs and enjoy a musical concert played on Old Judge's phonograph. Tune up around eighteen-hundred meters some quiet Sunday evening, and, if your set is good enough, you'll probably hear it.



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PACIFIC COAST UNIT

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The Camera Man Fell Down On The Job

That's why it's hard for us to tell you about the

"NORTHWESTERN" UNIT VARIOCOUPLER

Without a "Cut" which wasn't done on time.

Mounted	Unmounted
$15.00	**$6.50**

WELL, ANYWAY—It's a big brother to the variometer we showed you last month—panel same height, but twice as long—back connected thruout—and sure does "talk."

Hallock and Watson Radio Service

192 PARK ST. PORTLAND, ORE.

OPERATING STATIONS "KGG" AND "7XI"
(Only Five Watts, But She'll Grow)

The NEW EXIDE RADIO BATTERY

IS NOW READY

When the evening meal in countless homes is finished, the family settles itself comfortably in the living room for an evening's entertainment by wireless telephony.

The instrument is set up, a dial is turned, and from a distant city the voice of an operatic star fills the room. Or, at another turn of the dial, bed-time stories for the children are heard. Again, the strains of a church organ, the voices of the choir as well as a sermon, are heard from some church many miles away.

But to insure maximum enjoyment from any radio outfit, an absolutely dependable storage battery is essential—a battery designed to provide steady current—a battery whose voltage will not drop after a few minutes' use and necessitate frequent adjustments of the apparatus.

To meet these demands the Exide Radio Battery has been built.

From its practically unbreakable jars to its bolt connector terminals, every detail of this battery reflects the intimate knowledge of storage batteries which its builders possess.

The splendid results obtained with the Exide Radio Battery can be definitely attributed to the long experience behind it. For in the thirty-four years that Exide Batteries have been built for every purpose, much has been learned that was applied in designing a battery specifically for radio work.

Plates that insure long life without reducing this activity; wood separators of the type that have proved so successful in the famous Exide automobile batteries; jars that will withstand an unusual amount of hard usage; and terminals that insure perfect contact through the simple tightening of a nut—these are briefly, some of the features of the Exide Radio Battery.

The following table shows the four sizes in which this battery is made, with ampere-hour capacities ranging from 20 to 120, according to the number of plates. The over-all height of the battery is approximately 9⅝ inches; the width, 7 5/16; while the length, varying with the number of plates used, is given in the following table:

Type	Cat. No.	Length	Weight	Capacity	Price*
3-LXL-3	13735	4 9/16	15½ lbs.	20 amp. hrs.	$13.75
3-LXL-5	13736	5 11/16	24½ lbs.	40 amp. hrs.	17.85
3-LXL-9	13737	9 1/16	42½ lbs.	80 amp. hrs.	23.46
3-LXL-13	13750	12 7/16	59½ lbs.	120 amp. hrs.	30.60

*F. O. B. St. Louis, Mo.

Distributed by **J-Ray Mfg. Co.,** 1618 CHESTNUT STREET ST. LOUIS, MO.

NEWS OF RADIO BROADCASTING STATIONS

Continued from page 25

"Athletics," by Clarence P. Houston, Assistant Professor of Physical Education and a former Tufts football star; "The Story of the Bridge Builder," by Professor Edward H. Rockwell; "The Conservation of Bird Life," by Dr. Herbert V. Neal; "College Music," by Professor Leo R. Lewis. This lecture will be illustrated with selections by the Tufts College Glee Club. Professor Albert H. Gilmer will speak on "The Modern Drama," and Dean Lee Sullivan McCollester of the Crane Theological School will speak on "The Place of the Minister in Modern Society." A speaker to be selected by the Dean of the Dental School will treat the subject "The Relation of Dentistry to Medicine."

Although it is impossible to give the exact dates of the lectures, the entire course of 13 will be complete before May 1.

In the initial statement it was made clear that the lectures would be of a popular nature and not beyond the understanding of the thousands of young men and boys between the ages of 15 and 25 who are especially interested in wireless. Also the lectures will not exceed 30 minutes in length and will be delivered in such a way that "students" can take notes if desired. Some of the lectures will be given in the afternoon in order that women, many of whom are taking an interest in the radio telephone, may listen.

SEATTLE TO THE FRONT

Seattle, Wash., is awakening to the fact that there is such a thing as radio. Here are some of the recent developments:

The radiophone operated by the Northern Electric and Radio Co., in conjunction with the Seattle Post-Intelligencer, which has been giving concerts and news items for some time, is now transmitting several times a day. Aerials on house tops are becoming more common than the clothes line in the back yard. A very recent issue of one of the largest daily newspapers says:

"A new broadcasting station is to be operated here by Mr. V. I. Craft, and will give nightly concerts and press reports on 360 meters. The Times will have a set with a Magnavox at 1635 Westlake Ave., that will be in operation every Wednesday night, so the public can hear what is in the air.

"Since January 1 radiophone receiving sets have increased in use in Seattle by 100 per cent, according to the leading authority. He estimated that a thousand sets are now in operation in this city. A thousand sets means that ten times that number are daily hearing talk by wireless."

A dance was recently held at Camp Lewis, where the music was furnished by a Seattle radiophone. Another will be held at Alki Point which will depend on the radiophone for music. Recently a series of sermons was sent from the Catholic Church by radiophone. This series of lectures lasted a week.

BY WALTER HEMRICH, NORTH COAST PRODUCTS CO., ABERDEEN, WASH.

4cb, 6aau, 6abm, 6abx. 6aix 6ajr, 6alk, 6atk, 6ate, 6atu, 6ark, 6awr, 6cp, 6cq, 6ed, 6gr, 6gy, 6ic, 6qr, 6tu. 6vx, 6zf, 6zx, 6zam, 7ck, 7ge, 7jw, 7ke, 7ks, 7ln, 7ly, 7mf, 7mp, 7nz, 7nf, 7om, 7ot, 7ri, 7tj, 7vo, 7ya.

BY 6ASB, D. V. RUSSELL, BVA, CALIF.

Spark—5xd, 5za, 5ze, 6bd, 6bp, 6gr, 6gt, 6gy, 6hc, 6hp, 6ib, 6kc, 6ok, 6oh, 6pk, 6pj, 6qr, 6to, 6tu, 6tv, 6tc, 6vk, 6vx, 6zf, 6zi, 6zd, 6zu, 6zx, 6zz, 6zaj, 6zam, 6aak, 6aah, 6aau, 6abr, 6abu, 6acr, 6afd, 6afp, 6ahf, 6ain, 6ajh, 6ajr, 6ala, 6alr, 6amk, 6amw, 6amy, 6amz, 6aoe, 6aor, 6aqy, 6ard, 6ark, 6arx, 6ath, 6atq, 6bak, 6bam, 6bfg, 6liu, 7bp, 7eb, 7fj, 7ic, 7iw, (7jd), 7kc, 7mf, 7mp, 7mt, 7oh, 7vo, 7xa, 7ya, 7zm, 7zt.

C. W.—3fw, 5za, 6amd, 6bfp, 9db, 9hc.

BY C. C. WHYSALL, 8CMI, MARION, OHIO

1boq, 1ze, 1zak, 2el, 2fp, 2om, 3auw, 3dm, 3eh, 3xm, 4bk, 4bq, 4ft, 4gm, 4gn, 5aab, 5bm, 5by, 5fo, 5hk, 5lo, 5lw, 5py, 5uc, 5zz, 5zak, 8afb, 8aje, 8ajx, 8axk, 8ars, 8atu, 8ayx, 8anb, 8aoi, 8awu, 8bys, 8bq, 8bis, 8bfh, 8bxx, 8baz, 8cbe, 8daf, 8eb, 8hg, 8lb, 8ls, 8qq, 8rq, 8uc, 8vj cw, 8wz, 8xe, 8xv, 8yae, 8yk, 8ym, 8za, 8zp, 8zx, 9aaj, 9aas, 9aap, 9aeg, 9agr, 9acn, 9aif, 9ajh, 9aiu, 9aoe, 9aye, 9bp, 9dqq, 9dsd, 9dmj, 9dzi, 9dwp, 9dso, 9dfx, 9dug, 9hr, 9ki, 9lf, 9ms, 9uu, 9vl, 9xi, 9xt, 9xm, 9yb, 9yq. 9zj, 9zx.

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TRANSMITTING APPARATUS

FOR SALE: $300 500 cycle spark transmitter for $100 cash. Consists of ½ HP 3600 AC motor, generator and exciter switchboard with 500 cycle and 60 cycle volt and ammeters field rheostat and switches. Transmitter panel with Dubilier, O. T. transformer, quenched gap and radiation ammeter all mounted on bakelite. Spare armature, gaps and transformer go with the set. All above in good working condition. F. A. Brandis, 6IK, 1039 Merced, Berkeley, Cal.

FOR SALE CHEAP or exchange for C. W. apparatus: ¼ HP synchronous motor and Hyrad Disc. 6ACM, 1551 Emerson St., Palo Alto, Calif.

RECEIVING APPARATUS

ONE RADIO MAGNAVOX $45.00, used only few weeks. Reason for selling, going out of radio business. Sacrifice for $35.00. Perfect condition. J. B. Brun, 1701 Franklin St., San Francisco.

A BARGAIN: I. P. 500 Navy Standard Receiver, $160.00. 7KR, 528 Market, Portland, Ore.

VARIOCOUPLER PARTS: Hardwood rotors, 45c; stators, 60c; complete variocoupler, $3.50. Include postage. Louis Griewisch, 301 South Oakland, Green Bay, Wisc.

VARIOCOUPLER PARTS: Hardwood rotors, wound, 95c; stators wound, $1.00. Include postage. Louis Griewisch, 301 South Oakland, Green Bay, Wisc.

600-20,000 meter receiver including Radiotron, $35.00. 150-600 meter receiver including Radiotron, $35.00. Box 205, Williamsport, Penna.

3 LONG WAVE TUNERS, $2.00 each. 2 spark coils, $1.00 each. 1 Murdock tuning coil, $3.00. 1 Electro tuning coil, $2.00. 3 Murdock .001 variable condensers, $2.50 each. 1 Murdock .0005 variable, $2.00. Practice key, 30c; Martyn Coony, 475 30th St., San Francisco.

OCCASION. A complete Audion Receiving Set: Inductances, Primary and Secondary Condensers, Series and Parallel Switch, variable Grid-Leak, four Dials, A and B battery switches, Weston Ammeter and Voltmeter, Bakelite panel (B battery included). The whole enclosed in a polished mahogany case, with snap fasteners and lock and key—14x10x8 in. Range: 200 to 2500 meters. (Radio Concerts and Time-signals.) Price $40.00. Inspection and testing invited. C. E. W., 2630 Ridge Road, Berkeley, Cal.

Loop Antennae. With a vacuum tube set this Loop Antenna will receive radio without the need of an aerial on the roof. 3½ feet high, shipped knocked down, postpaid on receipt $2.50 money order. P. Anico, 421A West 26th Street, New York.

FOR TRADE: Two new $6 variometers for phones, tubes or other radio. R. W. Haynes, 1236 American Ave., Long Beach, Calif.

Must sell! Short wave REGENERATIVE RECEIVER for $35; cost $60. R. W. Haynes, 1236 American Ave., Long Beach, Calif.

FOR SALE: Short wave regenerative receiver, 150-600 meters. Brand new and fully guaranteed. Reasonable. Phone West 1357, San Francisco.

Bargain: Receiver and two step amplifier, $50. Crystal receiver including pair phones, $10. Two step amplifier, value $60, sell for $30. Magnavox, storage battery, rectifier, etc. H. E. Williams, 1819 Napa street, Vallejo, California.

RADIO STORAGE BATTERIES. 30 A. H. 2V. $1.70 per cell. Guarantee for 1 year. Order at once. You take no chances. Howard Hunt, Box 108, Macedonia, Ohio.

MISCELLANEOUS

Trade for radio: Remington 12A repeating rifle; sell $15; Blickensderfer Typewriter $10. Charles Vanderpool, Madill, Okla.

FOR SALE OR TRADE: 1/12 H. P. 3400 Revolution Westinghouse motor. Need loud speaker. Postoffice Box 128, Menlo Park, Calif.

BUILD RADIO SETS. We supply parts or complete units. Catalog 15 cents. Easily understood assembly drawings Crystal Detector Set, Non-regenerative Receiver, Regenerative Receiver, 2 Step Amplifier 25 cents EACH. All five $1.00. No stamps accepted. Hatfield Airfone Company, Owego, N. Y.

"A" BATTERY SALE—Have several new and rebuilt storage batteries, $6.00 up. New 6v nine plate radio batteries, $18.00. Farwell Battery Station, 2240 Russell St., Berkeley, Cal.

STOP! LOOK! and ACT! V. T.'s ACCESSORIES! With each of the listed tubes RADIOTRON U.V.200, $5.00, and A. P. MOORHEAD detectors $5.00; RADIOTRON U.V.201 $6.50, and A. P. Amplifiers, $6.50, we will supply free of charge your choice of either of these 5 premiums—latest FADA rheostat, $1.00; Paragon V. T. socket, $1.00; Murdock socket, $1.00; DeForest V. T. socket, $1.00; Remler rheostat, $1.00. Either of the FEDERAL single, closed or double circuit jacks listed respectively at 70c, 85c, and $1.00, will be given as premiums with each FEDERAL 226W or R. C. of A. U.V.712 amplifying transformers, $7.00 each. U.R.1714 Radio Frequency amplifying transformer. FADA 5 ampere NICHROME Thermoplax, power rheostat $1.35 or R. C. of A. U.R.542 porcelain V. T. socket will be given as premiums with each $8.00 U.V.202 power tube or A. P. MOORHEAD 5-watt Type C power tube, $7.50 each for C. W. or Radiophone transmission or power amplification. We absolutely guarantee the foregoing apparatus. Only new and high grade equipment carried in stock. Unsatisfactory goods subject to return within five days. 12 hour service or your remittance returned. Postage and insurance prepaid by us, thereby saving time and money. Remember us. THE KEHLER RADIO LABORATORIES, Dept. P., Abilene, Kansas.

CABINETS—High grade cabinets at reasonable prices. Cabinets made to order. Send sketch or full details for prices. Panels cut and drilled. Prompt service. Marvin Fallgatter, Waupaca, Wis.

INSTRUCTION

BKUMA YRLSBUG—TWO HUNDRED beginners tell how memorized wireless code in thirty minutes to two hours. Booklet, 10 red stamps. Dodge. Box 220, Mamaroneck, N. Y.

TELEGRAPHY—(Morse and Wireless) and Railway Accounting taught thoroughly; big salaries; great opportunities. Oldest, largest school. All expenses low—can earn large part. Catalogue free. DODGE'S INSTITUTE, Hass St., Valparaiso, Indiana.

RADIO BOOKS

"Arc Radio Manual," published by the engineers of the Federal Telegraph Company of San Francisco, and written in simple, interesting manner. Well illustrated with diagrams and photographs of the various types of arc radio apparatus used on shipboard and in shore stations. Price $2.50 per copy, postpaid in the U. S. For sale by Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

"License Quiz Book," for passing the U. S. Government radio examinations. The most popular selling radio book. Contains 106 pages of radio information. 80 illustrations. 250 questions and answers. Deals with every new radio development. Price $1.00 per copy, postpaid anywhere in the U. S., or given free with a one year subscription to "RADIO." Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

COPPERWELD ANTENNA WIRE

At radio frequency, the core of a wire performs no electrical service because it carries no current. The core may, therefore, be made to perform a great mechanical duty. Hence an ideal wire for radio should have a core of high strength metal (steel) and an outer covering of high conductivity metal (copper).

Copperweld antenna wire is made by permanently welding the protective and conducting outer coating of pure copper to the steel core. It has the same non-rusting qualities as copper wire. At radio frequency it has practically the same conductivity as copper wire of equal diameter.

Copperweld antenna wire is 50 per cent stronger than copper wire of equal size and will stay up under severe sleet and wind loads when other wires would be wrecked. Copperweld antenna wire does not sag and stretch with subsequent breaking as does hard-drawn copper. Many Copperweld amateur antennas have remained up during storms when hard-drawn copper antennas have broken down.

COMPLETE LIST OF BROADCASTING STATIONS

Ninety-eight radio stations were broadcasting music, concerts, lectures and market and weather reports, according to the Department of Commerce, on March 23. The list of stations sending entertainment on 360 meter wave follows:

KZM—Allen, Preston D., Hotel Oakland, Oakland, Calif.
WGI—American Radio & Research Corpn., Medford, Hillside, Mass.
KZY—Atlantic-Pacific Radio Supplies Co., Oakland, Calif.
WOR—Bamberger, L. & Co., Newark, N. J.
KJS—Bible Institute of Los Angeles.
WDM—Church of Covenant, Washington, D. C.
WBU—City of Chicago, Ill.
WHK—Cox, Warren R., Cleveland, Ohio.
WLW—Crossley Mfg. Co., Cincinnatti, Ohio.
WJX—DeForest Radio Telephone & Telegraph Co., New York, N. Y.
WWJ—Detroit News, Detroit, Mich.*
KQV—Doubleday-Hill Electric Co., Pittsburgh, Pa.
WRK—Doron Bros. Electric Co., Hamilton, Ohio.
WHU—Duck Co., Wm. B., Toledo, Ohio.
KLB—Dunn & Co., J. J., Pasadena, Calif.
KGC—Electric Lighting and Supply Co., Hollywood, Calif.
KUO—Examiner Printing Co., San Francisco, Calif.
WGY—General Electric Co., Schenectady, N. Y.
WCJ—Gilbert Co., A. C., New Haven, Conn.
KJQ—Gould, C. O., Stockton, Calif.
WLK—Hamilton Mfg. Co., Indianapolis, Ind.
WOH—Hatfield Electric Co., Indianapolis, Ind.
KQW—Herrold, Chas. D., San Jose, Calif.
KVQ—Hobrecht, J. C. (Sacramento Bee), Sacramento, Calif.
WGL—Howlett, Thos. F. J., Philadelphia, Pa.
WOC—Karlowa Radio Co., Rock Island, Ill.*
KLP—Kennedy, Colin B. Co., Los Altos, Calif.
KQL—Kluge, Arno A., Los Angeles, Calif.
KJR—Kraft, Vincent I., Seattle, Wash.
KGB—Lorden, Edwin L., San Francisco, Calif.
WSZ—Marshall-Gerken Co., Toledo, Ohio.*
WOU—Metropolitan Utilities District, Omaha, Neb.*
KDN—Meyberg Co., Leo J., San Francisco, Calif.
KYJ—Meyberg Co., Leo J., Los Angeles, Calif.
WOS—Missouri State Marketing Bureau, Jefferson City, Mo. (Markets.)
WGH—Montgomery Light & Water Power Co., Montgomery, Ala.*
WPB—Newspaper Printing Co., Pittsburgh, Pa.
KFC—Northern Radio & Electric Co., Seattle, Wash.
WOZ—Palladium Printing Co., Richmond, Ind.*
WOK—Pine Bluff Co., The, Pine Bluff, Ark.
KGF—Pomona Fixture & Wiring Co., Pomona, Calif.
KWG—Portable Wireless Tel. Co., Stockton, Calif.
WMH—Precision Equipment Co., Cincinnati, Ohio.*

Continued on page 79

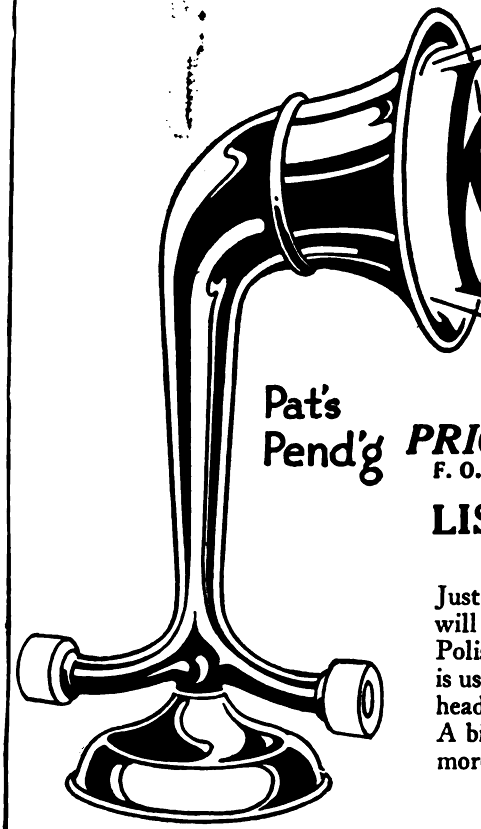
Radio frequency amplification is accomplished by increasing or relaying intercepted radio signals before the energy passes through the detector tube. In audio frequency amplification the current is built up after leaving the tube detector. Weak and distinct signals can be detected by the former method, whereas they would be inaudible with the latter.

A condenser instead of an antenna for transmission and reception of radio signals is being investigated by the U. S. Bureau of Standards. Taking advantage of the fact that the ordinary aerial corresponds to one plate of a condenser and the ground to the other, a pair of large metal plates is substituted and found to be freer from static disturbances and to offer better opportunity for portable sets.

1BZX—Experimenters' Information Service station at Thomas G. Plant factory, Boston 20, Mass. Initial concert given Feb. 17, 1922.

Compare it with ANY
It SPEAKS for ITSELF

INTRODUCING THE KING "AM-PLI-TONE" A RADIO SURPRISE



Pat's Pend'g

PRICE $12.00
F. O. B. New York City

LISTEN TO THE CONCERTS, NEWS AND DANCE WITH A KING *"AM-PLI-TONE"*

Just slip your head phones on the "AM-PLI-TONE" and you and your friends will be *SURPRISED!*
Polished cast aluminum body with nickel plated base and horn. No sheet metal is used. The tinny sound is left out. The volume is *DOUBLED* because *TWO* head phones are blended into one *POWERFUL* tone.
A big hit, a big seller, and immediate deliveries. Dealers and distributors, what more can you ask? Write today for territory—KING "AM-PLI-TONE."
NOTICE—All infringers of this device will be vigorously prosecuted.
82 Church St., New York City

THE ONE BEST WAY—PACENTIZE!

Why fuss about with binding posts and unsightly frayed wires when Pacent Radio Essentials will allow you to change connections in the twinkling of an eye? This Pacent combination was made to work as a unit in overcoming all connection problems in both receiving and transmitting apparatus. When the Plug, Twin-Adapter and Multi-jack are used together, they replace no less than fourteen binding posts!

PRICE $1.25

PACENT UNIVERSAL PLUG

This plug was the first real radio plug to make an appearance and it remains the first radio plug in quality. A solderless, biting contact is made which will not give rise to disturbing noises. You can use the Pacent Plug with 'phones, Duo-Lateral Coils, microphones, keys, etc. The Pacent Plug fits any jack. With its soft, velvety black finish it will add a touch of beauty to any receiver.

Catalog No. 50 PACENT UNIVERSAL PLUG, Price $1.25

PRICE $1.50

PACENT TWIN-ADAPTER

You can't put two plugs in a single jack, but you can make a single jack serve the purpose of two jacks with a Pacent Twin-Adapter. Just insert the Twin-Adapter and presto!—the usefulness of the jack is multiplied by two. Just the thing to use with a loud speaker; tune with the 'phones and then plug in the loud speaker. The Twin-Adapter has a multitude of uses in C. W. work.

Catalog No. 51 Pacent Twin-Adapter, Price $1.50

PRICE $1.50

PACENT MULTI-JACK

Here is another worthy member of the Pacent plug and jack combination. This is really three independent jacks built into a beautiful composition base. Screwed to the side of a receiving outfit it will allow three sets of 'phones to be plugged in or two sets of 'phones and a loud speaker. It may also be screwed to the table or the testing board. All standard plugs will fit into it, but it was designed especially for use with the Pacent Universal Plug or Pacent Twin-Adapter.

Catalog No. 52 PACENT MULTI-JACK, Price $1.50

Send for copy of circular N100

See the Pacent Radio Essentials at your dealers. Dealers and Jobbers—Write for our sales plan

PACENT ELECTRIC COMPANY

INCORPORATED
LOUIS GERARD PACENT, President
150 NASSAU STREET NEW YORK CITY
Member Associated Manufacturers of Electrical Supplies

QUERIES AND REPLIES

Continued from page 26

as several good articles on how to wind honeycomb coils have recently been published. To tap a honeycomb coil in five or six steps, estimate the number of layers in the coil and the number of turns in each layer and divide by five or six, whichever the case may be, to determine what layers are to be selected. Then scrape the insulation from the outside wire in the layers selected, and solder connecting wires at these points. The auxiliary tickler mentioned in Mr. Weihe's article is wound on the same cardboard tube with the primary, and adjacent to it.

Question: (a) Is a flat top antenna with a counterpoise strung beneath it more efficient than a vertical antenna with a counterpoise consisting of wires strung on a framework beneath the antenna?

(b) Is it more desirable to have an antenna whose natural wave is as near the 200 meter as possible or should the wave be ten or twenty meters lower and add inductance in the transmitter?

C. L. R., Lemar Grove, Calif.

Answer: (a) For 200 meter work a high vertical fan having a fundamental wave somewhat below 200 meters, used with the counterpoise you describe, would be more efficient, although not enough more than the flat top to warrant the additional expense.

(b) The wave should be nearer 40 or 50 meters lower than 200 in order to avoid the use of a series condenser.

4CB—CANADIAN

Continued from page 27

fan 80 ft., 65 ft. high and 4 wire counterpoise wi tuned gnd. Wavelength 215 M; radiation 2.2 amps C. W., and 1½ amps fone. "Surefire" crt. My receiver, long wave H. C. coils; short wave reg., variometer type; spider webs; audion det., 1 step R. F. and 2 step A. F. amplifier. Rec. aerial; break-in, 125 ft. long, one wire 95 ft. high end. Baldwin fones; loud speaker and 150 V storage "B" battery. All home-made. We use fone when calling U. S. stations and V when calling Canadian stations. U. S. stations should use "AA" when calling Canadian stations as shown in QST.

COMPLETE LIST OF BROADCASTING STATIONS

Continued from page 75

KFU—Precision Shop, Gridley, Calif.
WDW—Radio Const. & Electric Co., Washington, D. C.
WDY—Radio Corporation of America, Rosselle Park, N. J.
KJJ—Radio Shop, Sunnyvale, Calif.
KYY—Radio Telephone Shop, San Francisco, Calif.
KIZ—Reynolds Radio Co., Denver, Colo.*
WFO—Rike-Kumler Co., Dayton, Ohio.*
WHQ—Rochester Times-Union, Rochester, N. Y.*
WHW—Seeley, Stuart W., East Lansing, Mich. (Market and weather.)
WJK—Service Radio Equipment Co., Toledo, Ohio.
WDT—Ship Owners Radio Service, New York, N. Y.
WRL—Union College, Schenectady, N. Y.
WLB—University of Minnesota, Minneapolis, Minn.*
WHA—University of Wisconsin, Madison, Wis.*
KLS—Warner Bros., Oakland, Calif.
KHQ—Wasmer, Louis, Seattle, Wash.
WBZ—Westinghouse Electric & Mfg. Co., Springfield, Mass.
KYW—Westinghouse Electric & Mfg. Co., Chicago, Ill.
WJZ—Westinghouse Electric & Mfg. Co., Newark, N. J.
KDKA—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
KOG—Western Radio Electric Co., Los Angeles, Calif.
WOQ—Western Radio Co., Kansas City, Mo.*
WJH—White and Boyer, Washington, D. C.
WNO—Wireless Telephone Co., Hudson County, Jersey City, N. J.

*Designates also sending markets and weather on 485 wavelength.

WCN—Clark University, Worcester, Mass.**
WJT—Electric Equipment Co., Erie, Pa.
WSX—Erie Radio Co., Erie, Pa.
WPR—Federal Institute of Radio Teleg., Camden, N. J.
WIP—Gimbel Bros., Philadelphia, Pa.
WGV—Interstate Electric Co., New Orleans, La.
KGW—Oregonian Publishing Co., Portland, Ore.
KOA—Y. M. C. A., Denver, Colo.*
WPA—Fort Worth Record, Fort Worth, Texas.
KHJ—Kierulff, C. R. & Co., Los Angeles, Calif.
WHN—Ridgewood Times Print. and Pub. Co., Ridgewood, N. Y.
WBT—Southern Radio Co., Charlotte N. C.
WFI—Strawbridge and Clothier, Philadelphia, Pa.
WOO—Wanamaker, John, Philadelphia, Pa.
WSL—J. & M. Electric Co., Utica, N .Y.
KDPT—Southern Electric Co., San Diego, Calif.
WHD—West Va. Univ., Morgantown, W. Va.
WKY—Oklahoma Radio Shop, Oklahoma City, Okla.**
KGG—Hallock and Watson, Portland, Ore.
KGO—Altadena Radio Lab., Altadena, Calif.
WIL—Continental Electric Sup. Co., Washington, D. C.
KGU—Marion A. Mulrony, Honolulu, T. H.
WGR—Federal Tel. & Tel. Co., Buffalo, N. Y.***
KSD—Pulitzer Print. Co., St. Louis, Mo. (St. Louis Post Dispatch.)
WRW—Tarrytown Radio Research Lab., Tarrytown, N. Y.
WPM—Thos. J. Williams, Inc., Washington, D. C.
WIK—K. & L. Electric Co., McKeesport, Pa.
WRR—City of Dallas, Dallas, Texas.
KSL—The Emporium, San Francisco, Calif.
KRE—Maxwell Electric Co., Berkeley, Calif.
WBS—D. W. May, Inc., Newark, N. J.

*Only weather.
**Also weather.
***Also market and weather.

Bulletins C-1 and C-2 from Klitzen Radio Mfg. Co. of Racine, Wis., illustrate and describe the Klitzen variometer and variocoupler respectively.

5GI is heard now and then.

5XA pushes thru in fine shape.

5ZAP is one of the most active stations in the South.

5ZL helps to keep Little Rock on the map.

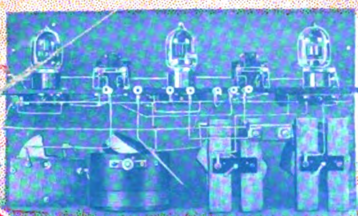
8DY breaks thru fine with his spark.

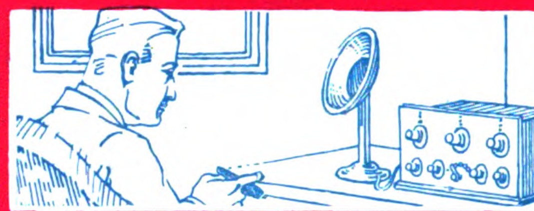
8XE now uses spark and C. W.

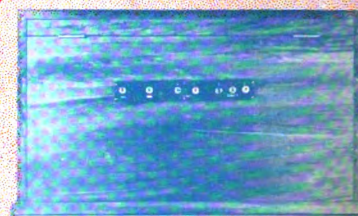
8LF pounds thru in fine shape.

8SR is operator LM at 1BIR. 8SR will be on again as soon as he returns from school at Exeter, N. H.

The MAN'S Set—







A view showing interior arrangement. Note the compactness and utter simplicity. The variometers are of special mahogany, designed for maximum inductance ratio from minimum to maximum. The detector circuit includes copper foil and mica grid and plate condensers with tubular grid leak. General radio sockets.

Exterior view of rear of set. Note the hinges, the entire top may be swung back, thus giving easy access to everything inside. Note the insulated panel in the rear center, to which all connections are made, thus freeing the front of unsightly wires. Note also the sturdy thickness of the heavy gumwood cabinet frame.

New regenerative receiver set TYPE A-P ONE

Manufactured by The Radio Shop, Sunnyvale, Cal. ***Exclusive distributors—Atlantic-Pacific Radio Supplies Co.***

If you would get a man's enjoyment from radio, you don't want a toy, you want a ***man's*** set. The new Regenerative Receiver Set, Type A-P one, is designed as a ***man's*** set. A real practical serviceable and efficient outfit for a man's office, his amateur station, or his home.

The cabinet is of grained gumwood, with a beautiful piano finish. The panel is of heavy Formica, on which all lettering is machine engraved in white. The dials are of polished German silver, with black engraved divisions in figures, and fitted with large tapering knobs, enabling fine tuning. The 180° rheostat matches the other dials. All wires and all metal parts, both exterior and interior, are nickel plated.

The set is designed especially for short-wave lengths of from 150 to 450 meters, to insure maximum audibility and clearness for concert and amateur use. Particularly is it ideal for home entertainment in receiving radio music, radio news, and other broadcasted features. But with real man-like versatility it operates with equal efficiency in receiving spark and C W. A-P vacuum tubes used throughout.

Whether you ***know*** radio, or simply know you are interested, Type A-P One is the set you want. Simple in adjustment, and extremely selective, yet highly sensitive. When you buy a set, make sure it's—***"A MAN'S set."***

USE A-P TUBES FOR EFFICIENCY

Call for a demonstration, or write us for a folder giving prices and full particulars. Orders should be placed quickly to insure delivery at the earliest possible moment.

DEALERS and JOBBERS—we have a man's proposition for you on "the Man's set." Write us.

ATLANTIC-PACIFIC RADIO SUPPLIES COMPANY

Henry M. Shaw, President

638 MISSION STREET
SAN FRANCISCO, CALIFORNIA

Exclusive distributors for Moorhead Laboratories, Inc.
Operating (KZY) Rock Ridge Radio Station, Oakland, Cal.

EASTERN OFFICE AT
5 KIRK PLACE, NEWARK, N. J.

Abbott-Brady Printing Corp., S. F.

June, 1922

CIRCULATION
OVER 60,000

25 Cents

RADIO

Over the "waves"

—enjoying a special concert number broadcasted from Rock Ridge (KZY) Oakland, Cal.

Everything for the radio user

Atlantic-Pacific Radio Supplies Company

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Operating (KZY) Rock Ridge Station,
Oakland, Cal.

EASTERN OFFICE AT

RADIO

Established 1917 as Pacific Radio News

Volume IV *for* JUNE, 1922 *Number 6*

CONTENTS *for* JUNE, 1922

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Forecast of Contributions for July Issue

Major Laurence Mott

Because of his keen interest in the progress of citizen radio, with a view to its paramount usefulness to the War Department, should occasion arise, Lawrence Mott, associate editor RADIO has been commissioned a Major in the Signal Corps, ORC-USA, by the President. The results achieved at 6XAD have been of great interest to General Squier, the Chief Signal Officer, for whom Major Mott has written several especially requested articles, dealing with the phenomena of his station,, and the local conditions, geographic, etc., at Catalina Island, Calif. An additional list of his recent d. x. work appears on another page of this issue. In the July number, Major Mott will have an article of vital interest to every real operator.

Prof. A. K. Aster has prepared an able paper on "Design of Iron-Core Audio-Frequency Choke Coils." This paper is illustrated by practical examples that should enable any intelligent amateur to design coils to meet given requirements.

G. W. Cattell, radio engineer with the navy, will again have some of his writings in these columns in an article on "Resistance and Susceptance Diagrams," which will afford an easy and quick method of analyzing radio circuits.

B. F. McNamee, one of the few men who really knows vacuum tubes, will tell about the how and why of "The Vacuum Tube As An Amplifier," in simple language that clarifies this complex subject. The subject of vacuum tubes will also be discussed by H. A. Eveleth in his series of articles in "The Radio Primer."

The next installment in J. B. Dow's "C. W. Manual" will be concerned with a 250-watt power amplifier. The complete book will be ready about June 15th, anticipating the completion of the series in RADIO by several months.

Those of our readers who have been enjoying the clever verse and grid leaks by Earl Ennis will welcome the announcement that he has some real fiction dealing in a most humorous but prophetic style with future developments in radio music. David P. Gibbons, in his inimitable "Japradionese," takes a fling at broadcasting.


"The right path is near,"
says Mencius,
"yet men seek it afar off,"
The right Receiver is here—
the Grebe CR-5—
The wise Radioist
need seek no further!
Doctor Mu
H.A. Weiss
GREBE RADIO
Licensed under
Armstrong U. S. Patent,
No. 1113149.

RADIO APPARATUS

Distributors of Reliable Radio Apparatus to Schools, Colleges, Radio Clubs and Experimenters All Over the World!

"PITTSCO"
Specializing on RADIO CORPORATION'S Products

"PITTSCO"
Now has three Stores.
Send us your orders.

The present tremendous demand for Radio Apparatus has practically made it impossible for us to render our usual SERVICE.
Reasonably prompt delivery however can be made on the items listed.

AMPLIFYING TRANSFORMERS

No. P-1 General Radio, semi-mounted	$ 5.00
No. 50 Chelsea, semi-mounted	4.50
No. A-2 Acme, semi-mounted	5.00

ANTENNA WIRE

"Pittsco" No. 14 Hard drawn copper, (80 ft. per lb.) per lb.	.40
500 ft. (Special value)	2.25
"Pittsco" 7 strand No. 22 tinned copper, per ft.	.01
500 ft.	4.00
1000 ft.	7.50
"Pittsco" 7 strand No. 20 Phosphor bronze per ft.	.02
500 ft.	7.50

ANTENNA INSULATORS

No. P-1 Electrose Ball insulator	.35
No. P-2 Electrose 4 inch strain insulator	.45
No. P-3 Electrose 10 inch strain insulator	.75

"A" BATTERIES (Storage Batteries)

Yale 6 volt 60 Ampere-hour	18.00
Yale 6 volt 80 Ampere-hour	21.00
Yale 6 volt 100 Ampere-hour	25.00

Note.—These batteries are shipped carefully crated and fully charged ready for use.

"A" BATTERY RECTIFIERS

No. P-1 Tungar, 5 ampere type, complete with bulb	28.00
No. P-2 Tungar, 2 ampere type, complete with bulb	18.00
No. P-3 F F Battery Booster, 5 ampere type	15.00

"B" BATTERIES

No. 763 Eveready, 22.5 volt, small size	1.75
No. 766 Eveready, 22.5 volt, large size, 16½ to 22½ volts	3.00
No. 774 Eveready, 43 volt, large size, variable	5.00

CRYSTAL RECEIVING SETS

Aeriola, Jr., Westinghouse, complete with telephones	$25.00
Every-man's DeForest, complete with telephones	25.00

CONDENSERS (Variable)

No. 1 Chelsea, fully mounted, .001 Mf.	5.00
No. 2 Chelsea, fully mounted, .0005 Mf.	4.50
No. 3 Chelsea, unmounted with dial, .001 Mf.	4.75
No. 4 Chelsea, unmounted with dial, .0005 Mf.	4.25
No. 367 Murdock, fully mounted, .001 Mf.	4.50
No. 368 Murdock, fully mounted, .0005 Mf.	4.00
No. 3660 Murdock, unmounted without knob and dial, .001 Mf.	4.00
No. 3680 Murdock, unmounted without knob and dial, .0005 Mf.	3.25

JACKS (Radio Type)

No. P-1 Open circuit	.70
No. P-2 Closed circuit	.85
No. P-3 Two circuit	1.00

LOUD SPEAKERS

Arkay, horn only, satin finish	5.00
Federal Pleiophone, complete with phone	14.00

PLUGS

No. 34-B Firco, round type	2.50
No. P-1 Western Electric	1.10

SOCKETS

No. 156 General Radio, improved model	1.50
No. P-1 Chelsea	1.00
No. P-2 Clapp-Eastham, bakelite type	1.00
No. UR-542 Radio Corporation	1.00

TELEPHONES

No. 56 Murdock, 2000 ohms	5.00
No. 56 Murdock, 3000 ohms	6.00
No. 2A Stromberg Carlson, 2000 ohms	7.50
No. P-1 Holtzer-Cabot, 2,200 ohms	8.00

Let "PITTSCO" fill your orders for any of the above items.
Our SERVICE on these at the present time will please you.

F. D. PITTS CO., Inc.

12 PARK SQUARE **BOSTON, MASS., U. S. A.**

Woolworth Building,
Providence, R. I.

3 STORES

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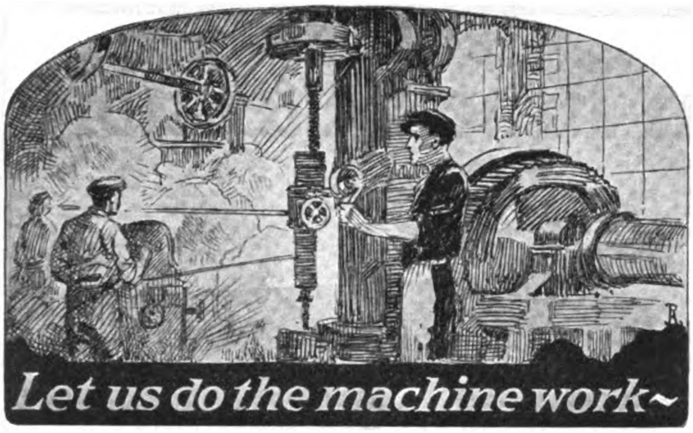
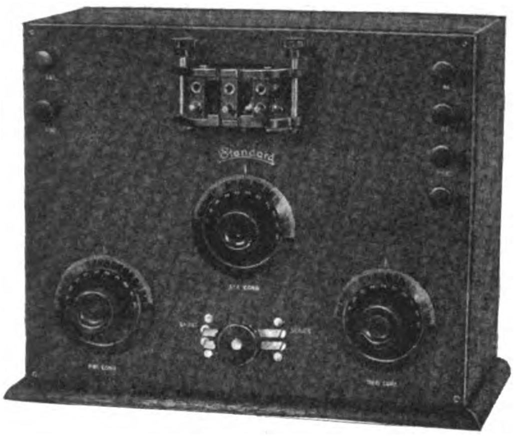
Springfield, Mass.



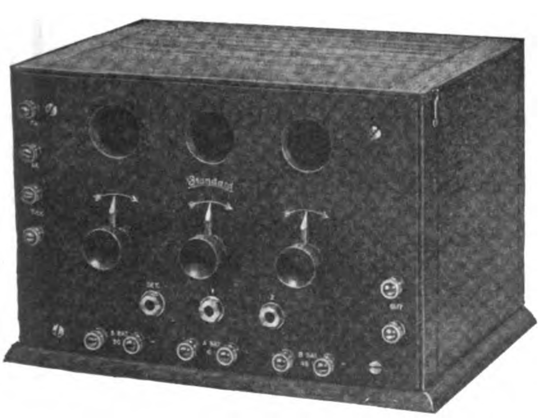
Save 20% or More on the Cost of High-Grade Radio Instruments!



Multiple Wave Tuner—Here you obtain in a single instrument the equipment to receive all classes of signals on all known wave-lengths—150 to 25,000 meters. Minimum number of controls provide extreme simplicity of operation, yet the design renders the tuning especially sensitive and selective.

Price, completely assembled, F. O. B. New York, $45.00

Set of 18 DL Coils, to receive all the most used wave-lengths, $40.00.



Detector and Two-Step Amplifier—Your choice of two types, Commercial or Amateur. The commercial type is assembled from the most costly, efficient units available. Radio Corporation UV-712 transformers and General Radio tube receptacles typify the quality thruout. The Amateur type is an exact duplicate, except that transformers and sockets of high efficiency, but lower cost, are used.

Prices, F. O. B. New York:

Commercial type, unwired...... $55.00
Amateur type, unwired......... 47.00

Here is clear saving of $10.00 in either case, thru the "Standard" Plan.

THERE are two parts in the building of radio apparatus; first the actual panel drilling and assembling, and second, the wiring.

The first is essentially machine work. At the same time, because it *is* machine work, it is really the less expensive part of the entire assembly.

The wiring, which is hand work, is the expensive part and also the part which you can do just as well yourself. The Standard Plan gives you an opportunity to secure commercial grade correctly assembled apparatus at prices only slightly more than you would pay for the individual instruments.

The Standard Plan ASSEMBLED but not WIRED!

The Standard Assembling Company makes a complete line of parts—fully ASSEMBLED but not WIRED. The actual machine work is done in a splendidly equipped factory. The workmanship is not excelled anywhere. The individual instruments and parts are of the highest quality obtainable and are bought in tremendous quantities at big discounts.

The wiring, which is expensive hand work, is left for you to finish. You can incorporate your own circuit if you wish, or, you can follow the wiring diagrams which are provided with every instrument.

Take advantage of the Standard Plan and save the expensive wiring costs. Only in this way can you get fully assembled high quality apparatus at such low prices.

Take this opportunity to *try* the Standard Plan at *our* Risk!

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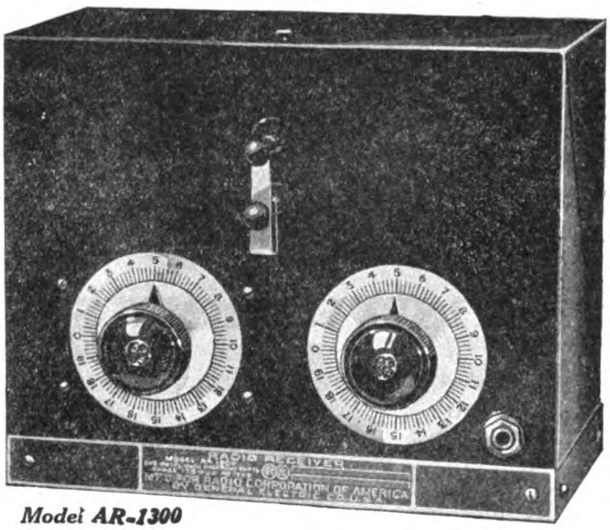
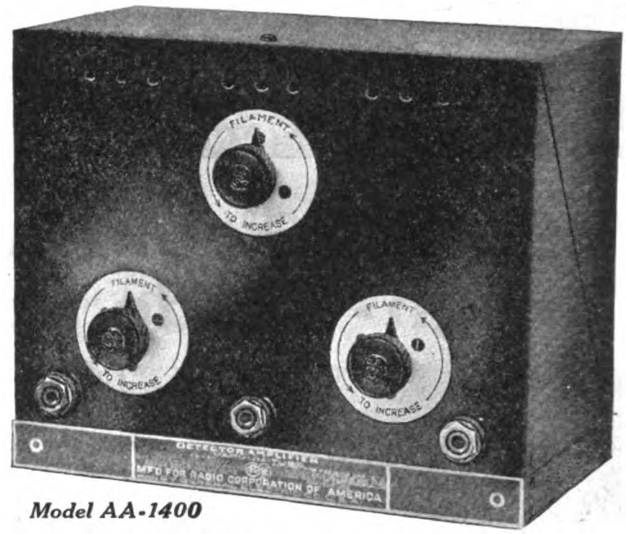


Model AR-1300



Model AA-1400

These two sets (radio receiver Model AR-1300 and Detector Amplifier Model AA-1400) meet the demand of the novice who wishes to start with a simple crystal detector and later to pass on to vacuum tube detection and amplification at minimum cost.

Radio receiver Model AR-1300 is a new tuner for the broadcast enthusiast. Used as a crystal detector it is a complete receiver. Used with Model AA-1400, here shown, the crystal detector is switched off and amplification is controlled by regeneration.

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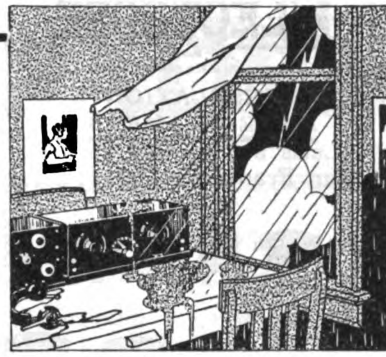

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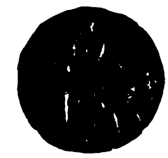

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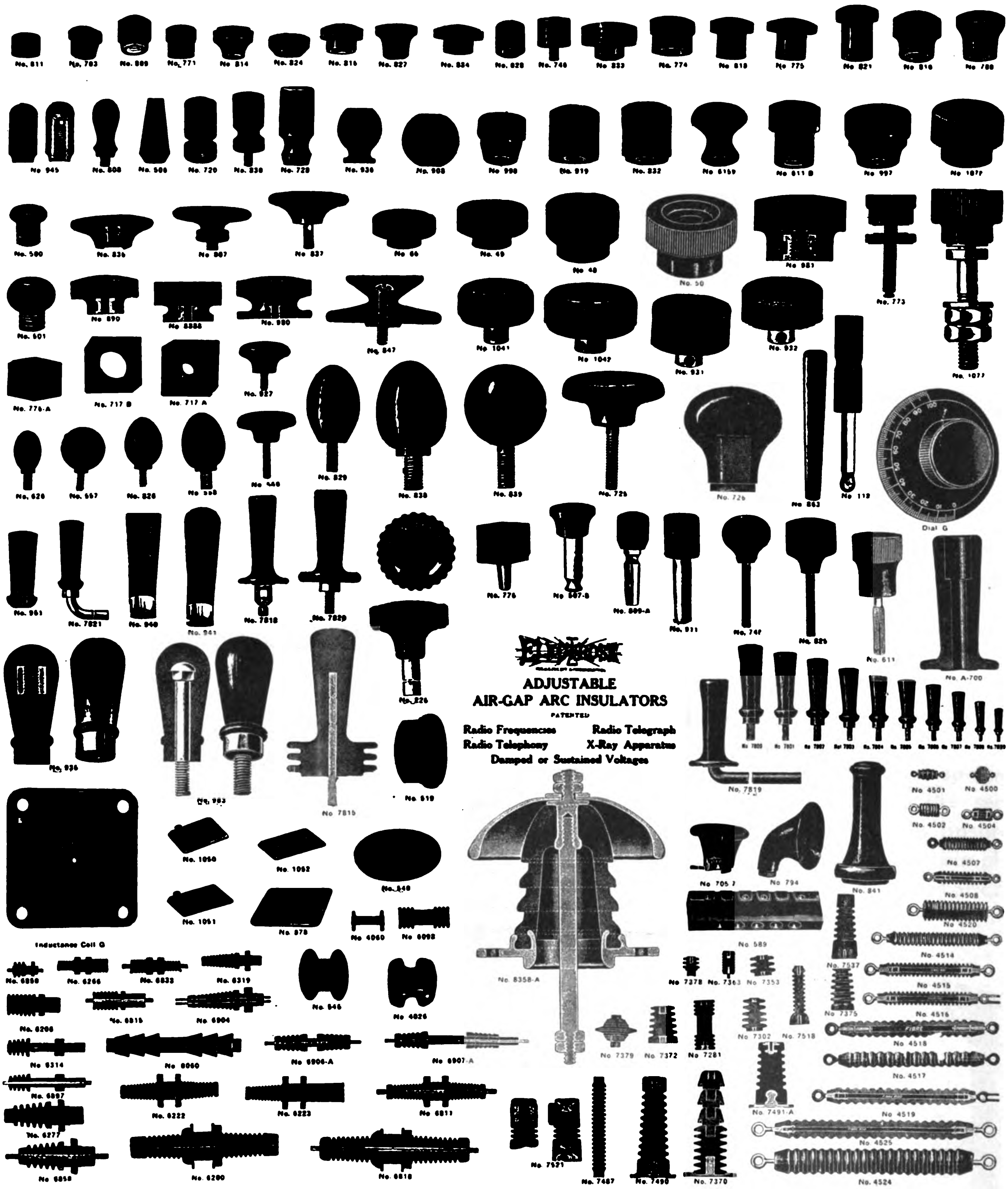

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June, 1922 | RADIO | Vol. 4 No. 6

Radiotorial Comment

THEY wrong radio who speak of it as a fad. For f-a-d is only for a day, while radio is here to stay. Although it will not displace the wire telephone any more than the telephone displaced the telegraph or the telegraph superseded the mail, radio opens up new avenues of communication which are not adequately met by the older agencies.

Radio constitutes one of the most revolutionary factors yet introduced into the life of the people. What existing habits of civilization it will upset is as difficult to prophesy as it was to forsee what changes would be wrought by the locomotive, the automobile or the airplane. Today it is largely a novel source of entertainment. Tomorrow it will be a vital necessity in business and domestic life.

With the opening up of a wider band of wavelengths for broadcasting purposes and with improvement and greater diversity in the character of programs broadcasted, geographical barriers will be eliminated, general knowledge and culture advanced, and radio as a permanent institution so intimately woven into the warp and woof of every day life as to become indispensible.

THE real radio amateur is not a receiver but a transmitter. The present popular interest in news and concert reception will ultimately be converted into a greater interest in sending. With the opening up of a wider band of wavelengths for amateur use and with the development of more sharply tuned transmitting equipment will come an enhanced opportunity for active transmission instead of mere passive reception.

The final recommendations of the Washington Radio Conference open up a broad wave band from 150 to 285 meters for amateur use. This more than doubles the present opportunity for operators and will make it possible for more work to be done with less interference than in the past. There is strong probability of early Congressional action in this matter so that within a few weeks there will be room on the air for thousands of new transmitting stations. There is likelihood, also, that as time goes on the broadly tuned spark set will be prohibited by law, though long before this is done most operators will be employing the more efficient and satisfactory continuous wave equipment which is now becoming available at low prices.

Meantime, until these changes are brought about, the sending enthusiast should wait a time with patience, just as he did during the war when the government put a stop to amateur radio. He can enjoy the concerts, study the code and electrical theory, and get ready for his examination for a first class license. When he finds that his transmission is interfering with the pleasure of others he will be wise to voluntarily lay off a little. For he should realize that if he makes himself a nuisance the privileges which he is soon to enjoy will be revoked. The amateur's future is in his own hands to make or mar. This is written in the broad spirit of one who desires to encourage the amateur and experimental use of radio, but who foresees the danger of restriction if some immediate consideration is not given the rights of others.

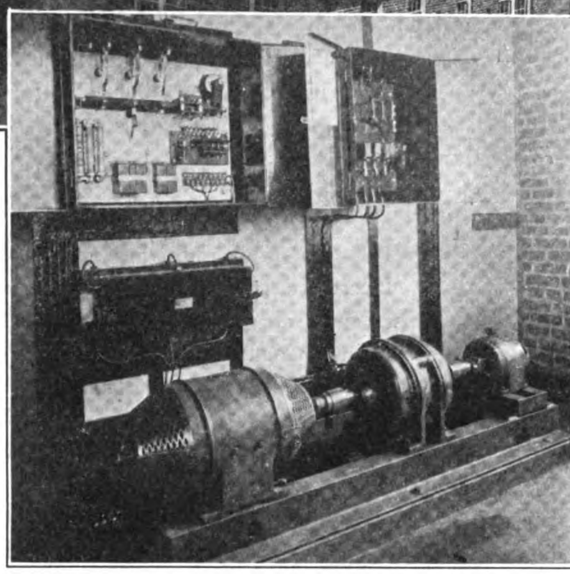
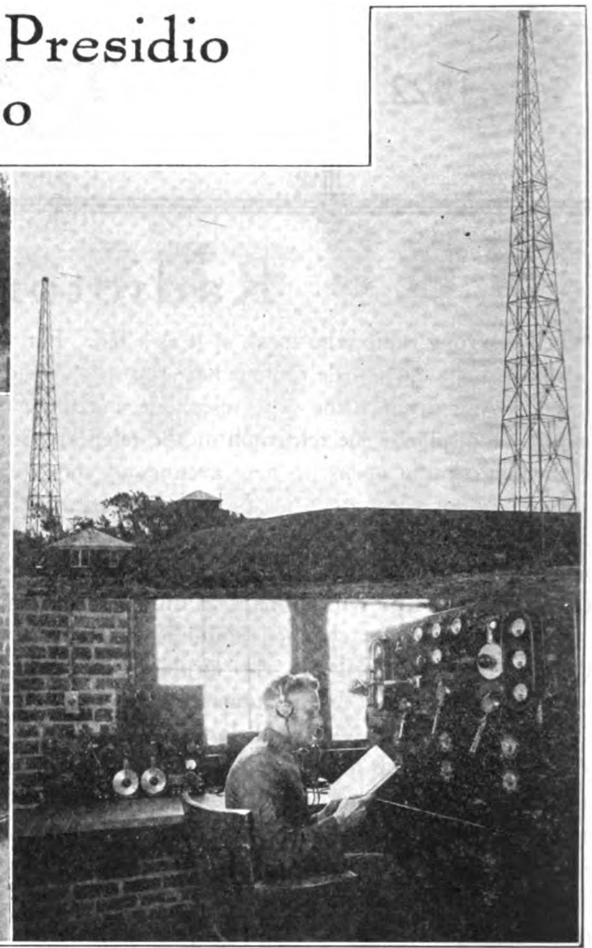
THE advent of radio has perturbed the music trades. Decreased phonograph sales are attributed to the increased sale of receiving sets. Music publishers are commencing to require royalties on songs sung over the radio and actors' associations are forbidding their members to broadcast their acts. The musicians' unions are fearful that radio entertainment and dance music will kill the market for their services.

Yet these are short-sighted and selfish views which will soon be broadened as the real vision and musical mission of radio is better understood. Increased sales of phonograph records advertised over the air will partly compensate for decreased sales of instruments. Music publishers will find it more efficient to introduce new songs to big audiences by radio than by hiring "pluggers" to sing before small audiences. Actors will realize that theatre-goers want to see as well as hear. Musicians will find a great demand for their services at broadcasting stations. And all should realize that it is useless to try to stem the tide of progress.

But these brief reasons as to the futility of opposing radio entertainment are trivial as compared with the tremendous popular interest and education in matters musical that radio is stimulating. It has long been recognized that anything bringing music to the people promotes the sale of musical instruments in the home. After a person has enjoyed a certain piece of music over the air, the desire is created to hear it often with an instrument of his own instead of waiting until the piece is again broadcasted. No better means can be imagined for popularizing classical music and teaching the people to discriminate against jazz. So, without question, radio should be welcomed as an able instrumentality for advancing the cause of better music.

Furthermore we venture the prediction that every music house will soon sell radio receiving sets. Many are already doing so, two of the largest manufacturers of musical instruments are now making and selling radio sets to the music trades, and the logical step is for the phonograph people to get into line with radio equipment housed in handsome cabinets of period furniture as an ornament to the home. Radio is not a competitor but an active co-operator in bringing an appreciation of music to all the people.

New C. W. Station at Presidio of San Francisco

Views of the Presidio 1500 Watt Radio Installation, Showing Site, Antenna, Motor-Generator Set, Transmitter and Receiving Equipment.

SITUATED on the highest point in the Presidio of San Francisco and overlooking San Francisco Bay, WVY, the new U. S. Army Radio Station, is now on the air after six months of preparation, construction and experimentation. With a power input of 1.5 K. W. to the antenna, this new station is expected to hold regular communication with similar stations at Fort D. A. Russell, Cheyenne, Wyo., Fort Douglas, Utah, and eastern stations.

WVY is to be the control station for all army radio traffic in the Ninth Corps Area and constitutes one of the units for official communication by radio telegraph between Washington, D. C. and the headquarters of the different corps areas and also for broadcasting weather bureau reports.

This station is also to be used by the Signal Corps Radio School as a means for educating amateur radio enthusiasts in radio telegraphy and telephony through broadcast telephone lectures and code lessons at stated speeds five nights a week.

The transmitting switchboard is arranged for quick change from C. W. buzzer modulator or telephone transmission at from 1000 to 3100 meters, the normal operating wavelength being 2150 meters. Telephone broadcasting will probably be on 1450 meters. The panel is equipped for remote control on both C. W. telegraphy and telephony so that communication can be maintained from headquarters without the necessity of the operator being at the station. As may be seen from the picture, the tubes, inductances, condensers and other transmitting instruments are compactly housed directly at the rear of the panel.

A power input of 1500 watts to the antenna is secured from a double motor-generator set supplying 1500 volts to the v. t. plates and for field excitation. The filaments are A. C. lighted and operate on a potential of 11 volts.

A 300 ft. six-wire flat-top aerial is used for transmission and normal reception. The aerial is supported by two 150 ft. steel towers. The ground system consists of an extensive net work of buried copper wire radiating from the station. The antenna and ground were constructed to secure as low resistance as possible, tests indicating a total of only 5½ ohms during normal San Francisco weather.

The receiving equipment consists of a regenerative 200 to 8000 meter tuner connected to either a loop aerial for elimination of interference, a subterranean antenna about 2000 ft. long or a large antenna for reception on commercial wavelengths. All parts of the equipment are shielded. Auxiliary to the receiver is an amplifier consisting of three steps of radio and two steps of audio frequency amplification with an external heterodyne for use with the radio frequency amplifier.

The station was constructed under the direction of the Ninth Corps Area Signal Officer, Lieut. Colonel Sebring C. Megill, Signal Corps, and officer in charge of installation; Captain C. I. Hoppough, Signal Corps, Radio Officer, Ninth Corps Area. Captain Hoppough was assisted by Sergeant Richard Tavers, Signal Corps, and students of the Signal Corps School, Presidio of San Francisco.

An Inexpensive 50-Watt C. W. Transmitter

Sixth Installment of "The C. W. Manual"

By J. B. Dow, Ensign U. S. N.

THE first thought of the average experimenter as to an inexpensive 50-watt C. W. transmitter may quite easily rest upon a motor generator involving an expenditure of $150 alone, or he might visualize an arrangement of apparatus consisting in part of two rectifying tubes at the modest price of $60.

With 60 cycle alternating current available, two circuits may quite easily be developed to eliminate both of the expensive combinations referred to above and at the same time provide an installation which will operate fully as satisfactorily as any that might be used involving the eliminated apparatus.

Fig. 46 illustrates a circuit employing a single 50-watt tube as an oscillation generator and using a source of high voltage alternating current pre-rectified by an arrangement of forty easily constructed rectifier units. The previous chapter dealt in part with the construction of such units.

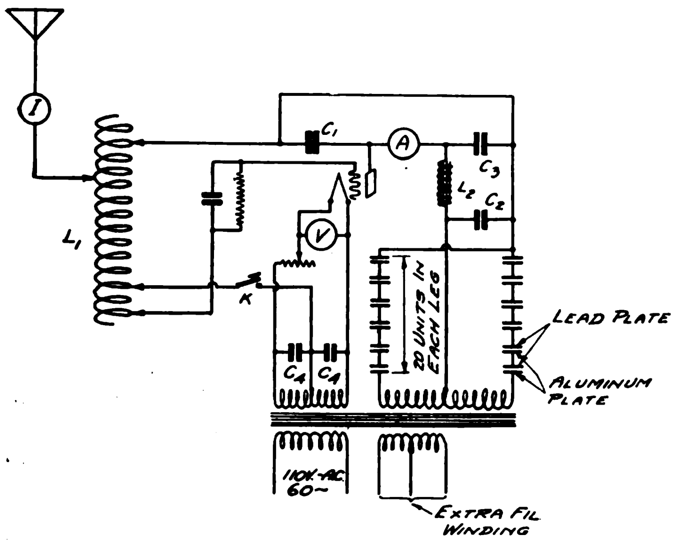


Fig. 46. Circuit Using One 50-Watt Tube as Oscillation Generator and Pre-rectified A. C. Power Supply

The details of the transformer, T, Fig. 46, follow, and it might be added that the output of this transformer is sufficient to supply four 50-watt tubes or a combination of two 50-watt tubes and two rectifier tubes.

Upon one of the longer legs of a core having a 2 by 2 inch section and a 6 by 3 inch window, wind a primary coil of 175 turns of No. 11 or 12 S. C. C. wire in three layers, insulating the winding from the core with 8 wraps of 10 mil fish paper, and each layer from the next with one wrap of the same material. Tap the primary at the following turns for voltage control: 165, 169, and 173. Over the primary place 8 wraps of 10 mil fish paper. Next, wind two secondary sections to fit over this, of 2400 turns of No. 24 enamel insulated wire in 32 layers. The 5 mil fish paper between each layer should be 2 in. wide and this will permit of a winding space of 1⅝ inches wide. Each section should be tapped at the 1600th turn and with the two sections connected in series with a midtap at the point of connection the output voltage will be approximately 935 or 1450 on each side of the midtap.

The filament heating secondaries should be wound upon the other long leg of the core over 8 wraps of 10 mil fish paper. These units should comprise two 22 turn coils of No. 8 D. C. C. magnet wire in two layers with midtaps, and will provide ample current at a potential of 12 volts for the filaments of power and rectifier tubes.

Connection posts for all taps may be brought out to a suitable panel secured to the core structure.

The filter circuit, C_2 C_3 L_2, may be modified by the elimination of the choke L_2, and the capacity C_2, if it is not contemplated to control the output telephonically. The capacities C_2 and C_3 should be of the order of a microfarad and designed to withstand the maximum voltage used. The choke coil L_2 has been described in detail in a previous chapter.

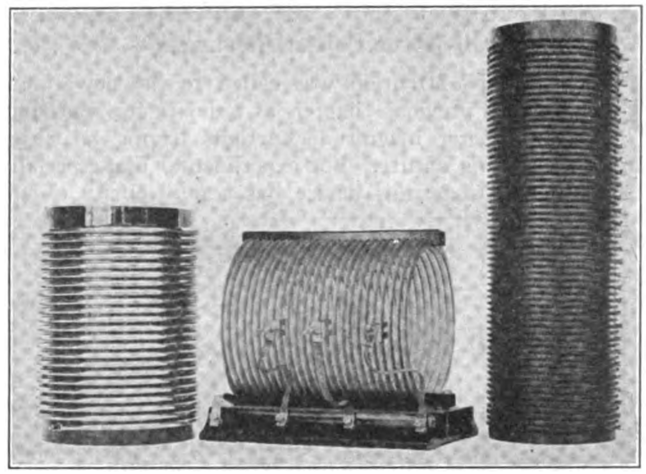


Fig. 45. Well Designed Types of Inductances

It will be observed in Fig. 46 that the capacities C_1 and C_3 are apparently shunted and the total capacity is the sum total of the two. It is obvious, therefore, that C_1 may be eliminated if the filter circuit, or more pertinent the capacity C_3, is in such proximity to C_1 that the reactive effect of intervening conductors is negligible. If the filter circuit is appreciably distant from C_1, this condenser should have a capacity of approximately 0.01 microfarad. The details of such a condenser may be found in Fig. 34.

The filament heating secondary, Fig. 46, is bridged by two one microfarad paper telephone condensers, C_4, and the midpoint of this arrangement is connected to the midpoint of that secondary to the key K.

The voltmeter, V, in the circuit facilitates the adjustment of the filament and is recommended in lieu of an ammeter for this purpose.

The grid leak of Fig. 27 or an equivalent one of 5000 to 10,000 ohms should be used in conjunction with a small capacity of 0.002 microfarad to obtain a sufficiently negative potential for efficient operation.

Fig. 45 shows three well designed types of inductances such as may be used at L_1. On the left is one constructed of ¼ inch O. D. copper tubing and manufactured by Heintz and Kohlmoos; the center one is the well known Radio

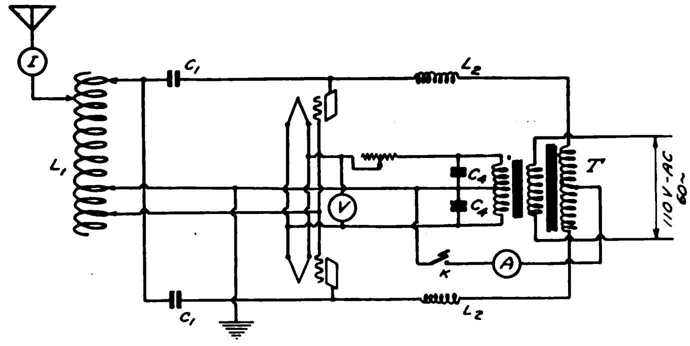


Fig. 47. Two-tube Self-rectifying Circuit

Corporation device made up of edgewise wound copper strip, and on the right is one designed by the author for use in the output circuit of a 250-watt power amplifier. This latter inductance is constructed with a special transmitting Litz.

The milliameter, A, reading to 250 M. A., and the radiation ammeter, I, reading to 5 amperes, complete the circuit.

As previously stated, Fig. 47 represents a two tube circuit in which the principal of self rectification is employed, one tube availing itself of one-half of the alternating current cycle, and the second tube the other half.

The nomenclature of this circuit conforms to that of Fig. 46, except that L_2 are radio frequency choke coils having an inductance of approximately two millihenries. Honeycomb coils may be used for this purpose.

A 10-Watt Power Amplifier

THE reader's attention was called to the power amplifier in a previous chapter, as a device for reproducing in greater magnitude currents having an alternating or pulsating nature. For experimental use, especially in shore installations, this device has a multiplicity of ad-

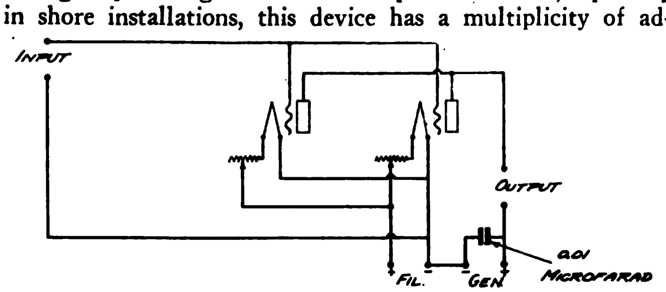


Fig. 48. Power Amplifier Circuit

vantages over other power generators of the vacuum tube type which operate in circuits involving different principles and which have been considered heretofore. Some of these advantages may be stated briefly as follows:

(1) Practically all experimenters who are using vacuum tube circuits for the first time are prone to begin by constructing low power equipment involving, for example, one or two 5-watt tubes, or one 50-watt tube. The progressive experimenter of today spares little expense in making his installation the best that can be had and very often even a small set represents an outlay of several hundred dollars.

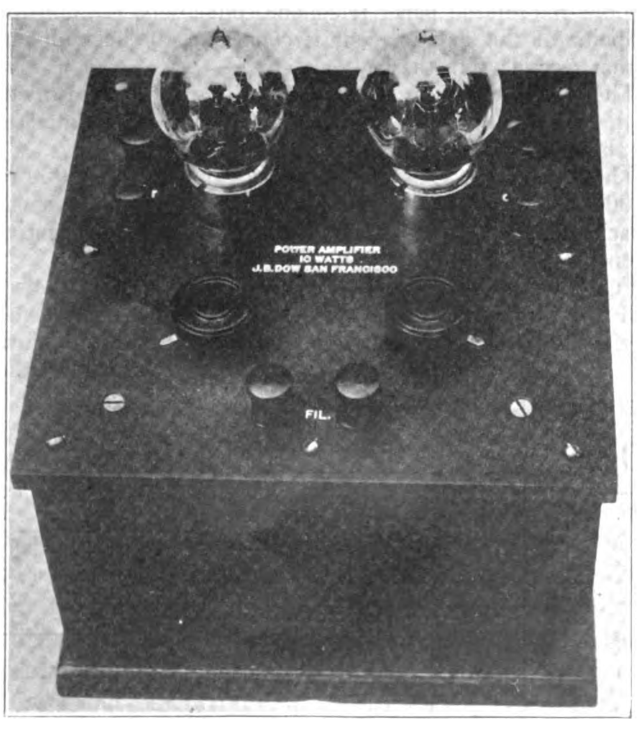


Fig. 50. 10-Watt Power Amplifier

The time soon comes when a more powerful installation is required and, ordinarily, the construction of a 5 or 10-watt set does not, for example, permit of the mere substitution of two 50-watt tubes to form a 100-watt set, or the substitution of a 250-watt tube to form a ¼ kilowatt set. To scrap, or reconstruct the low-powered equipment then represents a distinct loss. Few experimenters are aware of the fact that by the addition of a power amplifier having the desired output all of the advantages of totally new equipment may be had and many more, which are inherent in the power amplifier.

(2) The frequency of the emitted wave is more or less independent of the constants of the antenna circuit, consequently, fading of the received signal is less liable to occur because of a swaying antenna or moving objects in the electro-static field of the antenna. Such fading is very pronounced in present day experimental C. W. transmitters not

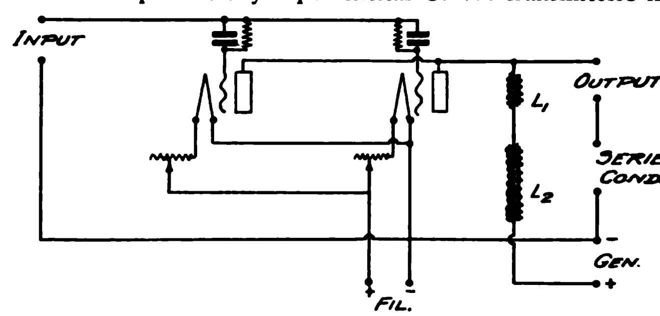


Fig. 49. Circuit for Use Either as an Amplifier or Oscillator

employing the amplifier as a means of obtaining the desired power output.

(3) In ordinary radiophone circuits involving even moderate powers (50 watts) it is very difficult to obtain the telegraph to telephone transmitting range ratio that is possible with much lower powers (5 watts) and oftentimes the experimenter is discouraged to learn that with his new 50-watt set he is obtaining no greater telephone range than was had with a previously constructed 5-watt set, although the radiation current is many times greater. This is due to the fact that the percentage modulation of the emitted wave is lower in the case of the higher-powered equipment. Distortion of the emitted wave also follows low percentage modulation. The use of the power amplifier overcomes all these difficulties, for the entire wave is amplified and the same percentage modulation obtains as was the case with the lower-powered equipment.

(*To be continued*)

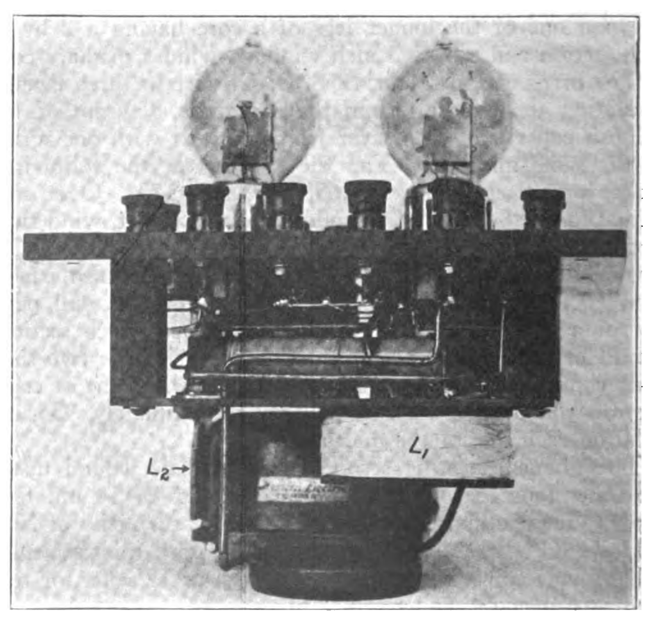


Fig. 51. Interior of 10-Watt Power Amplifier

Crystal Detection With Tube Amplification

By Gerald M. Best

THE present country-wide interest in radio has brought forth some queer looking pieces of apparatus, both new and old, and the German Army field receiving set shown here is so unique that a short description of its principal features will prove of interest to all.

The complete outfit was captured by Capt. John Robertson of the British Army in 1918 and has since reposed in the ex-soldier's pile of souvenirs. His description of how he captured the set is as follows:

"Just after the big German drive of 1918 had been stopped and we were counter-attacking all along the line, I was with my division just south of Arras. We attacked Boisleux-au-Mont (P. de C.), taking that place, Croiselles and other villages, in several days very heavy fighting, and were finally halted by the Hindenburg line in front of Bullecourt, that 'health resort' of the Australians. This we prepared to attack and I had a fighting patrol to take into the Hindenburg tunnels which ran all the way under the Hindenburg line. I had also to deal with any 'booby traps' and mines I found there. After several incidents with traps and enemy parties, I came on one elaborate trap which puzzled me a lot. I sent my men back a bit and then proceeded to investigate—very gingerly—in the dark.

"It took me some little time to realize that the elaborate mess of wire and mysterious boxes was not a new form of mine, but a wireless apparatus of some kind. Anyhow, having had some past experiences with our friend the enemy, I took no chances and cut all the wires and went on with the war.

"Later on I had some spare time and went back to investigate the boxes, ultimately getting them back to my headquarters, where I got a signaller friend to explain things a little to me. Incidently I might mention that the trenches overhead were taken and retaken about half a dozen times while we were below in the tunnels."

Wishing to take advantage of the numerous concerts, he recently had the set adapted for American tubes, since the German tubes were burned out, and is now enjoying the daily entertainment which the ether affords.

Referring to Fig. 1, the assembled apparatus is seen to include a tuner with crystal detector, a two stage amplifier and a battery box, which is complete with voltmeter, flexible connections and a filament rheostat. All instruments are connected with flexible cords and plugs, not a binding post or lug being used. Each plug is plainly marked to show the proper location and even a novice could easily connect up the set.

The tuner is the outstanding feature and shows the manner in which the Germans constructed their war radio equipment to withstand heavy shocks, and the wear and tear of trench use, yet remain withal scientific instruments of precision. At the left hand side of the tuner is seen the wavelength changing switch, with settings of 120-180, 160-250, 240-400 and 300-800 meters. The primary air condenser (Luftdrahtkreisabst) is directly under the wave control switch, and is cut out of a solid block of aluminum, as is the secondary air condenser (Zwischenkreisabst), at the right of the panel. At the top of the panel, in the center are the two replaceable units, the test buzzer and the crystal detector, the latter being of the composition mineral type, with soft iron contact spring. The coupling control dial occupies the center of the panel, and a switch to cut the secondary air condenser in or out of the circuit is at the upper right hand corner of the set.

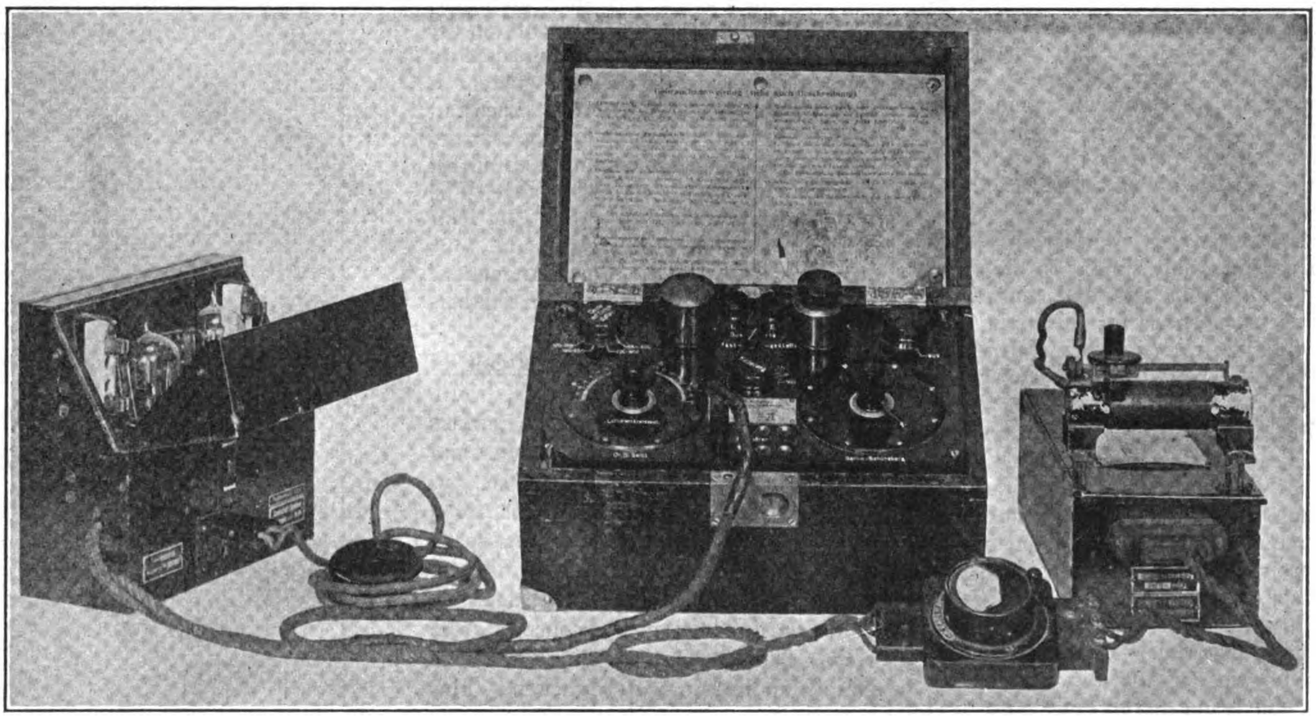


Fig. 1. Complete German Army Field Receiving Set

Fig. 2 shows the back of the panel, with the primary and secondary inductances and the various switches. All wiring is done with square copper wire, enameled in colors for ease in tracing the connections. The primary inductance consists of 120 turns of litzendraht wire wound in a three inch roll and fastened to a micarta disk by means of silk threads. This coil is tapped every 30 turns, and the leads brought out to the wavelength changing switch. The secondary coil is wound in the same manner as the primary and consists of 80 turns of litz mounted on a small disk. The coil, which is separated from the primary about one inch, is rotated eccentrically with respect to the primary to give 180 degrees coupling and produces wonderfully sharp tuning through

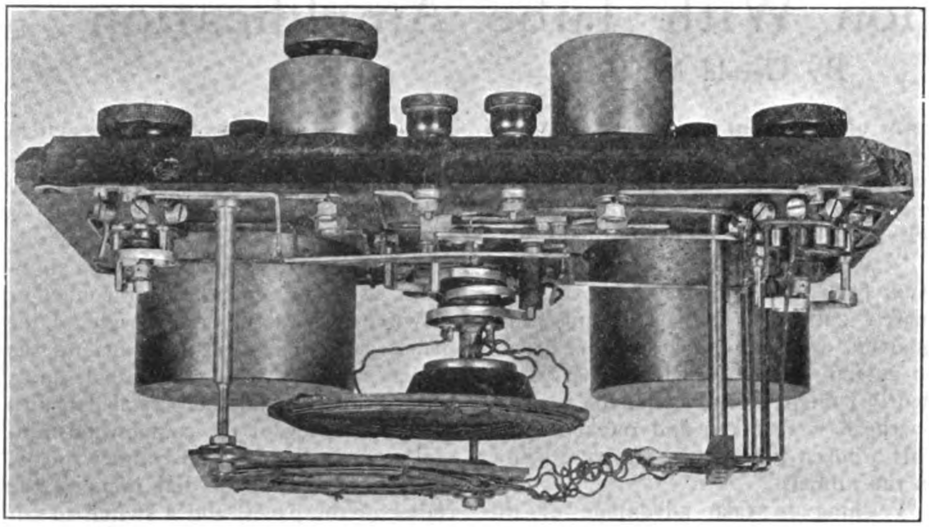


Fig. 2. Back of Panel

the entire range of the set. The secondary air condenser is calibrated in terms of the wavelength in meters, and by aid of the buzzer (which is bridged across the primary circuit when adjusting), the circuit may be made resonant at the desired wavelength without the necessity of listening for the actual radio signals.

The two stage amplifier (Verstahrker) is remarkably similar to the present day vacuum tube sets, and consists of a step-up transformer for the input to the first tube, an intertube transformer, and two type EVN-171 Telefunken vacuum tubes.

One of these tubes is illustrated in Fig. 3, and shows the peculiar construction of the elements. The filament is of tungsten, in the form of a horse-shoe, and requires a current of about one-half ampere at four volts. The grid is spiral in shape, and is directly above the plate, all three elements being held in place by the glass stem. Tubes of this type have no tips at the top of the bulb, this point being at the lower end of the tube, concealed by the base. Its characteristics are similar to the AP amplifier, and it delivers about the same amount of power.

A switch provided on the front of the amplifier cabinet enables the operator to connect the phones either to the crystal detector only, or the two stage amplifier, the switch lighting the filaments at the same time the phones are connected to the amplifiers. The filament current is controlled by an external rheostat, shown in Fig. 1 on top of the battery box. A voltmeter is employed to adjust the filaments to the proper voltage. The plate battery consists of four 22½ volt units, to furnish 90 volts, and four small American radio type batteries of 22½ volts made a perfect fit in the battery box.

Fig. 4 shows a schematic circuit of the entire assembly of apparatus.

After replacing the German sockets and tubes with American types, and cleaning the switch contacts, the set was connected to an amateur antenna for a test. On 200 meters, amateur spark signals were copied up to 750 miles at night, and 300 miles in the daytime, while on 360 meters the concerts from KFC in Seattle, Washington, were plainly audible in San Francisco. This proves that successful amplification of crystal detector signals is quite possible. While such a method is not advocated where a vacuum tube detector is available, it is of interest to know that such a thing can be and has been done, even many years ago.

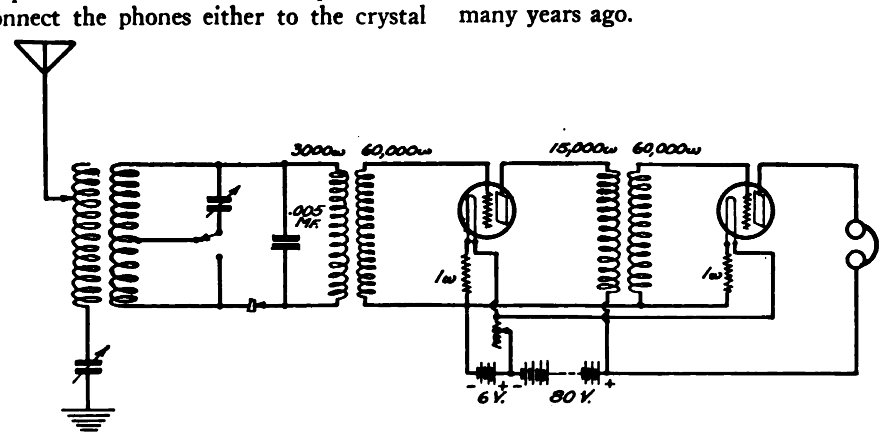


Fig. 4. Schematic Circuit of Crystal Detector and Two Stage Tube Amplifier

Trans-Pacific Naval radio service for commercial and press purposes has been extended until June 30, 1925, by means of a bill signed by President Harding. This extension, however, does not apply to messages designated for China, as that service terminates on January 1, 1924, on account of international wireless agreements. The signing of this bill relieves many business concerns and news services, especially on the Pacific Coast, as the present commercial facilities are said to be inadequate and expensive.

Fig. 3. EVN-171 Telefunken Vacuum Tube

The radio-equipped hotel is a probability of the near future with a radio receiving phone in every room. The Hotel Bellevue of San Francisco now supplies the patrons of its dining room with radio concerts by means of a pair of phones on each table. Seventy of these phones are connected to a central receiving set consisting of a detector and two stages of amplification.

Canned wireless was secured by W. E. Weaver of Hespeler, Ontario, when he used a dictaphone to record the music given by his loud speaker when KDKA was on the air at Pittsburg, Pa.

A 10-Watt Self-Rectifying C. W. Set

By O. Schuwendt

IN the following article the writer will describe the construction of a small and compact C. W. set of a type now in much favor. The set is entirely self-contained and is about as compact as can be made without lowering the efficiency by overcrowding the panel. The table space required is only 10 by 10 in., while the overall height is only 14 in.

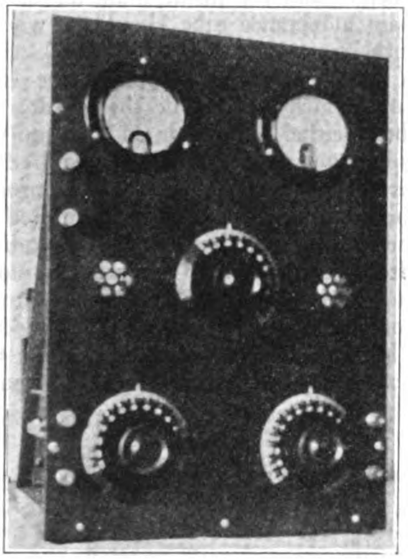


Fig. 1. Front View of Set

The set uses two 5-watt tubes in the circuit known as the reversed feed-back or British Aircraft circuit, which has been slightly modified to allow the self-rectifying feature to be used. This modification has the additional advantage of putting nearly all the various parts at ground potential, which is to be desired.

Figs. 1 and 2 are pictures of the set which will serve to give the builder a clearer conception of some parts which might not be made clear otherwise. In Fig. 3 is shown the assembly drawings of the set with general overall dimensions. Although the choke coil can be placed under the tube shelf as shown it would be preferable to place it between the shelf and the transformers, where there is enough room and which will allow the connections of the choke to be reached more readily for purposes explained later. Similar mountings to those of the transformers can be provided for the choke, as was done in the case of the set built by the writer.

There are two transformers provided, one for lighting the filaments of the tubes and the other for the high voltage for the plates. The main object in having the two transformers is that it enables the primary side of the high voltage transformer to be controlled rather than the secondary or high voltage side in telegraphing. This will eliminate the high voltage on the key right at the operator's finger tips which is so easy to get against and is far from pleasant. The low voltage transformer is designed to deliver 8 volts terminal voltage and is provided with a center tap on the low voltage side. The high voltage transformer is of the split secondary type giving approximately 750 volts on each side of the center tap. It should be remembered that these transformers have been designed for the use of only two tubes and while they might stand an additional load it is not recommended.

With reference to the wiring diagram shown in Fig. 4, the following nomenclature is used:

L_1 Main inductance.
L_2 Grid coil.
L_3 and L_4 Radio frequency chokes.
L_5 25 henry smoothing choke.
C_1 Grid coil tuning condenser .0005 to .001 mf.
C_2 Grid condenser .0005 mf.
R_1 Grid leak, 10,000 ohm semi-circular graphite potentiometer sector.
C_3 and C_4 Blocking condensers, .002 mf., preferably mica, able to withstand at least 1000 volts.
R_2 and R_3 Filament rheostat, 1½ ohm 3 amp. capacity.
C_5 and C_6 .001 mf. condensers. Can be of paper dielectric type.
T_1 Filament heating transformer.
T_2 High voltage transformer.
K Key.
MA Milliammeter, 0-150 milliamps either hotwire or dc. type.
HWA Hotwire ammeter, range 0-2 amps.

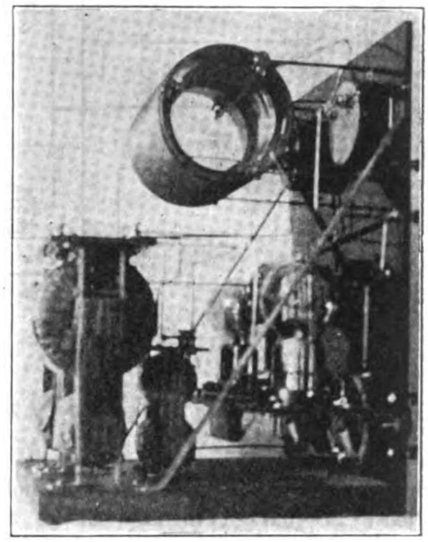


Fig. 2. Rear View of Set

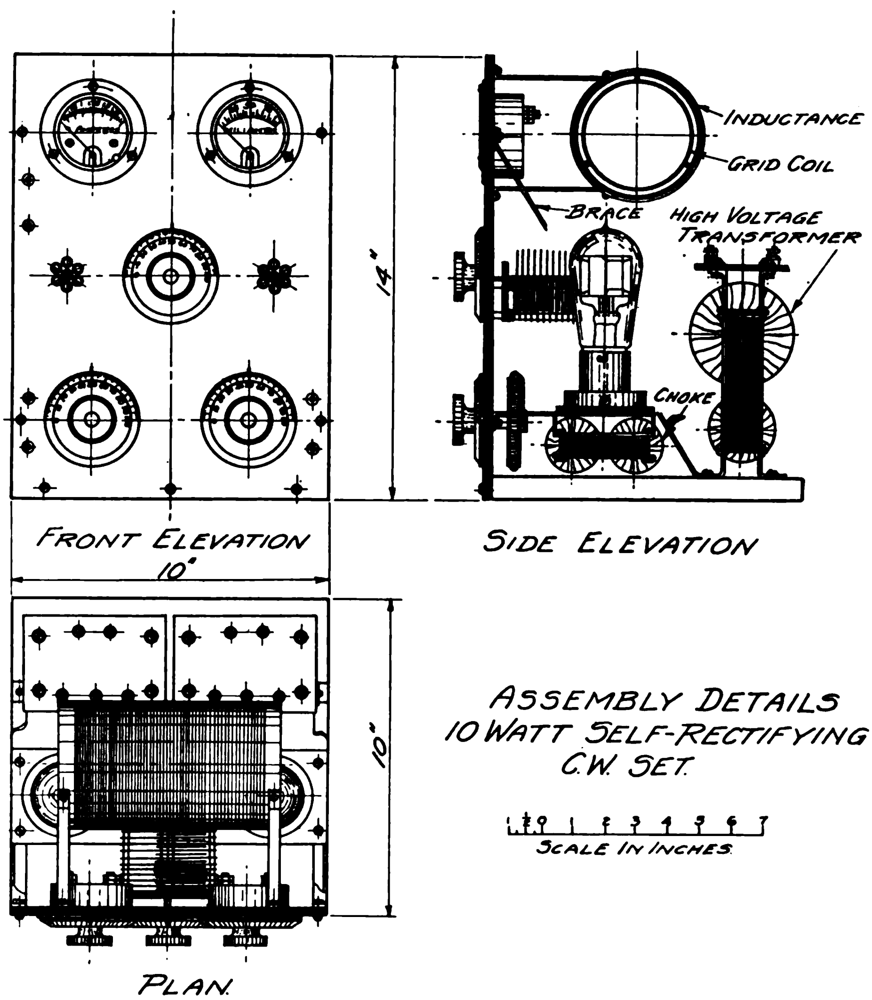


Fig. 3. Assembly Details, 10-Watt Self-Rectifying C. W. Set

In constructing the set it is well to begin with the laying out of the panel. This is made of ¼ in. bakelite or formica. The dimensions for the location of the various holes and their respective sizes are shown in Fig. 5. Before attempting to do any drilling the builder should lay the panel out to full scale on a sheet of drawing paper with all holes located on it. This is then fastened to the panel and the centers for the holes should be marked through on to the panel with a sharp prick punch. This method gives a good center for the drill and insures an accurate layout of the panel. It is well to drill through the panel first with a small drill for all holes before drilling through with the specified size of drill. The observation holes are made by drilling through with a small drill as stated above and then countersunk with a ⅜ in. diameter drill on each side, after which the hole is drilled on through with a ¼ in. drill. The large holes for the meters will probably present the greatest difficulty in drilling the panel and if no other means is at hand the builder will probably have to drill a series of small holes around the circumference of the opening and afterwards smooth the hole with a half-round file. After the holes are all drilled the builder may either grain the surface of the panel or polish it as may suit his fancy.

The tube shelf is a simple job as it requires only a few holes to be drilled as indicated in the drawing in Fig. 5. The braces and tube shelf brackets are each made up as also shown in the above mentioned figure from 3/32 in. thick by ½ in. wide brass and should present no difficulties.

The base consists of a piece of mahogany or other suitable wood ¾ in. thick by 10 in. square. The edges should be slightly rounded to improve the appearance and should be given a couple of coats of shellac before fastening the panel to it. Four small rubber headed tacks should be provided underneath at the corners of the base.

The inductance can be one of the various types now on the market or the builder can purchase a threaded formica tube and wind his own inductance. It should be about 4 in. in diameter and should have at least 30 turns of No. 12 or 14 bare copper wire. No switches are provided for varying the inductance, but this can be accomplished by an improvised clip of some kind and after all adjustments have been made and the set is tuned to the proper wavelength the two variable leads should be soldered in place. This does away with a mass of connections and is really the most efficient method of making the cönnections to the inductance.

The grid coil may be made up in practically any manner which the builder may desire, but the writer would recommend a method which is both simple and effective. A tube, preferably of formica, about ½ in. less in diameter than the inside diameter of the main inductance tube, should be wound with 25 turns of No. 14 D. C. C. wire. A tap should be taken off at the 10th turn, which will enable the operator to obtain either 10, 15, or 25 turns on the inductance coil as might be required in his particular circumstances. The proper end of the grid coil to be connected to the ground will have to be determined after the set is put in operation in much the same manner as the proper connections for a tickler coil in a receiving set. The grid coil can be fastened inside the main inductance either by means of small

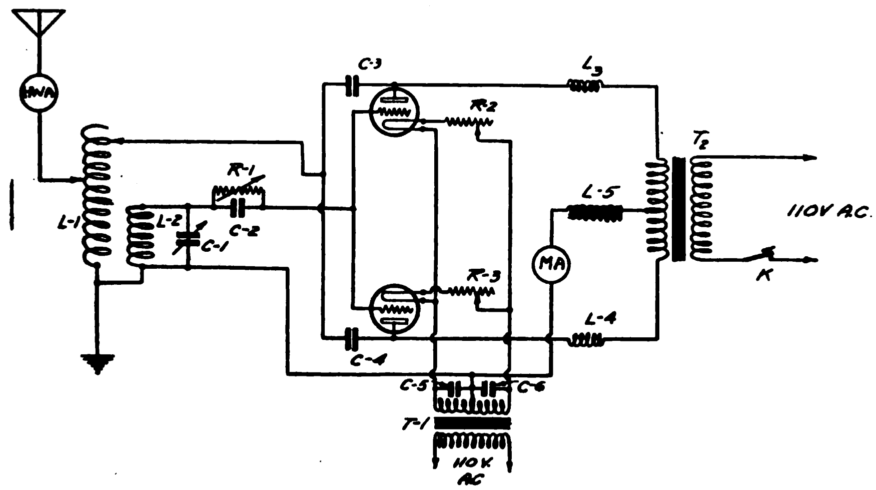


Fig. 4. Hook-up for 10-Watt Self-Rectifying C. W. Set

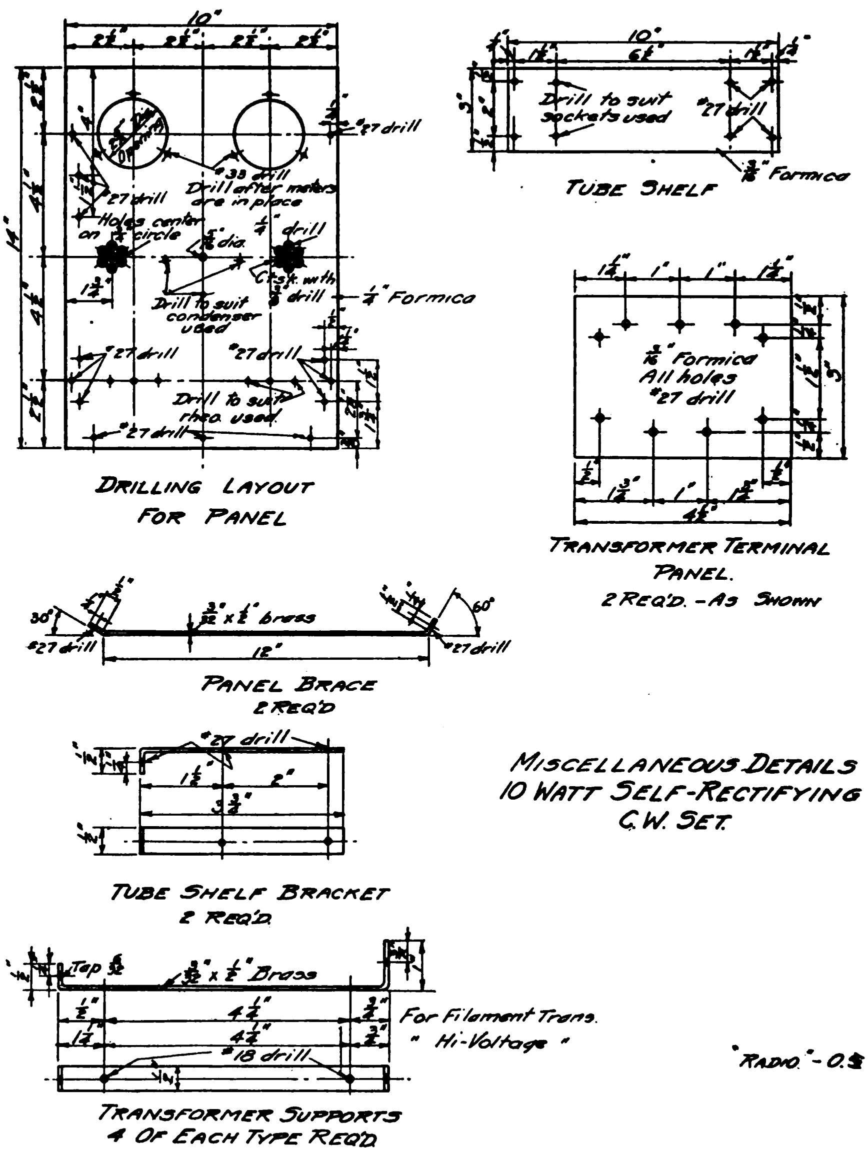


Fig. 5. Miscellaneous Details, 10-Watt Self-Rectifying C. W. Set

bakelite or formica wedges or by means of small brass brackets, or any other method that the builder might prefer.

The main inductance might well be fastened to the panel by means of brass brackets as shown in the assembly drawing. If placed as shown the upper screw in the meter flanges can be used as one fastening and the other bracket can be fastened by a screw countersunk in the panel and hidden behind the flange of the meter. Binding posts are provided for aerial and ground connections and for the key and power. The two at the upper left hand part of the panel are for the aerial and ground connections and those directly below are for the key. The other two binding posts on the right hand side of the panel are for power leads.

As can be seen from the various details of the set, standard pieces of apparatus have been used wherever possible, such as: General Radio hotwire ammeter, Jewell milliammeter, Remler rheostats, General Radio sockets, etc. Almost any type of variable condenser of the required capacity can be used across the grid coil as no high voltage is applied across it and there is no danger of it breaking down.

The construction of the transformers is an interesting part of the construction of the set and the builder should not become doubtful when he reaches this point, as it is not as difficult a job as might be expected. It will be necessary to rig up a small winding device of some sort which may be nothing more than a square block of wood of the proper size for the coils mounted on a shaft and provided with a crank. If the builder can devise a means for fastening a speed indicator or revolution counter of the common type at the end of the shaft to keep track of the number of turns much time can be saved and the work made much easier. This will enable the winding form to be revolved at a speed greater than the speed of the crank by driving the form by means of a belt and having the crank fastened to a large pulley that can be made from half inch wood. A sketch of the method used by the writer in winding his transformer is shown in Fig. 7. This also shows the wooden side pieces that are used in winding the secondary sections. These are not necessary for the primary windings.

In winding the transformers the primaries should be considered first. A square form is made of medium weight cardboard in one thickness and should measure 1¼ in. on a side and should be about 3 in. long. A few layers of paper are wound on the square wooden form of the winding rig to make a fairly

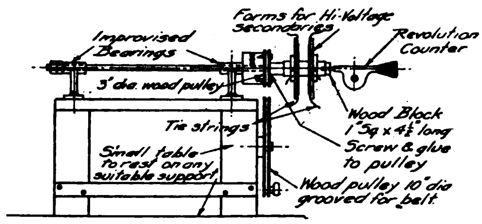


Fig. 7. Winding Rig

snug fit for the square tube made above and the latter then slipped on over this. The primary of the filament transformer is to have a total of 735 turns of No. 24 D. C. C. copper wire and the primary of the high voltage is to have 765 turns of the same size wire. The two primaries together will take about one pound of wire. In winding the coils each layer is wound with one turn less than the preceding layer and this will give a tapered form to the winding. After winding the coils are slipped off of the winding rig, the square cardboard form is trimmed flush with the edges of the winding and the coils are then wrapped with either empire cloth tape or with linen tape which is later varnished or shellaced. It should be noted that the square cardboard form is allowed to remain inside the coil.

The low voltage winding of the filament transformer is also wound on a square cardboard form identical with the one above and has 54 turns of No. 14 D. C. C. copper wire with a tap taken off at the center of the winding or 27th turn. The cardboard form is also cut off flush with the winding and left inside after which the coil is wrapped as before.

The secondaries of the high voltage transformer are each wound separately. These are wound on square cardboard forms as were the other coils, but it is also necessary to provide circular discs with square holes on each side of the winding. The blocks shown on the winding rig in Fig. 7 are used in this case in order that the coil may be wound to a given size. The space between the side pieces should be just 1⅛ in. Four strings should be put on the form in such a way that when the winding is completed they can be tied and the winding held securely in the desired shape. The coil is then slipped off the winding rig, the inside form trimmed to size, the circular pieces trimmed down to the limits of the coil and then the coil should be wrapped as before. Each secondary section is wound with 5200 turns of No. 32 S. C. C. wire and need not be wound on in layers which will make the con-

Continued on page 48

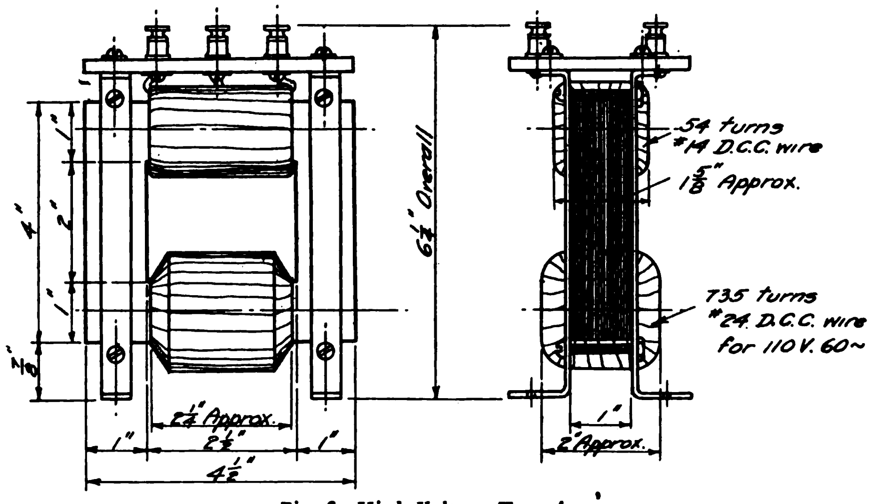


Fig. 8. High Voltage Transformers

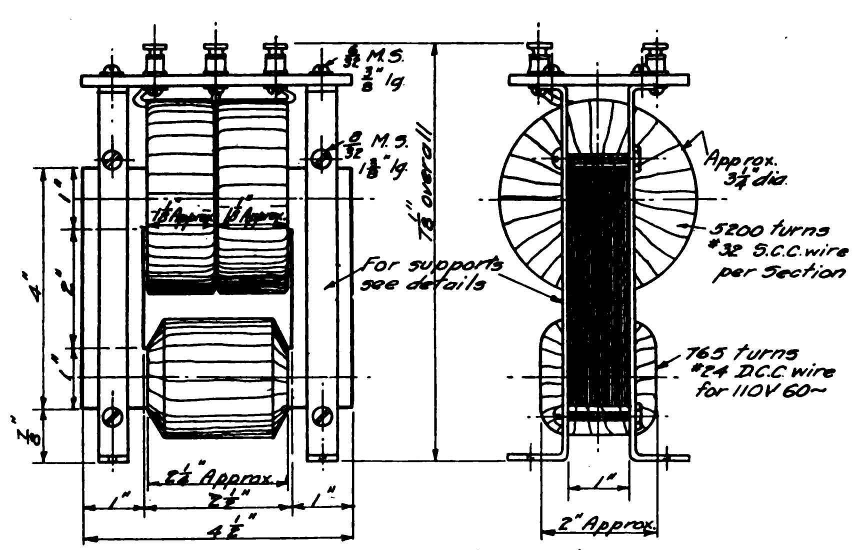


Fig. 9. Filament Heating Transformer

Scratchi Flunks in Severe Test

By David P. Gibbons

To Editor "RADIO" (which pours soothing oils on troublesome ether at welcome intervals):

Dear Mr.—

On opening day of month which have just left us behind—to witty, May One (National Holiday for Bolsheviks), my cousin Scratchi make very vain attempt to gain new style license.

Before he go for exam. Scratchi have devote several daily hours at local ham foundry gathering speed and can copy group-spasms like 6BJW2 and so forth at thirty per, so for grand final he give himself special tryout at NPG's spark press. He claim world record, as he grab all of regular code letters and quite a few of Indian signs and Hungarian characters which operator insert to make press of interest to the generally public. He then make brief trip on luxuriant lumber tub and for practicing, he revise downward all apparatus on board it. While doing thus one day, mate of this ocean blood-hound stick head into shack and yap out:

"Hay, you! I smell something like burning rubber!"

"I should inform jap-eyed universe that you always do so!" Scratchi quiz him. "Mightbe heated bath would assist you!"

Such nasty cracker make the 90% Scowegian person quite rattley and he blow out: "Shut down! Pipe up! you poverty fish! I should knock you along for roe of ferry buildings!" But Scratchi throw lightning switch into neutral and fill shack with blue fieryworks and mate go away from there.

On return he approach Hon. Govt. Insp. for slight receiving test which are all he believe necessary for such. Jolly Insp. Gent however remove this depression and express details of examinings which brite youths must pass thru from now onwards when desiring tickets. My cousin tell me in very peevy speech what he think of these, and whilst I think sometime he are rather silly burro, as Limo one time inform him, yet, as even you can see, Mr. Editor, he have perhaps cause for present burstup.

First question which he pose at Scratchi are to know if he possess startled memory for people with faces, and my cousin assure him: "Indeed yes, I have first rank diploma from Mr. Rott's Memorial Corresponding School, and can call back time when NPX last answer ship call."

"That count ten points," say Hon. Insp., "since to be purser you must rapidly detect stowaways and bums from company officials making underground trips. What are your experience as good mixer and shaker?"

My cousin deny he are chasing bartend job, but Insp. tell him that good purser must be expert handshaker and easy mixer amidst all classes including movie actresses and so forth.

"But I are only seeking radio test for operating license," Scratchi blurb with vacant expression of really bug.

"That come last," shoot examiner gent, "and only count two points. I now wish to discover if you have some freight clerking abilities concealed on your person," and he donate to my cousin lengthy list of edisons which he must answer right off the batter. For an instance, here are some:

(1) What are true rate on ripe tomatoes, burlapped and folded flat?

(2) How should you classify shovel handles, in glass, not decorated and how many per cents extra for refrigerating same when not requested by shipper?

(3) Give correct rate on eggs, nested, but not otherwise indicated by names.

(4) What are rate on fresh bootleg in boxes, bales, barrels, cases, cartons, lockers, trunks, gunnysax an' everything?

When my cousin have arrived at number four he was waving head sideways like movie comediot who have just received heavy policewallop on dome, but number five was the cat's mustache and he crumble over in exhaust. Hr. nr. 5. How would you classify Ford car which come on board with no paint scratched, no fenders dented or bent and no lamps or tires missing?

Inspee. endeavor to insert in Scratchi's mind that this one are mere absurb goak, but he seem slightly dizzy upstairs still and make serious response thus:

"I should wait until after bedtime story hour, and then, taking large monkey's wrench along, crawl into cellar of ship where such car are stowed and I should make this Lizzie conform to rule 3-11-33 or hop into ocean or both."

Scratchi then require to know how many other knowledge branches are necessity to grasp such combination positions, and examer announce he must learn inside story of hash-making so as to assist steward and must also take intense course in squegee tecknick to help along bo'sun dept.

"How far shall this combination exude?" Scratchi deplore in quenched tone.

"Until ship crew are again one man job like well known Nancy's Brig," say merry tester gent. "Then operator will do everything from skippering to cooking."

"Everything?" gasp Scratchi.

"Except operate!" yip Inspeck.

So, wishing you several kinds of luck, Mr. Editor, I still remain your combination reader and writer,

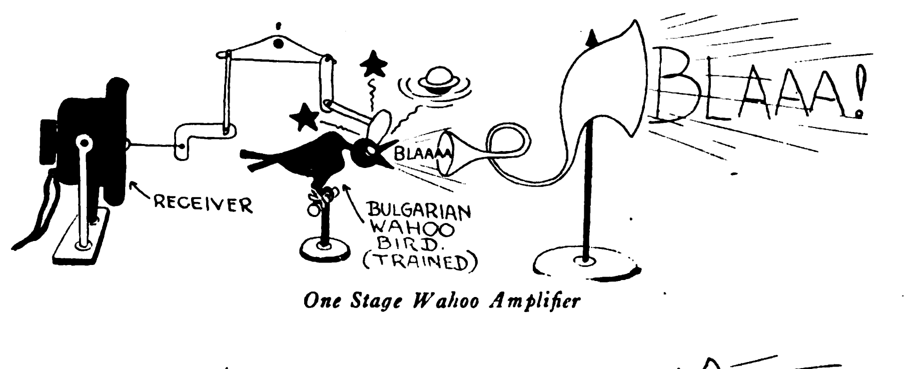
HILOLI NOGO.

THE RADIOPHONE

By EARL ENNIS

A mystery box, held in the hollow hand of Science—
A lamp aglow with whirling atoms caught from space,
A shore where billows ripple in from distance oceans,
A force that startles—like a slumbering giant's face.

Man's listening ear—new-tuned to higher rhythms,
Hears here the conch-shell roar of unseen time—
Through this, he tears another veil asunder,
And lifts himself another inch from out the slime.



One Stage Wahoo Amplifier

Three Stage Wahoo Amplifier

The Conquest of Ouglamuck

A Samuel Jones Story

By Volney G. Mathison

I HEAR there's some rumors goin' around in th' United States that I've abandoned my old peaceful profession of brass-poundin' an' degenerated into one of them highbrow conglomerations of hydrophobiac algebra, discomposed electrons, an' dumfoundin' decrements otherwise known as radio engineers. But I want to make it plain that all them reports about my havin' adopted a new system of defraudin' my employers out of three squares a day an' a place to sleep are nothin' but low-down misrepresentations.

Radio engineerin' an' myself have separated company. Constructin' wireless stations is all right in books an' amateurs' wood-sheds — but not in Alaska. Buildin' power-houses an' raisin' hundred-an'-fifty-foot wireless-masts up among th' Siwashes an' snow-blizzards of th' Aleutian Islands is interestin' work; but hereafter I am selectin' some kind of a more soothin' occupation— such as mixin' up nitroglycerin' in a bomb factory, or piloting a flyin'-machine with a busted rudder in a cyclone.

Long about last Christmas, I quits poundin' brass at KVI over on Unga Island, on account of th' insufficient feministic environments; an' after makin' preparations to disunite myself from Alaska on th' east-bound mail-boat, I decides to breeze over to Popoff Island to say farewell to Hell-Fire, my desperate brother-in-radio at KOXN.

Ramblin' in my fishin'-dory around to Pirate Cove, th' hard-boiled hangout where KOXN is dislocated, I finds Hell-Fire sittin' solitary-like up on th' lop-sided wharf, in th' freezin' north wind, his heavy red mackinaw peaked up around his ears, an' lookin' about as joyful as a tom-cat spendin' the evenin' on a back-alley ash-can.

He reciprocates my cheerful greetin's by kickin' his shins against th' side of th' old salmon-barrel he's roostin' on, like a sourdough tryin' to bust th' ice out a' th' family wash-basin after a cold night, an' remains about as conversible as a Point Barrow iceberg until I remarks that I'm permanently removin' myself off of Shumagin Island *terra firma* in th' mornin'.

"You're quittin' KVI?" he scrunches, twistin' his neck about a sixteenth of a inch.

"Quit already," I repeats.

"Then you're just in time to take a fine job!" exclaims th' infamous builder of KVI and KOXN, his physiognomy crackin' loose into a bunch of refrigerated smiles, like a river breakin' up after a hard winter. "Come up to th' shack, an'—

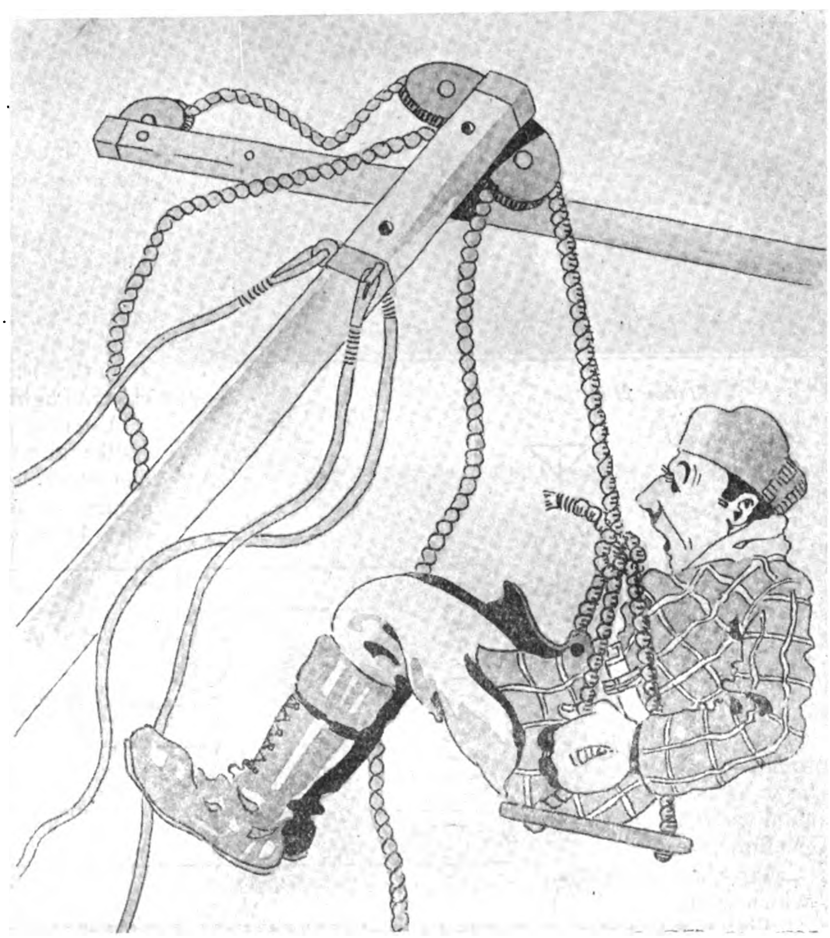
"I come over here to say good-bye— not to get another darned hunk of brass to pound," I objects; but Hell-Fire refuses to listen.

"Th' schooner *'Pirate King'* is comin' in from Frisco with a load of gear to build a wireless station at th' company's fishin' dump out on Ouglamuck Island," he explains, draggin' me up to his shack; "I'm s'posed to build it, but th' relief operator for KOXN won't be here till th' May mail-boat; so I can't leave. You can go an' put up th' station; an' if you want'a operate it afterward, ya can.

"It's gonna be a swell job, because th' company are plannin' on a combination operator-superintendent to boss th' whole works at Ouglamuck—in fact all th' instructions about it are lyin' up there in th' company office right now. Th' sourdough who is runnin' th' joint at present is showin' too much favor to th' fishermen, an' th' company is disratin' him to straw-boss—so between handlin' th' wireless station an' rulin' over th' codfish snailers, you'll be th' big pebble on th' Ouglamuck beach."

"An' how does th' present Ouglamuck fish-boss feel about gettin' deflated of his authority?" I inquires, prudent-like.

"Oh, he's nothin' but a little calf-livered shrimp," Hell-Fire assures me, careless-like. "Only his squaw is a kinda fractious old hag. Th' company have already sent four different superintendents up to Ouglamuck, an' I've been told that she bothered 'em a little—knifed a couple, an' poisoned one, an' th' last one she made drunk an' burned him up sleepin' in his shack. Ya see, she figures that if her old man loses his job she loses her meal-ticket——"



"Leavin' me an' my wireless-pole to start swingin' down through space with th' graceful, breath-catchin' swoop of a shootin' star."

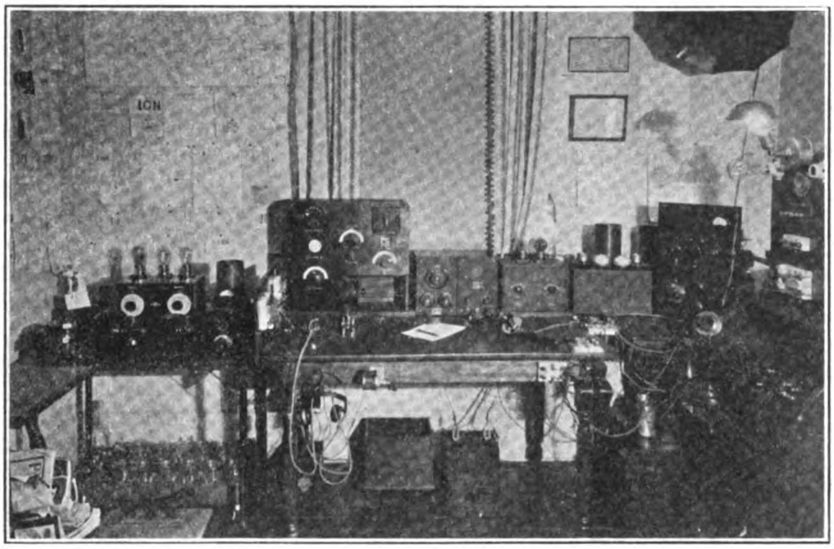
"Say, I think you better go yourself," I breaks in, somehow feelin' a shortage of exuberance over this proposition. "I might consider relievin' you here at KOXN——"

"Yes, but I can't leave now anyway," intersperses Hell-Fire, decided-like. "I've paid in a hundred an' fifty dollars fer a season's seat in th' spring stud-poker tournament which begins next month up in Five-Ace Sharpeneck's shack—an' ya don't expect me to pass up a whole spring stud-poker tournament just to go an' build a darned wireless station some place, do ya?"

Continued on page 62

DESCRIPTION OF STATION 2LH

2LH is located at the highest point in White Plains, 22 miles north of New York City and 5 miles west of Long Island Sound. The aerial system consists of a ten-wire cage, 65 ft. long and 70 ft. high. An 18-wire "clock" counterpoise is located beneath the aerial and 8 ft. above ground. A one-wire aerial 200 ft. long is used for receiving, making possible a break-in system.



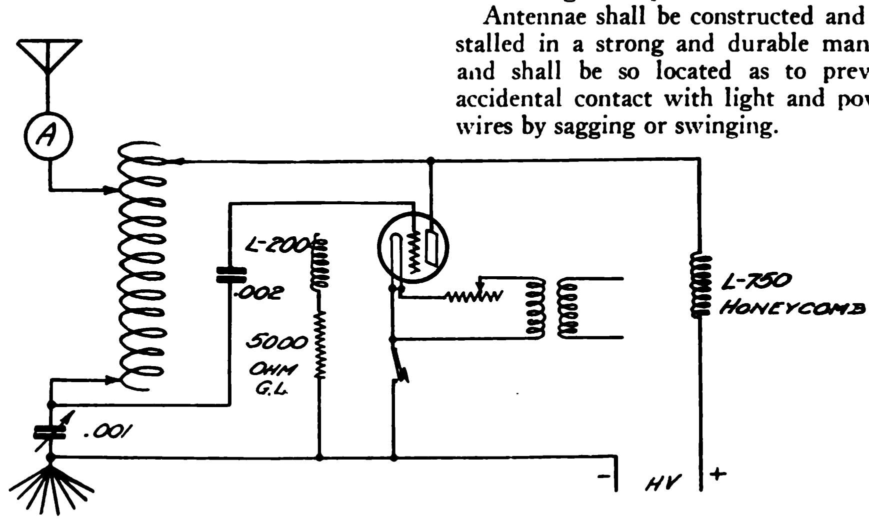
Station 2LH

Normal radiation on four 5-watt tubes is about 4 amperes, 2.8 amperes on two tubes. Until recently but two tubes were used most of the time. 2LH's signals have been reported in 40 states and stations in over 30 states have been worked and traffic handled. Voice signals have been reported as far west as Chicago.

The transmitter consists of four 5-watt tubes, all used as oscillators in a circuit similar to that used by 8LF, 2AID and several other prominent stations. A new rectifier scheme is used which results in a note similar to that obtained from a motor generator set. Voice modulation, even at a very short distance, is nearly perfect, which is unusual for an a.c. phone set. This new rectifier has been given a thorough test at 2LH and it is much superior to anything tried before.

Description of picture from left to right is as follows: Radio frequency experimental set, motor generator 450 volts, experimental 5-watt C. W. set. Pre-war tuner still used for NAA and navy signals. Westinghouse R. C. tuner and amplifier. Radio frequency amplifier, experimental 100-watt C. W. set and the 20-watt set. Battery charging panel on extreme right. Electrolytic rectifier in use at time picture was taken is beneath left hand table.

The operators at 2LH are William S. Halstead and Fred Sipp, signatures DC and FS respectively.



Circuit Diagram, 2LH

MODIFY RADIO REGULATIONS

THE National Board of Fire Underwriters has issued tentative regulations covering radio receiving installations, that disclose considerable modification as compared with the requirements previously issued by fire underwriters.

The specifications that follow were drawn up by a special committee of the National Fire Protection Association, which is the authority for the National Electrical Code and whose findings are standards of engineering practice. Besides the underwriting organizations represented upon this special committee, engineers acting for the American Radio Relay League, American Telephone and Telegraph Company, Radio Corporation of America and the Independent Telephone Association, also participated.

The new rules are being published as proposed amendments to be included in future editions of the Electrical Code. It is stated that the requirements contained in the current edition of the code were based largely on the hazards incident to the equipment of wireless telegraph transmitting stations where antennae of considerable height and length were used and where the hazard of high potential equipment had to be considered.

The recent widespread installation of radio telephone receiving sets has necessitated a revision of the regulations. The receiving set having an indoor antenna is considered devoid of hazard. With any receiving set, the publication says, the principal danger is from lightning brought in over the antenna to the equipment, or to some part of the building. Where there is no exterior antenna this hazard is removed.

The following specifications are for receiving stations only:

RULE 86
NATIONAL ELECTRICAL CODE

Specifications: (For Receiving Stations Only.)

ANTENNA

a. Antennae outside of buildings shall not cross over or under electric light or power wires of any circuit carrying current of more than six hundred volts, or railway trolley or feeder wires, nor shall it be so located that a failure of either antenna or of the above mentioned electric light or power wires can result in a contact between the antenna and such electric light or power wires.

Antennae shall be constructed and installed in a strong and durable manner and shall be so located as to prevent accidental contact with light and power wires by sagging or swinging.

Splices and joints in the antenna span, unless made with approved clamps or splicing devices, shall be soldered.

Antennae installed inside of buildings are not covered by the above specifications.

LEAD-IN-WIRES

b. Lead-in-wires shall be of copper, approved copper-clad steel or other approved metal which will not corrode excessively, and in no case shall they be smaller than No. 14 B. & S. gage except that approved copper-clad steel not less than No. 17 B. & S. gage may be used.

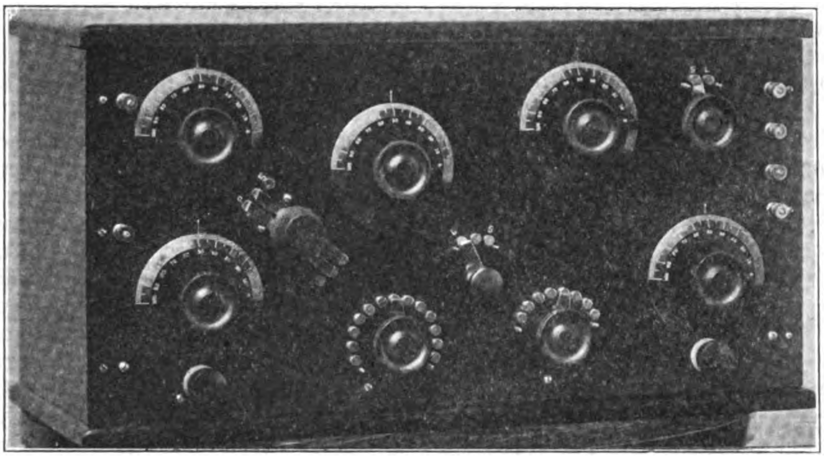
Lead-in-wires on the outside of build-

Continued on page 86

A 200 to 5000 Meter Regenerative Receiver

By R. C. Anderson, Long Beach, California

THE receiver about to be described is the outcome of a strong desire, after several years experimenting in amateur radio, for something better—a receiver which would work like the average amateur variometer short wave sets, with the same selectivity plus increased range to cover commercial stations, time signals, and medium wave arc stations. The set can be made by the average amateur who has a few good tools and some mechanical knowledge at a cost for material and parts of about \$50. The cabinet will cost from \$4 to \$12, depending on the finish.



Front of Panel

The parts needed comprise the following:

2 variometers of good make (I use 1 Remler and 1 Tuska).
2 variable condensers, one 43 plate and one 23 plate (or 29 plate) (Wireless Shop).
2 ⅛ in. formica tubes, 4 in. diameter and average 4½ in. long.
1 coupling ring and assembly (should be made in a good shop). Or, formica tubing will be fine, if can be had in proper diameter—secondary, 3¾ in. long, primary 4½ in. long.
1 series parallel switch.
5 3-in. dials, 4 switches, 6 binding posts.
1 bakelite panel, 8½x17½, by ⅛ or 3/16.
1 piece of thin copper sheeting for shield.
3 coupling bushings, of fibre or some good insulating material for bar and coupling shafts.
About 2½ doz. switch points, stops, etc.
275 feet of No. 22 D. S. wire for primary.
375 feet of No. 24 (or No. 26) D. S. wire for secondary.
50 feet of No. 24 D. S. wire for coupling ring, together with some bus bar wire, etc., for wiring the cabinet.

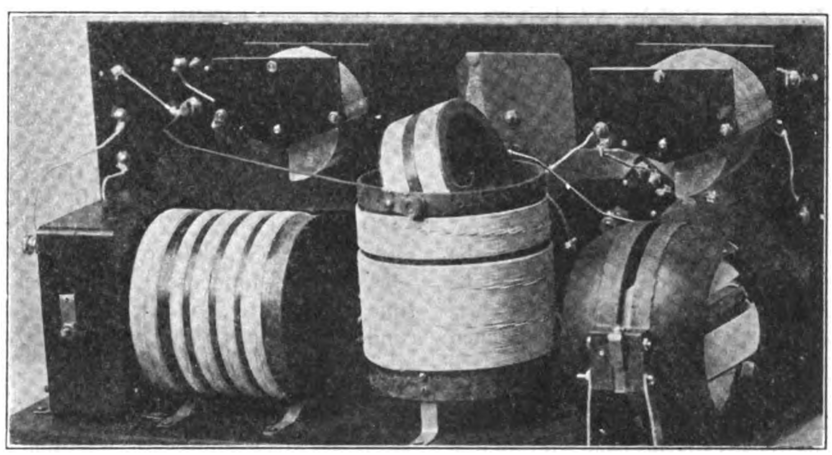
If the experimenter will make this set to exact detail, he will have something to be proud of, as practically every detail of the design has some part to play in the final performance.

For instance, the coupling ring with a flat face, is far sharper in tuning than a regular oval face coupling ball. Also, the placing of the coils at right angles on the panel, or sub base, at such distance that the windings will be about two inches apart, is a factor of value on the long waves.

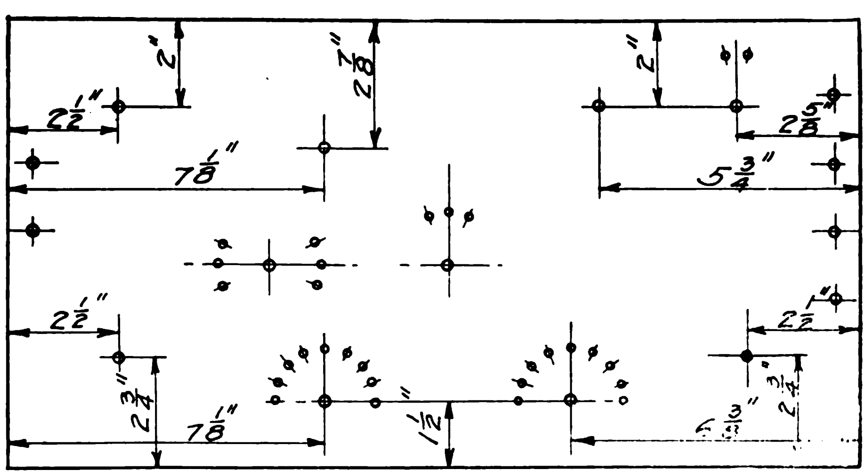
The dead end switch on primary is very essential, and it is necessary to connect like diagram so as to short the portion disconnected, or it will be useless. Likewise, it is essential to short the last tap of the secondary coil to the switch center to eliminate dead end effects and render calibration, as given later.

The panel is best laid out and drilled first, then the switches, tops and condensers assembled. Later the coils and sub base and variometer may be mounted temporarily for alignment, and lastly the parts dissembled, the panel grained first with fine sand paper, finishing with oil stone powder, and oil.

The panel is exactly 17½x8½ and may be drilled as per sketch and dimensions. The holes for taps and switch centers will of course have to be made to suit the kind of switches used. I used Remler switches, Fada series-par switch, Remler dials, and a Tuska variometer for the plate side, while a Remler or Tuska may be used for the grid side. If Remler is used it will be necessary to remove 5 turns from each side of the center of both rotor and stator, to give the proper minimum. The Tuska is of right inductance value.



Rear of Panel

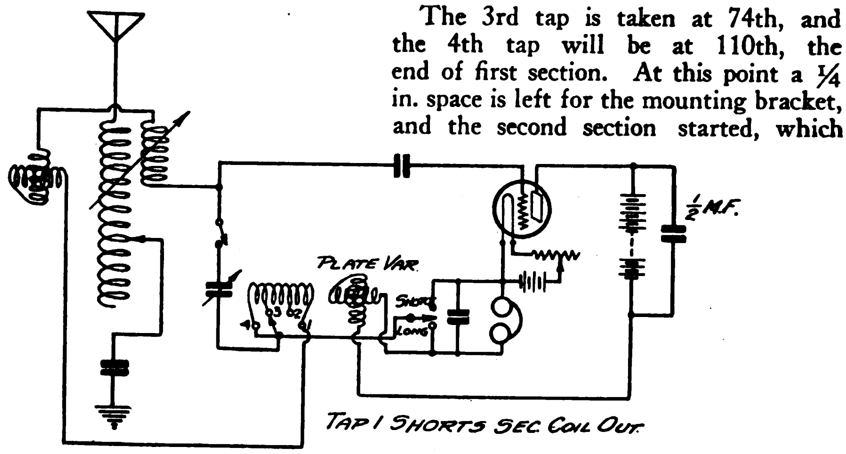


Panel Layout

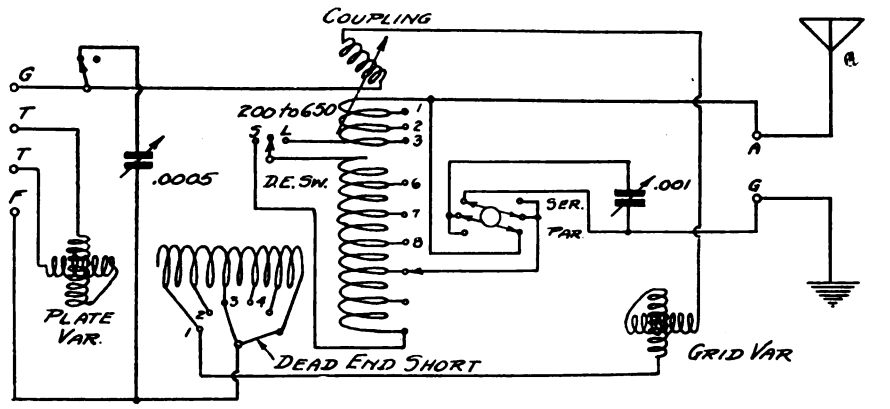
With the panel drilled and switches assembled, 1 in. radius on switches and condensers mounted, a sub base of three ply veneer ⅜ in. thick and ¾ in. less in length from each end of panel, by about 7 in. wide, should be mounted to panel, allowing panel to go ¼ in. below bottom side of sub base.

We are now ready to make and assemble the coils. The primary coil is made as follows:

The coupling assembly having been drilled and mounted for trial, at a point about ¾ inch from end of core, start the winding, right hand direction, and make it 2 bank until 55 turns have been wound on, tapping as you wind at the 7th, 17th, 27th, 39th and end of winding. These taps will represent, with a one-wire aerial of about 200 ft. long and an average of 40 ft. high, and the primary condenser in series, 200, 275, 375, 475, 600, 650 meter waves respectively.



Circuit Diagram



Wiring Diagram

These figures will vary with a different aerial, but there is a good overlap and unless the aerial should have a capacity much less than the one above, the range of from 200 to 650 meters will be covered by the above tappings, and furthermore, if the condenser be switched to shunt, the range will be increased to 1200 meters.

So much for the short end of primary, which by means of the dead end switch shown in diagram, is practically a separate primary.

The 360 to 375 wave for music and experimental stations will tune on tap three, and series condenser about 30. Six hundred meters will tune at tap five (end of winding) and series condenser 50. I strongly recommend using the primary condenser in series on all waves up to 2000 meters on account of sharpness.

Starting our main primary winding at a point 3/16 in. separation (which should connect to D E switch as per diagram) from end of the first section, we proceed to wind a continuous section of 3 bank type, tapping as we go as follows:

Tap 6, 16th turn, which will be the 69th turn from the beginning; tap 7, at 90th; tap 8, at 111th; tap 9, at 134th; tap 10, at 162nd; tap 11, at 190th; tap 12 at 226th, and tap 13 at 262nd, the end of winding.

Using the condenser series, these taps represent the following waves, condenser at about 50: Tap 6, 752; taps 7 and 8, 800 to 952; taps 9 and 10, 1200 to 1400; taps 11 and 12, 1512 to 1800; taps 12 and 13, 1800 to 2000.

With the condenser in parallel we tune 2500 meters on the 11th tap and condenser 10, and so on increasing, with all the coil in use, the condenser will reach about 5000 at maximum. The coupling rod should go thru core about ⅜ in. above beginning of winding.

The secondary coil is made of 4 bank winding wound to right, sectionalized into 5 parts with about 3/16 in. space between each section. The first section is started ⅛ in. from margin and wound to the 41st turn, at which point a tap is taken, being tap 2, as the first tap shorts out the coil and represents the beginning of winding.

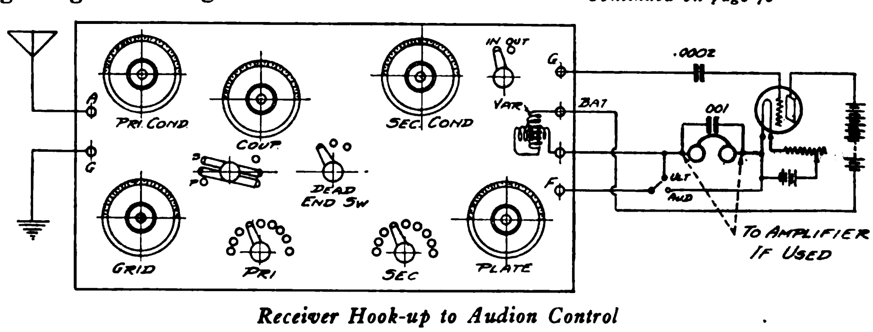
The 3rd tap is taken at 74th, and the 4th tap will be at 110th, the end of first section. At this point a ¼ in. space is left for the mounting bracket, and the second section started, which will consist of 46 turns, and the end will be tap 5, representing the 952 wave. The next section has 68 turns and the end of it will be tap 6, or about 1200 meters. The fourth section contains 62 turns and its tap 7 represents 1600 meters approximately. The last section has 73 turns and makes tap 8, the end of winding, and corresponds to about 1900 meters. The calibrations given are meant to be in conjunction with about 10 degrees of the secondary condenser in use. Our idea is to use a minimum of capacity in tuning and give our plate variometer a strong feed back effect.

Two thousand five hundred meters will tune with all the coil in use and 25 points of the condenser. Four thousand six hundred and fifty meters, Mare Island arc time sigs, will tune at about 95, nearly the maximum of secondary condenser. The 600 meter wave will tune on tap 3, and condenser at 10, and 800 meters at tap 4, and condenser about the same.

The coupling ring was turned for me by the Wireless Shop from mahogany to the following dimensions, to fit the core: Diameter over all 3⅜ in., thickness ⅜ in., width 1½ in., with a ¼ in. center space to separate windings, and also a slight narrow edge each side to hold winding. The face of winding space exactly flat. Forty-four turns of No. 24 D. S. will fill the ring exactly. Rod is 3/16 in. brass.

No shellac should be used on any of the windings, but Squibb's collodion may be used sparingly in reinforcing the edges of the bank sections. Many articles have appeared from time to time

Continued on page 78



Receiver Hook-up to Audion Control

The Radio Direction Finder

Abstract of Bureau of Standards Paper No. 428

By Frederick A. Kolster and F. W. Dunmore

THE direction finder whose principles and operation are here described is installed on shipboard where it may be operated by the navigating officer who can take bearings at any time in any one or more of the radio fog signalling stations established and operated by the Bureau of Lighthouses. Sailing charts show the location of these stations, whose characteristic signals are automatically transmitted during fogs or such time as may be necessary.

The fundamental radio circuit is made up of inductance and capacity. These elements appear in various forms, and in the ideal circuit, as shown diagrammatically in Fig. 1, the inductance is entirely concentrated or lumped in the coil L, and the capacity is likewise concentrated or lumped in the condenser C.

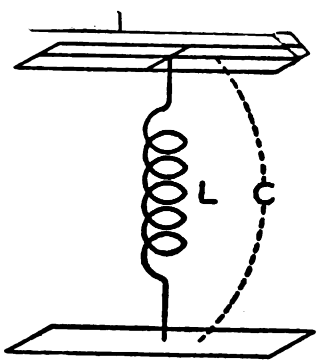


Fig. 2. Antenna Consisting of Elevated Conductors (Condenser Type)

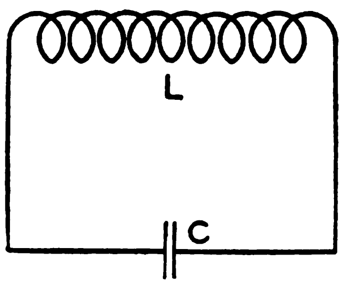


Fig. 1. Simple Radio Circuit

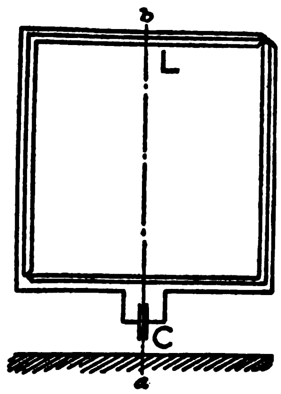


Fig. 3. Antenna Consisting of Closed Coil (Inductance Type)

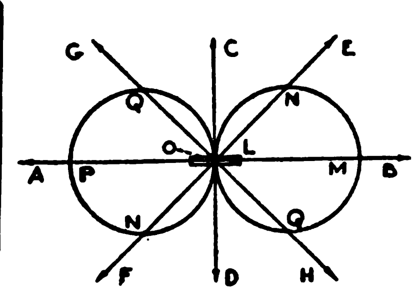


Fig. 4. Theoretical Directional Characteristics of Closed Coil Antenna

Power may be supplied to such a circuit either by applying a resonant voltage across the condenser C or by inducing a resonant voltage in the coil L, or by action of both in proper phase relation.

In the ordinary antenna circuit, as used in present-day radio communication, we find, generally speaking, that the inductance is substantially concentrated in the form of a coil L, and that the capacity is formed by a conductor or group of conductors elevated above the ground, the elevated conductors forming one plate of the condenser and the ground or counterpoise forming the other plate, as shown in Fig. 2.

It may be said, therefore, that energy is received in the ordinary radio antenna system by virtue of the fact that its capacity is exposed to the incoming electromagnetic wave, or in other words, that energy enters the system by way of its capacity, thereafter to be transferred to its inductance. The electrical capacity of an antenna as well as the potential impressed upon it by the incoming electromagnetic wave depends largely upon its physical dimensions, generally the size and height of its elevated area and in special types of antennas, mainly upon the length of the antenna wires.

Referring now to Fig. 3, we have what may be considered as the reverse of the antenna system shown in Fig. 2. In this case energy is received in the system by virtue of the fact that its inductance L is exposed to the incoming electromagnetic wave or, in other words, energy enters the system by way of its inductance, thereafter to be transferred to its capacity.

The inductance of coil L depends upon the number of turns, the area inclosed, and the spacing of the turns. The current in the receiving circuit depends largely upon these factors as well as the resistance of the circuit. For given physical dimensions, however, any value of inductance may be obtained by winding the proper number of turns in the coil L, so that the electrical dimensions of the coil system are not so dependent upon its physical dimensions as in the ordinary antenna system. As a matter of fact, a coil system of very small dimensions as compared with an antenna may be used for the reception of radio signals.

Although the coil-receiving system is superior in many respects to the antenna system, its chief advantage lies in its directive properties. If the coil L in Fig. 3, for example, is rotated about its vertical axis *ab*, the received signal intensity from any given source of transmission will vary approximately in accordance with the diagram shown in Fig. 4.

Maximum signal intensity OP or OM is obtained when the plane of the coil L lies in the direction of the source of transmission A or B. If the source is in the direction C or D, or exactly normal or at right angles to the plane of the coil L, then the signal intensity is zero. In all other directions the intensity varies in accordance with the figure-of-eight characteristics in Fig. 4. For example, in directions OE or OF, OG or OH, the distances ON or OQ respectively represent the relative signal intensities as compared with the maximum OM or OP.

It is immediately apparent, therefore, that if the coil L in Fig. 3 is of sufficiently small dimensions to permit rotation about its vertical axis, signals transmitted from any given source will be received with gradually varying degrees of intensity until the coil becomes normal or at right angles to the direction in which the transmitting source lies, at which time the signal intensity becomes zero. This position of silence is critical, and therefore may be used to indicate, with great accuracy, the line of direction of the source.

It is upon these simple principles that the direction finder as developed at the Bureau of Standards is based.

As the result of a long series of calculations and experiments, radio fog signalling equipment has been permanently installed on the Fire Island and Ambrose Channel light vessels and at the Sea Girt light station on the New Jersey coast. The radio transmitter is of the quenched spark type, supplied from a 500 cycle, 1-kw. generator. The automatic signalling system at the last named is designed to transmit a characteristic signal consisting of three dots sent out in rapid succession at frequent intervals. The Fire Island light station sends out two dots, and the Ambrose Channel light station single dots. The wavelength is 1000 meters.

A typical shipboard installation is that on the lighthouse tender *Tulip*, as illustrated herewith. The direction finder coil consists of 11 turns of insulated wire wound on a rigid skeleton form 4 ft. square. The coil is attached to a shaft which extends into the pilot house through suitable bearings and supported on ball-bearings to permit ease and uniformity of rotation by means of a hand wheel. The bearing of the signalling station is read directly on the magnetic compass card.

A calibration or correction curve was made by taking simultaneous visual and radio bearings as the *Tulip* cruised around the station. This connection scale was attached to the binnacle as shown in the illustration.

From the electrical circuit of the direction finder it will be noted that the variable condenser C_0 together with the coil L_0 form the main receiving circuit which is tuned to the signaling wavelength. Connected across the condenser C_0, either directly or through a potential transformer P, is the vacuum tube amplifying and detecting apparatus D. This consists of a three-stage radio-frequency amplifier, a detector, and a two-stage audio-frequency amplifier made up as a unit with a minimum number of operating adjustments.

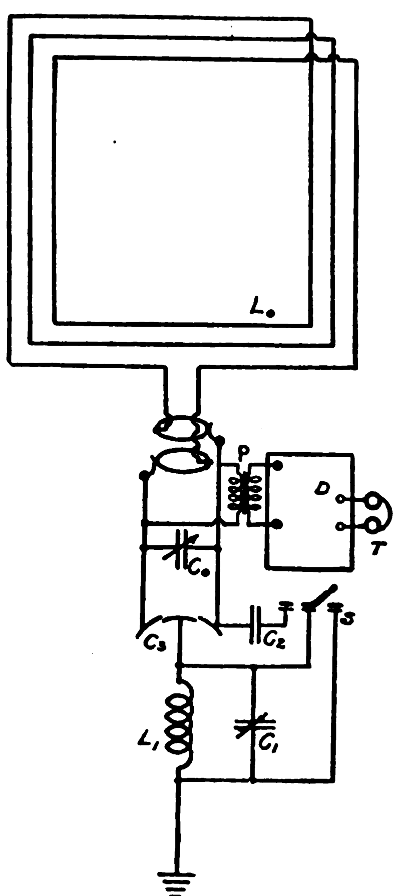


Fig. 7. The Direction Finder Circuit

The telephone receivers T are located in a fixed position at a sufficient distance from the magnetic compass to avoid any effect upon the compass due to the magnets within the telephone receivers. A brass tube is attached to the telephone receivers with a flexible rubber tubing completing the circuit to the earpieces worn by the observer. By the proper choice of the length of the brass tube a desirable quality is given to the signal tone by virtue of acoustical resonance.

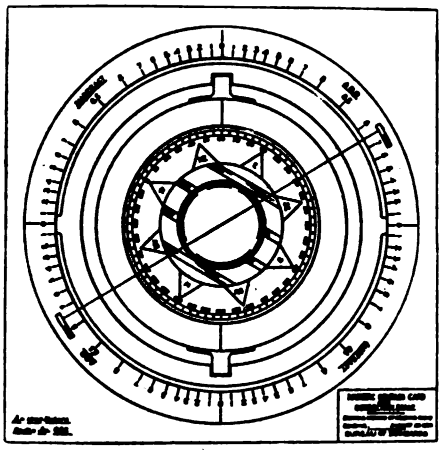


Fig. 6. Magnetic Compass Card and Correction Scale Showing the Direct-Reading Method of Obtaining a Corrected Radio Bearing.

The auxiliary circuits of the direction finder are controlled by the switch S. With this switch closed to the right, the middle plates of the double condenser C_3 are directly grounded. The double condenser is utilized to bring about electrical symmetry of the coil system with respect to earth. In other words, by adjusting the middle plates of the condenser C_3 to the right or left, the earth connection is brought to the electrical mid-point of the coil system, and the parasitic effects are eliminated, that is to say, the signal received in the telephones T results only from the energy directly received in the coil L_0.

With the switch S closed to the left, a small condenser C_2 is connected across half of the double condenser C_3 and the inductance L_1 and tuning condenser C_1 are inserted in the ground lead. Under these conditions, the coil system is no longer electrically symmetrical with respect to earth, and received energy enters the coil circuit L_0C_0 directly through the tuned ground circuit of which the capacity of the complete coil system to earth forms a part.

By the proper adjustment of the capacity C_2 and the circuit L_1C_1, a complete unidirectional effect can be obtained as previously described.

In the practical operation of the direction finder, all tuning adjustments remain set for the 1000 meter wavelength of the signaling station. Switch S is closed to the right when observing the line of direction of a given signalling station and to the left when it is desired to determine the sense of direction. In other words, to determine the line of direction of a station, the coil system which is directly grounded at its electrical mid-point by throwing switch S to the right is rotated to the position of critical silence, at which time the plane of the coil is normal to the direction of approval of the signalling wave. To determine the sense of direction of the station switch S is closed to the left and the coil rotated to the position of maximum signal intensity at which time the plane of the coil is in the direction of approval of the signalling wave and pointing toward the signalling station as indicated by an index pointer provided for that purpose.

Radio on pilot boats is used at the mouth of the Seine River in France to report the arrival of all vessels and to receive instructions as to where ships are to be placed in the harbor.

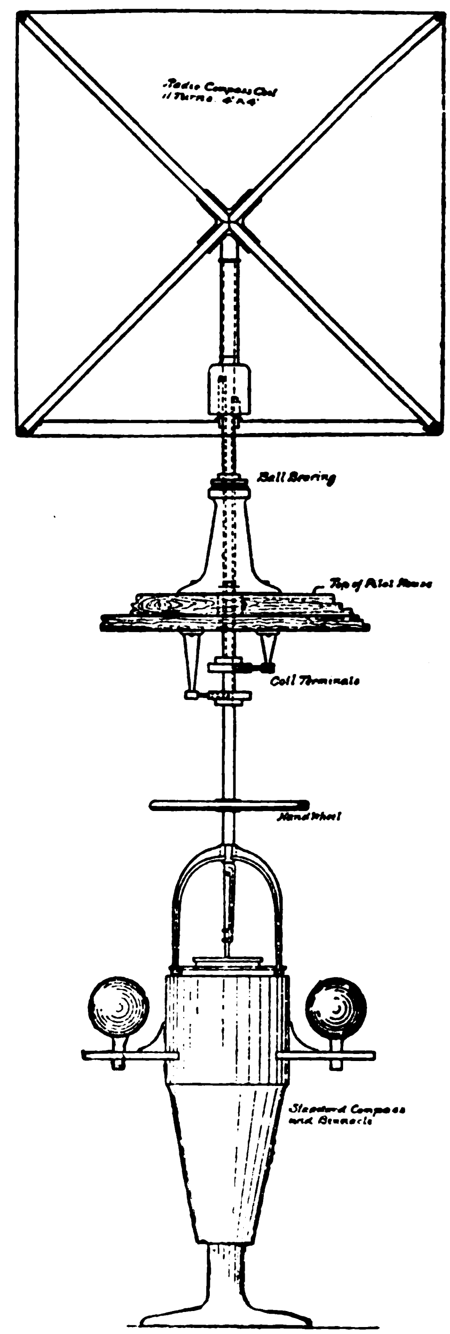


Fig. 5. Radio Compass as Installed on Tulip

A Radio Primer

By H. A. Eveleth

INDUCTANCE AND CAPACITY

Before the details of receiving and transmitting apparatus and circuits are taken up a clear understanding of the meanings of inductance and capacity should be had. The efficient operation of sending apparatus and the tuning of receiving apparatus depends on the proper adjustments of inductance and capacity.

When an electric current flows through a wire a magnetic field is established about the wire. A compass needle placed near the wire will be deflected. If the current is stopped or if there is a variation in the intensity of the current the magnetic field will cease or vary in intensity and a current will be established in the wire in a direction opposite to that of the current which caused the magnetic field to be established. This is due to the fact that the wire is cut by the lines of magnetic force when the magnetic field varies in intensity and, as already explained, a current is set up in a conductor when it is cut by a moving magnetic field. This phenomenon is called self-induction.

If the wire is coiled, the effect will be much more pronounced because the adjacent turns of the coil will combine their effects and the total self-induction will be much greater than if the conductor were a straight wire. The circuit is said to have greater inductance.

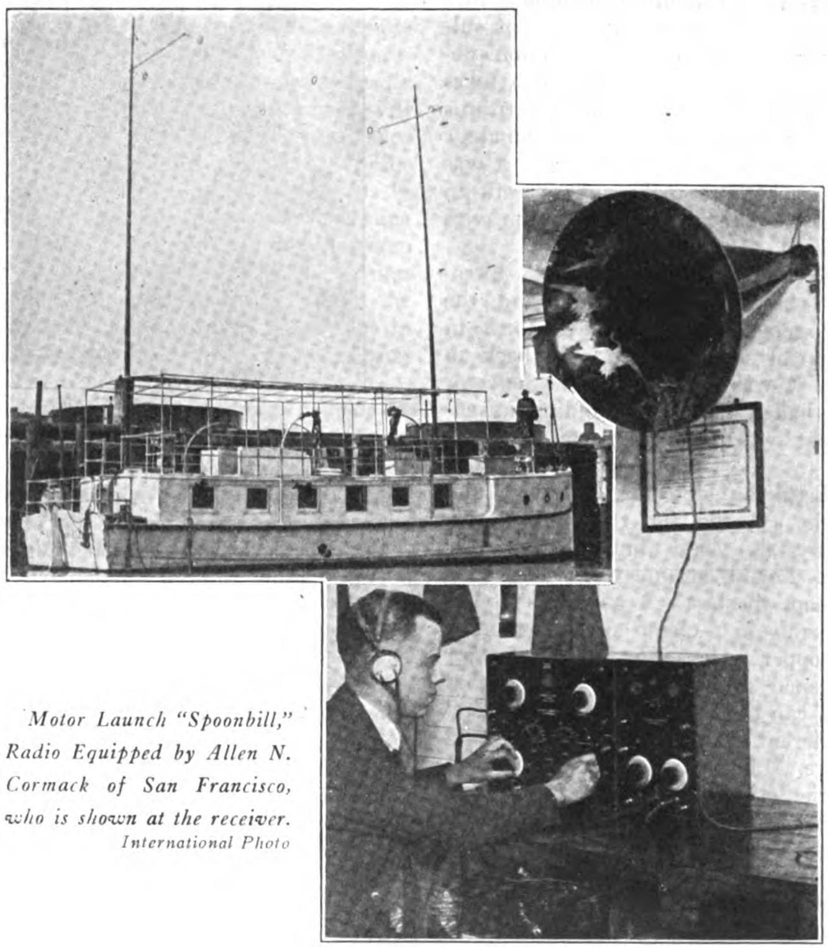
A circuit which can store electrical energy is said to have capacity. Do not confuse this with the storage battery which does not store electrical energy but changes electrical energy to chemical energy and later delivers an electric current by chemical reaction. A condenser is used to give capacity to a circuit. A condenser consists of two conductors separated by an insulator, or dielectric, as it is called. For instance, it may consist of two metallic plates separated by a sheet of glass, two conductors separated by air or sheets of tin foil separated by paper. The aerial and the earth and the air between the two form a condenser. The capacity of the condenser depends on the nature of the dielectric, the distance between the conductors, the size of the conductors and the voltage or potential to which the condenser is subjected.

The wave-length of a circuit depends on the product of its inductance by its capacity. Two circuits are in resonance or in tune when the products of the two are equal. A receiving set includes inductances and capacities, the values of which can be varied, and the receiving circuit is tuned to the wave-length of the transmitting station by adjusting the values of inductance and capacitance.

THE SIMPLE RECEIVING SET

The simple receiving set should include an inductance or a capacity, the value of which can be changed so that we can tune to the wave-length of the transmitting station. It must include a detector of some kind to rectify the inaudible radio frequency oscillations received from the transmitter circuit to an audible frequency which will act on the telephone receivers and produce an audible sound.

The variable condenser usually consists of two sets of metallic plates. One set is stationary and the different plates or sections are spaced a short distance apart. The other set of plates can be revolved so that they slide in between the plates of the first set but at the same time do not touch. Since the capacity is affected by the space between the two sets of plates it will be realized that maximum capacity is obtained when the leaves of the movable set are exactly opposite those of the stationary set and minimum when the movable plates are withdrawn. If this variable condenser is shunted around the inductance, that is, connected across the terminals of the inductance, it can be used to increase the wave-length of the open-circuit beyond that which could be secured with the inductance alone and it also permits of a closer adjustment of wave-length when used with the inductance because it gives a combination adjustment of both inductance and capacity. The inductance coil may have ten turns to the tap. Using the coil alone we could not get closer adjustment than in steps of ten turns. Using both inductance and variable condenser we could get any fraction of ten turns.



Motor Launch "Spoonbill," Radio Equipped by Allen N. Cormack of San Francisco, who is shown at the receiver.
International Photo

The variable inductance may consist of a coil of wire with taps taken off at intervals and brought to a series of contacts so that the number of turns in the active part of the coil can be varied. The inductance is connected in series with the aerial and the ground wire. When the wave-length of the three combined, that is, the wave-length of the aerial-inductance-ground circuit is equal to the wave-length of the passing ether waves from the sending station this open-circuit, as it is called, will absorb the most energy from the passing ether waves and the open-circuit will be in tune with the sending station.

The variable condenser may be connected in series with the inductance and ground or inductance and aerial to reduce the wave-length of the open-circuit, thus giving an effective wave range lower than could be secured with the inductance alone.

Remember this—A condenser in multiple with an inductance is used to increase wave-lengths and a condenser in series with an inductance is used to decrease wave-lengths.

The detector of the simple receiving set must be fairly sensitive, easy to adjust and should not require the use of a battery to operate it.

Before the advent of the vacuum tube detector, crystal detectors were used almost universally. There was one form, the electrolytic detector, which consisted of a very fine platinum wire dipping into a solution of 20 per cent nitric or sulphuric acid, the rectifying action depending on the electrolysis which takes place. But in those days radio apparatus was hard to procure and the amateur usually had to make his own and it was some job both to make and operate an electrolytic detector—and platinum wire came high.

The carborundum crystal was introduced about the same time and the writer remembers using this form in commercial work aboard ship back in 1912. It was very crude as a detector but it had a faculty of holding its adjustment when the ship was buffeted about.

The silicon detector followed and then the Perikon and the Pyron (special crystals) and finally came the galena. For all around work the galena is perhaps the best. A galena crystal is held firmly in a clamp and a very fine, bare copper wire (No. 36 or smaller) is fastened to a movable arm so that its end can be made to touch the crystal at different points and with varying pressure. The point of the wire is run over the crystal until a sensitive spot is found and the pressure is varied until the signals are heard with maximum intensity. The end of the wire should be clipped off every few days to present a new surface and a thin layer of oil may be put on the crystal to exclude moisture. A disadvantage of this type of detector is that a slight mechanical shock may disturb the point and throw it out of adjustment.

It seems that when certain substances are placed together in not too close contact they have the property of producing a pulsating direct current when an alternating current passes through them. In some crystals the ratio of current flow is as high as 400 to 1, that is, current flows in one direction 400 times as easy as in the opposite direction. This rectifying action takes place between the galena crystal and the fine copper wire and the high-frequency currents generated in the receiving circuits pass through this crystal rectifier, in part at least, and the resulting pulsating direct current flows through the windings of the telephone receivers and affects the diaphragms.

There must be some kind of apparatus to change the audio frequency current into sound and the telephones serve this purpose. The magnets of the telephones are wound with very fine silk-covered or enameled copper wire so as to get the greatest number of turns in the smallest possible space and the resistance is anywhere from 1000 to 3000 ohms. This makes an extremely sensitive device which responds to very small currents.

A small fixed condenser, that is, one whose capacity is fixed, is usually shunted across the terminals of the phones. The impedance of the phone windings is considerable and the condenser serves as a by-pass for the radio frequency current, the detector and phones being connected in series, but the audio-frequency pulsating current passes through the phone winding.

There are a number of these "crystal" home receiving sets on the market today and they are satisfactory for local receiving. These sets usually consist of a variable inductance, a crystal detector and phones with fixed condenser. The inductance consists of a single layer of wire with taps brought out to switch points so that more or less turns can be used as desired.

Anyone, with little trouble and less expense can construct a portable receiving set which will enable them to receive music or code signals. Hang about 75 feet of bell wire out of the window for an aerial and use the radiator or water-pipe for a ground.

To make the most simple kind of portable set get the following material:

A cardboard or wood box three inches square by two high.

An empty spool ¾ inch in diameter by 1½ inches long.

Enough No. 28 or No. 30 insulated copper wire to wind one layer on the spool.

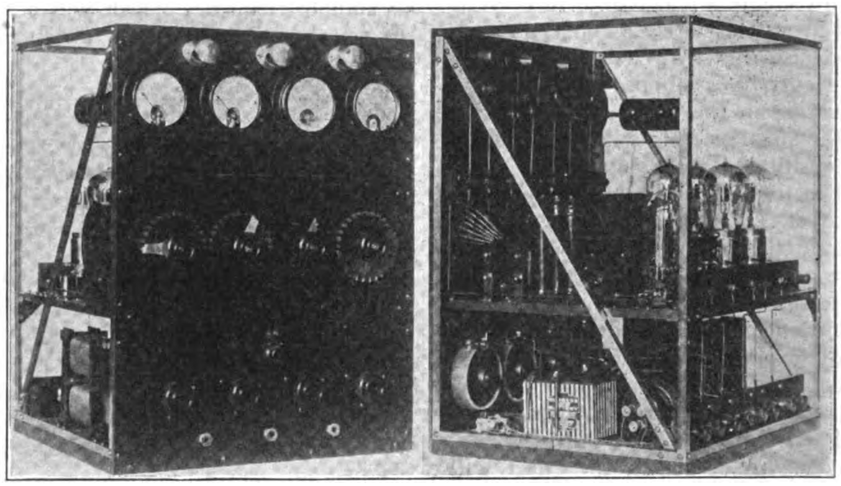
A small battery clip to hold a piece of tested galena.

Two or three inches of No. 36 bare copper wire. Mount so that one end rests lightly on the galena.

Three binding posts.

One pair 2,000 ohm Murdock phones.

Connect the aerial to one end of the spool winding and the fine wire to the other end. The second end of the fine wire rests on the galena. Connect the clip to ground and shunt the phones around the galena. Wiggle the free end of the fine wire around on the galena. You will be surprised!



9FM, a Neat and Compact C. W. Transmitter

9FM—A NEAT AND COMPACT C. W. TRANSMITTER

Home radiophone builders well may study the accompanying pictures of a 20-watt phone set built by 9FM, Dr. Sidney J. Blum, Shukert Bldg., Kansas City, Mo. They stand in a class by themselves for effective portrayal of a set which is clever and compact in design and neat and workmanlike in construction. This has worked the Atlantic Coast many times. It has a radiation of 2.4 amps., with 500 volt plate current.

9FM also operates a 100-watt C. W. transmitter which has worked with 6XAD, Catalina Island, and has been reported QSA from Vancouver, B. C. This set gives a radiation of 2.8 amps. with 800 volts rectified ac. on the plates of two 50-watt tubes and 9 volts on the filament. Dr. Blum is making some changes in his location to do away with poor aerial and operating conditions—and is also going to try the use of two dc. generators in series—500 and 800 volts—instead of using rectified ac.

Protecting Radio Sets From Lightning

By L. S. Brach

The purpose of this explanation is to off-set any fear in the reader's mind as to the possibility of the radio antenna conducting lightning currents into the house. Generation of lightning is the building up of small charges of electricity which accumulate on moisture. These charges combine as the moisture forms into fog, clouds and raindrops, and subsequently becomes so heavy as to discharge to other clouds or to the earth. It is the presence of moisture in the air that permits the conductance of the discharge between the clouds and the earth.

The damage done by lightning may be caused either by the direct stroke of the discharge striking a wire or by an inductive charge being built up in the wire by reason of the flash of lightning passed between two clouds or between clouds and the earth. All lightning discharges have an area of electrification, and wires located within this zone are subject to the induced potential which would, if not properly side-tracked into the earth, enter into the apparatus and result in damage. Direct discharges are always too violent to be protected against except by the antenna wire itself, which generally melts and breaks the circuit. Even a heavy switch will not cause suitable protection, but the possibility of such a condition occurring would be no greater with the antenna than it would be without.

The strength of the induced charges in lines depends upon the nearness of the direct discharge, length of line and its position in the electrified zone. It is safe to say that the longer the antenna circuits, the more subject they are to being affected by passing storms. These tests reveal that discharges occur in two different ways; one is the brush discharge in which lightning passes through insulating material readily and is harmless in passing; the other occurs in a line of thread-like discharge and with it sufficient heat is produced to cause damage to the parts between which the discharges occur. In the designing of arresters, we treat only with the latter type of discharge, and it is essential that protectors must carry such discharges freely and without injury to themselves. The most efficient arrester is therefore one that will instantaneously and repeatedly dissipate the largest amount of energy without being affected.

The potential at which an arrester should discharge should be determined by the insulation of the apparatus or circuits that are to be protected. For example: If the apparatus is tested to withstand 500 volts between its windings and other parts, the protector should discharge at a potential of approximately 375 to 400 volts, that would insure an operation of the arrester in preference to the damage of the insulation. It is possible to design arresters that will discharge at different potentials to a certain degree, but in this we are limited in getting below 375 volts in practical types of arresters.

Another test which will reveal the sensitiveness of an arrester to static current is the comparison of the efficiency of the arrester with an adjustable air-gap, thereby getting an air-gap equivalent. The process in doing this is to have two needle points supported in a way that a micrometer adjustment may be had. These are to be held in multiple with the arrester and an electric generator. The separation at which the needle gap is adjusted when the arrester will start to assume the discharge in place of its passing across the needle point would give a value to the arrester as in the air-gap equivalent. Therefore, when we say a certain arrester has an air-gap equivalent of .001 or .002, we mean that the arrester will start to discharge the current from a generator when held in multiple circuit with a needle held that distance apart.

There are three principal designs of lightning arresters, the air-gap, vacuum, and high resistance types. In addition to this there is the choke coil, but choke coils, when used, are generally found in combination with one of the three types mentioned. The air-gap design depends on its efficiently bringing close together two electrodes, one connected to the line and one connected to ground. The air between the two electrodes acts as the insulation for the normal operating currents. Air-gap arrester electrodes are generally made with carbon or metal as the conducting medium forming the electrodes. The efficiency of this arrester depends on the closeness of the two electrodes. It is necessary to keep in mind that in this design, there is always present danger of the two electrodes fusing together by passing discharge or the serrated points burning back and its effectiveness thereby changing—due to the lengthening of the gap.

The vacuum arrester consists of two electrodes held in a fixed position in a sealed chamber from which the air has been exhausted, and through this vacuum we find that inductive currents readily pass, even when the electrodes are held much farther apart than in the air-gap types, and equally good results obtained. The vacuum types are practically free from the fusing together of electrodes or the collection of moisture or dust on the operating parts. It is a well known fact that discharges will occur at a lower potential between conductors at a given separation in a vacuum than in air, and this fact has been taken advantage of in the designing of protectors so as to provide protectors of low voltage potential discharge value having a fairly high carrying capacity.

The high resistance medium arrester consists of a composition block, generally a mixture of carborundum or silicon with a clay binder, placed between the line and ground. The carborundum has the property of conduction and the clay binder acts as an insulator. The binder being porous and the conductive material being in very small particles, it is found that when mixed together we have an insulating mass with small conductive particles that arrange themselves in a way that the total mass is of exceptionally high resistance, but static current will pass from particle to particle through the binder and then discharge itself. While this type of arrester is sensitive to static currents it will not discharge at a low potential, and is therefore of little value for protection against crosses, but highly sensitive to lightning induction.

For radio antenna protection we have depended entirely on the efficiency of the vacuum type. We believe it is the best suited, inasmuch as with the other types, if constructed on efficient lines, they would take off, or cause to be lost, some of the radiophone voice currents, thereby affecting the strength of the receiving current to that extent.

Tube reception with a. c. lighting current, thus doing away with the necessity of batteries, is being developed by the U. S. Bureau of Standards. Briefly, the scheme is to utilize a 60 cycle lighting current for both filaments and plates of the electron tubes. The amplifier recommended in the report has three radio-frequency stages, and two audio-frequency stages, and requires a crystal detector. A 60 cycle current when used in an ordinary amplifier carries a strong hum, or ripple, offering serious interference with messages, but this is eliminated by balancing resistances, grid condensers and special grid leaks of comparatively low resistance, a telephone transformer in the output circuit and a crystal detector instead of an electron tube. It is said that the amplification was as good with alternating current as with direct. The complete set is light and compact for portable use.

C. W. Station 6EA

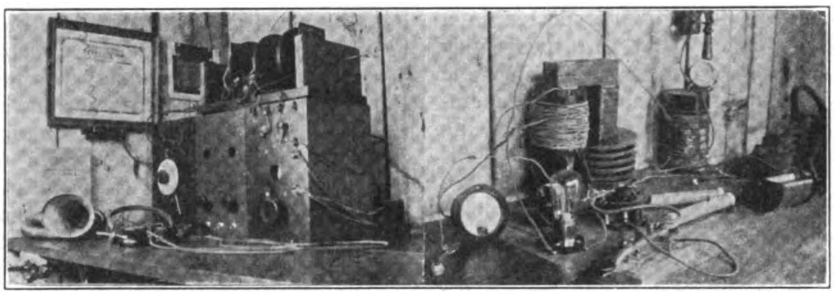
By H. C. Seefred

The a.c. C. W. transmitter as shown in the accompanying picture consists of one 5-watt "Cunningham" tube, a "General Radio" V. T. socket, a "Jewell" filament 0 to 15 voltmeter, a "General Radio" filament rheostat, a "Boston" radio key, two 5000 ohm "Radio Corp." grid leaks, a "Murdock" 23 plate variable condenser for the grid, a "Wireless Shop" C. W. variable condenser for grid-tickler coil, an "Eldredge" hot-wire ammeter, a home-made antenna inductance (34 turns of No. 12 D. C. C. copper wire wound on a mush cardboard box), a home-made grid-tickler inductance (6 turns of No. 18 D. C. C. copper wire wound on a mush cardboard box and same inserted in the larger box), a home-made C. W. plate voltage transformer (500 turns of No. 14 D. C. C. copper wire on primary with 40 turns of No. 12 D. C. C. copper wire wound over primary with middle tap for filament voltage, and 2800 turns of No. 31 D. C. C. copper wire for secondary). Also use the old spark oil immersed condenser shunted across secondary of plate voltage transformer to smooth out the tone. The transformer used to be an old spark transformer built in 1912 and used till 1921. Primary was rewound and all secondary "pan-cake" sections taken off except four of them. Plate voltage, about 750 volts, and antenna radiation is from 1.5 to 1.7 amps. (hot-wire readings) using no elevated insulated counterpoise. Just the regular ordinary antenna and ground system are used. The famous British Aircraft grid-tickler C. W. circuit is also used.

During only one month which the a.c. C. W. was in operation, I have communicated with 9DVA, 7XG, 7DP, 7LN, 6ZAM, 6QR, and also many others in California.

The C. W. receiver as shown in the accompanying photo consists of three home-made spiral wound inductances (primary, secondary and tickler), "De Forest" variable condenser with vernier attachment for secondary tuning, a home-made two stage amplifier, and "Type E" Baldwin phones. An old brass automobile horn attached to a "Type C" "Baldwin" phone is used for visitors during concert hours.

Throughout the past winter I have obtained fair results on C. W. reception, having heard 2FP, 8XV, 9XM, 9NX, Canadian 9BD, 9AMB, 9BEX, 9BJI, 9DTH, 9DTM, 9WD, 9XAQ, 9ZAF, WV6, CL8, 7XF, and 5ZA, all over 800 miles from Los Angeles.



Transmitter and Receiver at 6EA

RADIO CONFLICT BETWEEN GOD AND MAMMON

SCENE: Two broadcasters, one a church representative, and the other operating a news broadcasting station.

NEWS BROADCASTER: "Well, you fellows are required to co-operate with all the rest of us, why and who are you to say that you won't stand by during the 11:00 and 12:30 period?"

CHURCH BROADCASTER: "The proposition of our sermons being interrupted is preposterous. Why, God himself demands that we be given this period."

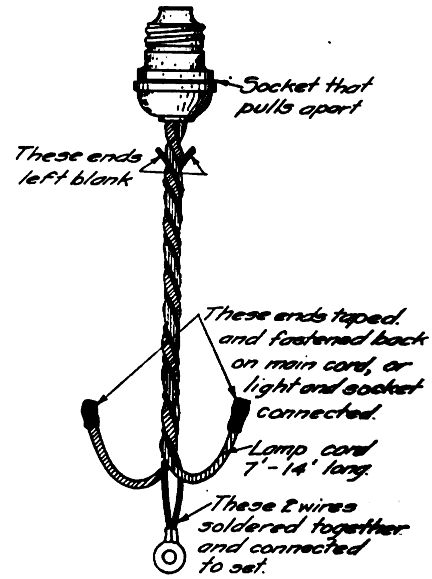
NEWS BROADCASTER: "All right, then, as soon as you present a letter from God, stating the necessity of your continuous operation, I'll withdraw my objections entirely."

A baseball game report by radio was recently given by a newspaper reporter who covered the opening game of the Washington and New York Yankees team with a radiophone. From the time the first batter stepped to the plate until the last one fanned, all local radio fans got the game inning by inning, if they listened in. Hereafter when the Washington team is in Washington the radio reporter will cover the game for all local fans who cannot attend, it is announced.

A NOVEL INDOOR ANTENNA

By L. F. SEEFRED, Radio 6EB

NO MORE will it be necessary to string up one long wire to hear the concerts. That is, providing you are not located in a house that has all its wiring in grounded conduit. Otherwise you will be able to construct an antenna for about one dollar which can be taken down every day, moved to any room in the house, or coiled up and put away in a suit case. The accompanying drawing shows how to make it. Ordinary



International photo
Connection for Using Lighting Circuit as Aerial

single wires will do to twist around the cord, but I used two wires, 16 strands of No. 28 D. C. C. each. The ends of the drop cord may be taped to prevent shorting, or a light and socket may be connected so you can read the paper or listen to the concerts.

I used this type of antenna not long ago while I was in bed one week with the "flu." It worked fine on crystal for listening to signals around town, while with an audion detector I could hear all long distance work as well as with a 125 ft. one-wire antenna. Amplifiers help a great bit, of course, and no hum is received from the alternating current on the house wires. I took an antenna of this type over to a fellow's house who has not been in the game long, and he was surprised to see that it worked better than the antenna (4 wires) he had erected above his house.

Try it out, folks, but *don't send* on it. If you want to see fire-works, wait until the Fourth of July!

Four stages of amplification in tandem is equivalent to over 100 miles of standard cable which corresponds to a power amplification of over three billion times.

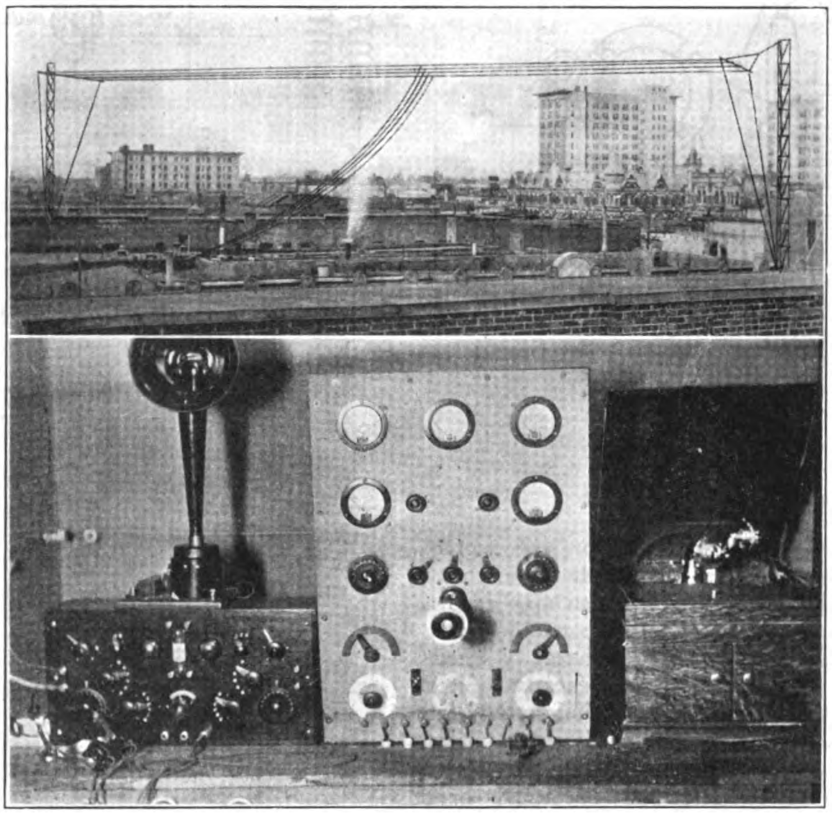
News of the Broadcasting Stations

KJM OF FRESNO, CALIF.

A new broadcasting station has been established by the San Joaquin Light & Power Corporation at Fresno, Calif. This station is operated by R. C. Denny, under the call letters KMJ and is licensed to broadcast three concerts weekly, on Sundays 5:00 to 6:00 P.M. and on Tuesdays and Fridays, 7:00 to 8:00 P.M.

The power company is experimenting with the radio telephone as an emergency means of communication, supplementary to the private telephone lines for system operation or dispatching. This is the primary object in the broadcasting, which will serve as a means of testing into the mountains and to all parts of the power system. Secondarily, it provides entertainment for the consumers, patrons and employees of the company over the entire system. Post card announcements of the week's program will be mailed out to all parties desiring same.

The transmitting set shown in the accompanying photograph was built by Mr. Denny and consists principally of Radio Corporation apparatus. The prime idea in the design was to develop a set that was as near fool proof as possible to make it, something to simply be plugged in on the alternating current at any of the power houses and operated by any of the operators in any emergency when the phone lines should fail. Something simple of adjustment with no rotary machinery to get out of order and not even any "B" batteries to run down. Nothing to do but talk, and replace a burned out tube occasionally. One 50 watt oscillator tube is used, which gets its filament current from the UP-1016 transformer and its rectified plate current through two UV-217 Kenotrons from the same transformer. The radiation is 2 amperes with the absorption loop modulation. Tube modulation will be used as soon as there is another 50 watt tube available. Jewel meters are used, the following being considered necessary for such a set:



Aerial and Transmitter of KJM

1-0 to 150 volt, 60 cycle A.C., 1-0 to 15 volts, 60 cycles A.C., 1-0 to 5 amps. radio frequency, 1-0 to 1500 volts D.C. and 1-0 to 500 milliamps, D.C. The 0 to 150 voltmeter indicates which tap of the power transformer to work on while final filament adjustments are by rheostats in connection with the 0 to 15 voltmeter.

The aerial is the ordinary flat top T type at an elevation of 75 feet above the earth, with a counterpoise of identical dimensions suspended directly beneath it, at a distance of 40 feet. Preliminary tests indicated a consistent day range of well over 100 miles. Mr. Denny would appreciate getting reports on reception of these concerts from points at any considerable distance from Fresno.

NEW BROADCASTING STATIONS

WMB—Auburn Electrical Co., Auburn, Maine.

WEB—Benwood Company, Inc., St. Louis, Mo.

WDZ—James L. Bush, Tulscola, Ill.

WPE—Central Radio Co., Inc., Kansas City, Missouri.

WCK—Stix-Baer-Fuller, St. Louis, Mo.

KNR—Beacon Light Co., Los Angeles, Calif.

KXS—Braun Corporation, Los Angeles, Calif.

WAAH—Commonwealth Electric Co., Inc., St. Paul, Minn.

KZI—Cooper, Irving S., Los Angeles, Calif.

WAAJ—Eastern Radio Institute, Boston, Mass.

KON — Holzwasser, Inc., Los Angeles, Calif.

WAAL—Minnesota Tribune Co., Minneapolis, Minn.

WAAG—Mullins Electric Co., Tacoma, Wash.

WAAM—I. R. Nelson Co., Newark, N. J.

KSS—Prest and Dean Radio Research Lab., Long Beach, Calif.

WAAO—Radio Service Co., Charleston, W. Va.

KNV—Radio Supply Co. of Calif., Los Angeles, Calif.

KJC—Standard Radio Co., Los Angeles, Calif.

WSB—Atlanta Journal Co., Atlanta, Ga.

KQP—Blue Diamond Electric Co., Hood River, Ore.

KUS—City Dye Works & Laundry Co., Los Angeles, Calif.

WAAG—Elliot Electric Co., Shreveport, La.

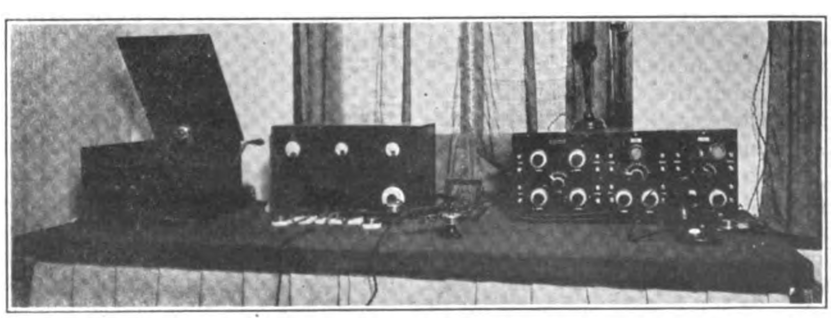
WAAK—Gimbel Bros. Dept. Store, Milwaukee, Wis.

WAAR—Groves-Thornton Hardware Co., Huntington, W. Va.

KXD—Herald Publishing Co., Modesto, Calif.

WAAZ—Hollister Miller Motor Co., Emporia, Kansas.

Continued on page 55



The Emporium's Transmitter

AN ACCURATE WAY TO WIND RADIO COILS

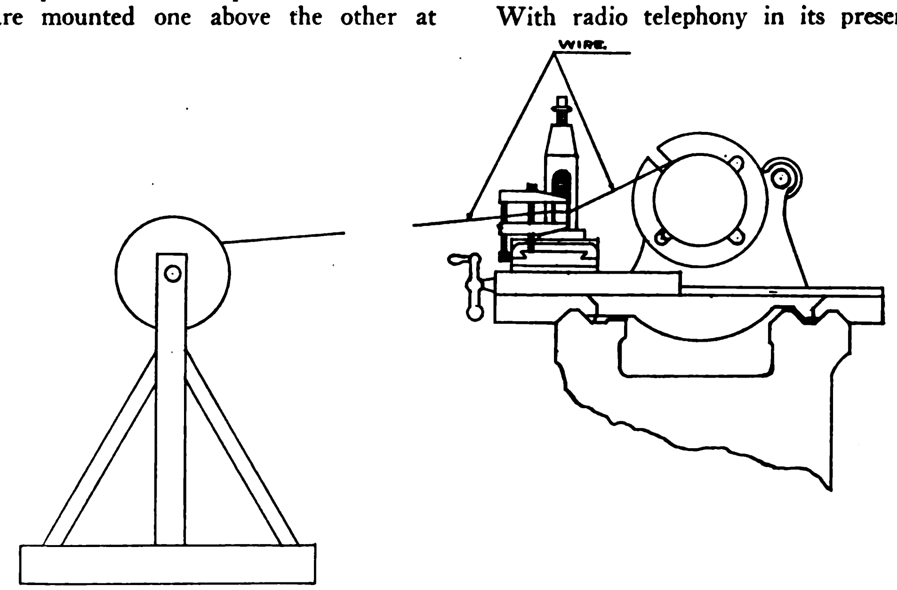
By EDWIN G. BAKER

CONSIDERABLE difficulty is usually experienced in winding coils for electrical instruments, especially in keeping a uniform tension on the wire so that it is wound tight, and in properly guiding it so that the turns are close together. The following description of how to do this should prove helpful to any one who has access to a lathe.

To keep the wire at an even tension it is run between two wooden blocks clamped in the tool post. The blocks are mounted one above the other at right angles to the tool post and clamped tight. A small clamp is screwed on the end of the blocks and tightened just enough to put sufficient tension on the wire. This arrangement not only keeps the wire tight, but guides it as well. The spool of wire can then be run loose on any temporary reel.

To wind the wire snug, i. e., one turn tight against the other, which is especially necessary in slide tuning-coils, the carriage of the lathe must be fed forward exactly the thickness of the wire for each revolution of the spindle. To do this by hand is very difficult, for if the carriage is moved too slowly, the wire will crawl upon the former turn, and if too fast it will leave a space. Recourse can therefore be had to the thread cutting feed. The first thing to know is the thickness of the wire in thousandths of an inch. If a micrometer is not at hand, this can be had from a table of wire sizes. When the thickness is found it is only necessary to divide it into one thousand to find how many turns there will be to a linear inch. This is read directly as threads per inch on the chart of the lathe. For example, if it is required to wind a coil with No. 24 wire, the diameter is found to be .020 and divided into one thousand gives 50 turns to the inch. Set the lathe to cut fifty threads per inch. If there is no corresponding thread on the lathe, use the next higher figure, as this will run the carriage slower and have a tendency to pack the wire. To equalize the slower feed, the compound rest should be set at right angles to the cross-slide, and an occasional turn of the compound handle will keep the wire in perfect alignment.

The accompanying sketch shows the set-up of the lathe inside the tail-stock, including the reel.



Lathe Set-up for Winding Coils

NICKEL IN THE SLOT RADIO STATIONS NEXT

With radio telephony in its present stage, it only remains for some enterprising person to open public radio phone booths, wherein any citizen may drop a coin and "listen in." He could choose his entertainment from the daily schedules, which need by no means be limited to music, but might include press dispatches, baseball bulletins, prize fights by rounds, and election returns. Those who have no home radio receiver will undoubtedly soon have the privilege of renting one temporarily when desirous of "hearing" what is in the air. It is an opportunity for some genius to combine a nickel-in-the-slot machine with a wireless receiving set.

HOOK-UP FOR V. T. DETECTOR AND LOOSE COUPLER

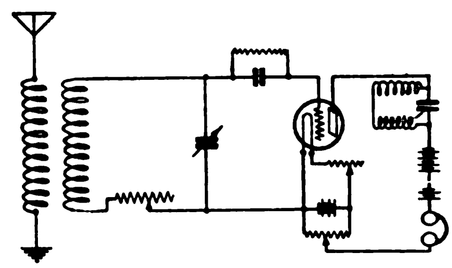
By HARRY E. THOMAS

For the amateurs who have changed from crystal detector to the vacuum tube detector, using the loose coupler for tuning with the straight detector hook-up without regeneration, I am putting at their disposal the hook-up I use, making use of a slide tuning coil, two variable condensers and two home-made honeycomb coils.

Many amateurs who change from crystal to tube use just the loose coupler as a tuner, as I said before, discarding all other apparata which they used with the crystal. Two variable condensers, a tuning coil, and two home-made honeycomb coils were all that were necessary for me to get results unthought of when I used the plain circuit.

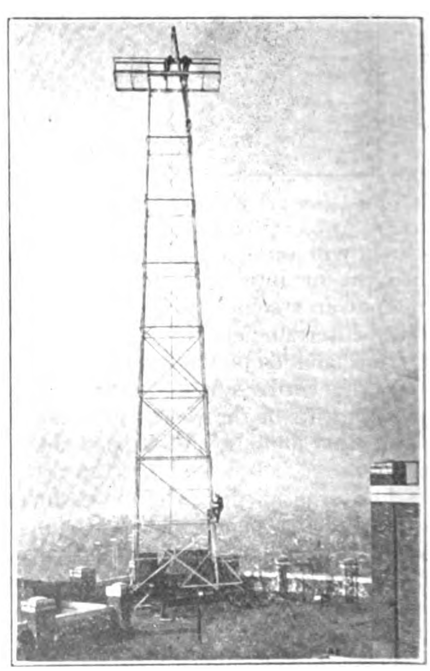
I do not mean to say that I discovered a sensational new circuit. Nothing of the sort. I merely mean to bring out the fact that discarded apparata sometimes comes in very handy.

I placed the slide tuner in the filament circuit instead of a variometer and inserted the two honeycombs, of three or four layers each connected in series in the plate circuit, straddling a variable condenser across.



Hook-up for V. T. Detector and Loose Coupler

At my present location, San Francisco, I am using a one-wire aerial 30 ft. high and about 35 ft. long. I get the concerts around the bay 5 ft. from the phones, receive ships four and five days out, and can read NPE and NPC fairly well. I hear amateurs in the seventh district, 6ZZ in Arizona and 6KC in San Diego. I copied a ninth district amateur also, and do most of my tuning with the plate variable condenser.



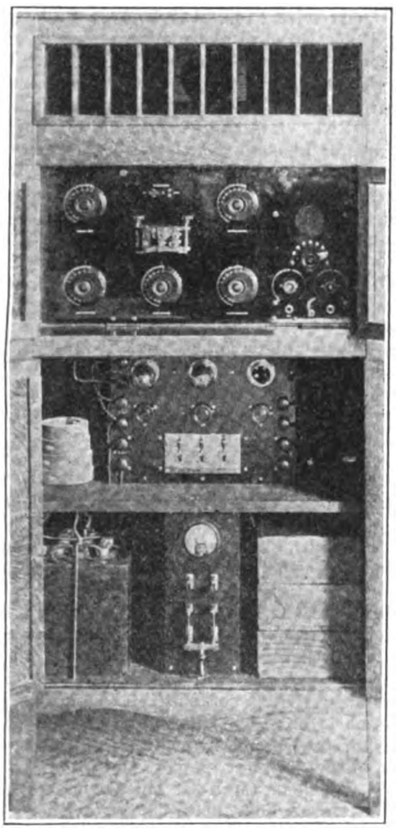
International Photo

American Tel. & Tel. Company's Toll Broadcasting Station Tower at 24 Walker St., New York City

TRADE ASSOCIATION INSTALLS DEMONSTRATION SET

As part of a comprehensive campaign of radio education the Pacific Radio Trade Association has installed an all-wave receiver with Magnavox power amplifier in the Engineers' Club of San Francisco. This set is used for demonstration of concert and code reception in conjunction with popular lectures given before the various clubs and associations whose special meetings may be held in the club rooms. The set is made up of parts contributed and assembled at the expense of the association members.

The entire set is housed in a handsome oak cabinet with a built-in sound box, much after the style of a Victrola. The sound box opens in a grill 6 in. high and 22 in. wide. Across the front



All-Wave Radio Demonstration Set

of the cabinet, beneath the grill, is a pair of glass doors, behind which are placed the tuning apparatus and detector controls. The lower portion of the cabinet has a pair of oak doors. The power amplifier, the storage battery, B batteries, the battery charger and space for accessories are in this lower box.

The storage battery is provided with vents which carry the gases given off by the solution out through the rear of the cabinet, thus preventing these fumes from injuring the apparatus. A switch throws the storage battery to either charge or discharge, and a voltmeter shows the condition of charge. The only terminals on the exterior of the cabinet are the aerial and ground binding posts and a cord and plug for connecting to an A. C. lamp socket, to provide the current for charging the storage battery.

A pair of phones is provided so as to be plugged in instead of the loud speaker for tuning in the various stations. Duolateral coils are used for wavelengths over 600 meters, but for amateur work and music broadcasting, a short wave regenerative circuit is used, consisting of a variometer and two variocouplers. A "wiggle" switch is used to select either the short or long wave tuning apparatus.

The experience of a great many who have tried to combine short and long wave tuning apparatus has been that efficiency was sacrificed in doing so. This difficulty has been overcome in the present set by a rather novel circuit, so that both long and short wave apparatus are just as effective as if either was used alone for its particular work.

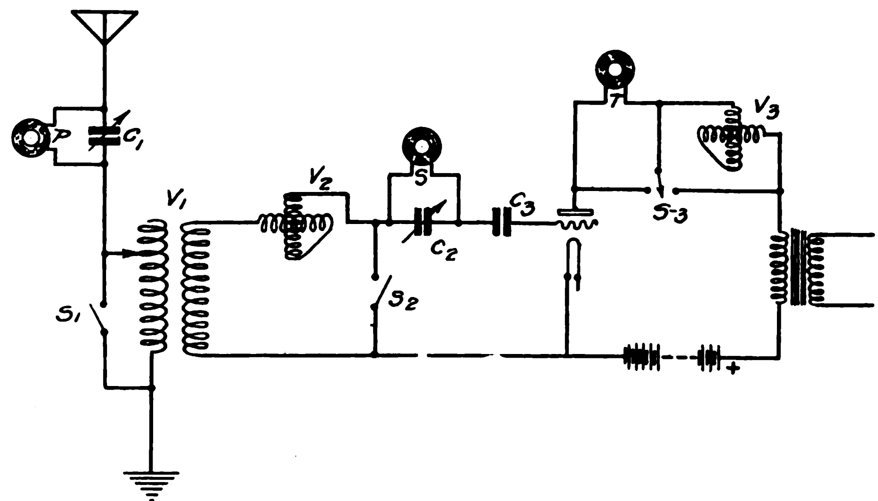


Diagram of All-Wave Receiver

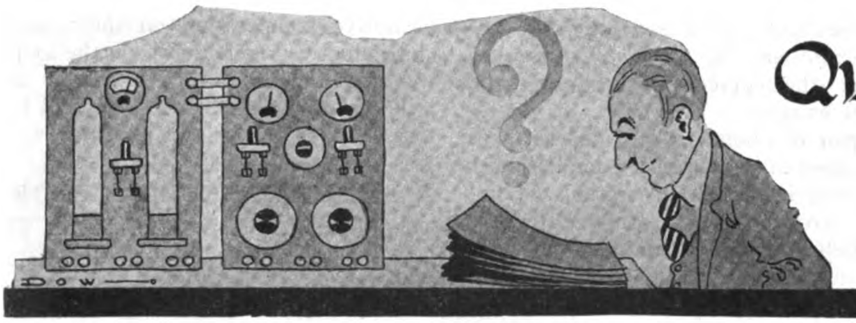
The circuit is shown in the diagram. V_1 is a variocoupler and V_2 and V_3 are variometers. P, S, and T are plugs for the primary, secondary and tickler duolateral coils respectively. C_1 and C_2 are variable condensers, and C_3 a small fixed grid condenser. S_1, S_2 and S_3 are three of the four blades of a 90 capacity switch. When S_1 and S_2 are opened, S_3 is closed to the left, and with no honeycomb coils in place we have the usual type of short wave regenerative set, with one exception: that is, the variable condenser C_2 is in series with the fixed condenser C_3 and permits of very fine regenerative adjustments. For very long wavelengths, honeycomb coils of suitable size are plugged in to P, S, and T, and the "wiggle" switch is thrown to the long wave position. This closes S_1 and S_2, and closes S_3 to the right. C_1 now becomes a parallel primary condenser and C_2 a parallel secondary condenser. The short wave coils are now all short circuited, so that there is no tendency for the set to tune to both long and short waves at the same time.

This combination provided for capacitative regeneration on short waves and inductive regeneration on the longer waves. The usual type of power amplifier is provided with 350 volts B battery.

A RADIO DETECTIVE STORY

William J. Burns, chief of the Department of Justice Bureau of Investigation, told a story recently in which radio took the part of Sherlock Holmes. A dapper and bright young man appeared one day before the sales manager of a large radio manufacturing plant, and explained that he wanted to purchase a very fine receiving set for a local high school. He was greeted cordially and the best of the house's set were demonstrated. Ordering an expensive set, he managed somehow to secure delivery without payment, and then disappeared. The set also vanished from the place it had been shipped to originally, much to the chagrin of the manufacturers, who decided to advertise their loss through radio itself, being able to give a very accurate description of the young man, who had a noticeable scar on his cheek.

Chapter two opens in an apartment where a genial and fine appearing young man, with a scar on his cheek, is entertaining his friends with a new receiving set. Suddenly the instrument begins to tell of the manufacturer's loss and give a detailed description of the thief—unmistakeably the host! The consternation of the guests may be imagined. The next morning a very worried mother paid for the instrument which her son had wanted so badly, he had evolved the above scheme for getting it, whereupon the manufacturer dropped the matter.



Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

If a slanting L antenna were used, with a counterpoise, for transmitting, would the entire length of wire used in the counterpoise be figured as the ground lead? If the regular ground was used in conjunction with the counterpoise, would this length of ground wire be figured in with the length of wire used on counterpoise? H. S., Sand Springs, Okla.

No. Figure to the point where the counterpoise commences to branch out. In the second case, figure the length of the ground lead and neglect the counterpoise in your computation.

Please publish the hook-up of a five-watt C. W. set using A.C. on both plate and filament. G. W. C., Portland, Ore.

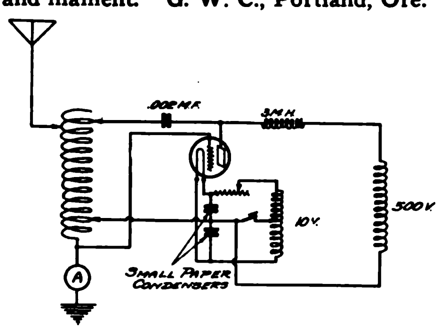


Fig. 1

The circuit requested is shown in Fig. 1.

In April RADIO, page 18, regarding construction of tuner, Fig. 3, what would be the wavelength range of this set when connected to an antenna 115 ft. long, 30 ft. high, of two wires, 6 ft. apart? Would it be any advantage to put on more of the 10 complete turns if added wavelength range is desired? O. M. S., Berlamont, Mich.

About 1200 meters. Added turns on the inductance would raise the wavelength, but it is not desirable to load the coil too much, as its efficiency would be greatly impaired.

Please publish a circuit employing the Armstrong hook-up in connection with two variometers and a variocoupler. F. S., Marion, Ohio.

This circuit was published in March RADIO, on page 29. If you cannot obtain a copy of this number, write and I will send you a copy of the circuit.

What are the proper honeycomb coils for the 150-25,000 meter set described in February RADIO? H. E. T., Oil City, Pa.

Coils of 500 and 1500 turns are the ones required.

Can you give me instructions for making a set capable of receiving 1000 miles or more? C. A. B., Weeping Water, Neb.

The set described in articles by D. B. McGown, in March and May issues of RADIO, will cover 1000 miles under favorable conditions.

CORRECTION—The Editor wishes to correct Fig. 2 on page 28 of April RADIO, where an electrolytic rectifier is shown. The elements in the two jars at the top of the sketch should be interchanged, so that the aluminum plates are connected to the positive D. C. lead.

Am unable to get a Wayne transformer for use as a choke coil in the power amplifier circuit described in March RADIO. Does the Thordarson bell ringing transformer have the proper inductive value for use in place of the Wayne (30 Henries)? A. K. L., Vancouver, Wn.

Apparently the Wayne transformer is a scarce article, as several others besides yourself have been experiencing difficulty in locating such an article. A very satisfactory choke can be constructed by winding 5000 turns of No. 28 or No. 30 enameled wire on a half inch core made of fine iron wires. This coil would then have the same general appearance as a telephone induction coil, and while it would probably not have as high an inductance as 30 henries, yet it would be sufficiently high to answer the purpose. If you do not care to wind the coil, secure several 500 ohm ringer coils from an old telephone and connect them in series.

Please advise whether one should use iron or copper to build shields around each stage of a 3 stage radio frequency amplifier. U. J. B., Metcalf, Ariz.

Thin sheet copper would be preferable where the cabinet is to be of wood.

How can one determine which of the 110 volt A.C. mains in the house, is grounded? J. H. R., Los Angeles, Calif.

The easiest way is to bridge an ordinary 110 volt Mazda lamp between the ground and each of the two line wires in turn. The wire which is not grounded will light the lamp, thus indicating which of the two has the ground connection.

Claremont, Calif., April 7, 1922.

Editor RADIO—Dear Sir:

I should like to protest against your statement that cages have no electrical advantages.

In RADIO for April, 1922, page 26, you admit that "This 'skin effect' increases with the frequency and at very high frequencies the current flows entirely on the surface of the conductor." On a flat-top antenna, this means the two outside wires carry *all* the current going to the antenna, by reason of the "skin effect." Hence every flat-top antenna is a two wire antenna in effectiveness, and all flat-tops must have high resistance. "Considering the radio circuit and resistance in general, it may be said that aside from the power losses entailed by the resistance in the circuit, it has also the effect of increasing the damping of the oscillations taking place in that circuit and of lowering the 'sharpness of resonance.' Increasing the resistance in such a circuit will cause it to tune 'broad,' all other constants remaining the same."

This probably explains the "broad C. W."

"Since the antenna may be considered as a simple radio circuit, it is apparent that if we want sharp tuning and a 'persistent' antenna, we should keep the ohmic resistance of the system as low as possible." A boost for the cage!

To turn to the Transatlantics, we find the cage vindicated again. 1BCG, the "wonder station," used an eight-wire cage, and he was "wonderfully steady" (QST). 2FD, with six-wire cage, was fine, clear, and strong. 1RU, six-wire cage, was "strong and clear." 2BM got through with a cage and a rotten note. 1YK had a four-wire cage 27 ft. high, overloaded a 50-watt tube to 72 watts, used a Hartley circuit, and yet got across in spite of bad QRM. His cage is the only redeeming feature of his set. 1AFU with a twelve-wire vertical cage shoved three messages to an English amateur. Reception of an American station by an ordinary receiver on the English midget antenna! The cage is all there in theory and practice. A certain unlicensed ham with a 50 ft. six-wire cage and a flivver coil with gap between antenna and ground was believed to be a local ham in a large city thirty miles away. He is shut down now. The same ham took a 110 volt relay, converted it into a buzzer and was heard three miles away on the same antenna.

To get back to the original article, it was stated that cage antennae were used because the hoops would hold up any wires shot away. Spreaders could be put at intervals on the flat-top antenna and accomplish the same result. Thus that explanation cannot hold, and efficiency is the only explanation left.

By the way, why do the descriptions of "high-efficiency C. W. sets" include an elaborate method of changing waves by an elaborate array of variable condensers, high-resistance switch contacts, etc. On the good old spark outfit, we didn't change wave from 175 m. to 375 m. every few minutes. We just threw on our power and punched the key. We look for a C. W. set on the same setting as an hour before if we wish to hear him, and if you change your wave all over, we can't hear you. Incidently the DX, C. W. outfits don't change their waves. Their set is out of the way and they just have one switch to throw the power on the whole outfit. Quick come-back. Let's get away from "trick C. W." A READER.

NOTES FROM THE OPERATORS

Radio call 7FX has been reassigned to Albert C. Gordon, 964 N. E. 28th St., Portland, Ore.

Call 6RR has been reassigned to Dr. C. P. Ballard, 415 N. Gower St., Los Angeles.

Call 6IV is Lloyd E. West, 342 Main St., Riverside, Calif.

6AGP is Paul Talbot, 310 W. 2nd St., Pomona, Calif. 6AOW is D. H. and G. A. Keet, 131 Sierra St., Riverside, Calif.

Lawrence Mott, 6XAD, President — *G. G. Griffeth, 6AA, Secretary* — *H. O. de la Montanya, 6AUL, Treasurer*

NEW DX RECORD BY 6ZAC, 6ZF AND NOF

No better argument as to the efficiency of C. W. is needed than the remarkable results that are being secured by 6ZAC with the set designed and constructed by members of the C. W. Association of America. The astounding reception by 6ZAC, as first reported in these columns, are being equalled by his transmitting work. This station is owned and operated by Clifford J. Dow at Wailuku, Maui, Hawaii. Mr. Dow is the Hawaiian representative of the C. W. Association of America and is setting a pace for other members of the association to emulate.

For the first time in the history of American amateur radio, on the evening of April 13th, 1922, 6ZAC succeeded in reaching the Pacific Coast with his signals, actually WORKING five stations in one evening. Numerous messages were exchanged with these mainland stations, with little or no difficulty on account of interference.

A new long distance record was also established when 6ZF, W. W. Lindsay, Jr., at Reedley, in central California, received a message from NOF, a naval station of low power and situated in Washington, D. C., acknowledged its receipt, and relayed it IMMEDIATELY to Dow at Wailuku, thus making the total distance the message was transmitted at approximately 5000 miles. This eclipses any previous relay records, as the amateur has been limited by the bounds of the United States or Canada, and Dow's entry into the field with a powerful transmitting set will enable him to work directly with not only the Pacific Coast, but stations east of the Rockies as well, judging from the number of eastern stations he has been hearing lately.

As this article is being written, a letter from Dow is at hand, reporting continued reception of 2FP, Brooklyn, N. Y., on a wavelength of 200 meters. This is by far the greatest distance that amateur signals have been consistently heard, and the evidence submitted by Dow shows that his work is not freaky, but steady and reliable, night after night. 2FP is using one 250 watt tube, and his record of 5000 miles is without doubt the longest distance yet covered by an amateur station.

The transmitter used by Dow was described in detail in the May issue of RADIO, so that no further description of it is necessary except to say that it employs two 50 watt tubes in a self-rectifying circuit with 60 cycle alternating current source. The set was shipped from San Francisco late in March, and arrived at Wailuku on April 1st, ready to set up. Some delay was experienced, however, with the antenna system, as Mr. Dow's receiving antenna was wholly inadequate for transmitting purposes, so a new and much larger one had to be erected. On April 10th a 90 ft. mast was placed in position and a four wire cage antenna of a very durable nature was strung between the top of the mast and the roof of a nearby building. A seven wire counterpoise was placed 55 ft. underneath the antenna, or 35 ft. above the ground. This produced an antenna system of very low resistance, as later tests showed. Two days were spent in tuning the transmitting set to the proper wave, and a radiation of 6.5 amperes was obtained when the power supply was at the proper voltage.

A quotation from Mr. Dow's log will perhaps give the reader the best description of how he finally got across on the 13th:

"The set was adjusted Wednesday evening, but owing to doubt about the wavelength, was not worked. Next day got a check from Honolulu that she was O. K., so that evening I made a lot of noise along about 8:30, trying to get Mr. Babcock (6ZAF) and slip him the first honors, but he wasn't with me, and when 6ZQ (Berkeley, Calif.) nearly knocked me out of my chair with his loud spark, I worked him for an hour. He took my two messages without repeats and gave me one. Guess no one expected me over there, so didn't hear anyone else after him. Friday evening Mr. Babcock was the second station to work trans-Pacific, for I took a message from him. Then I worked 6ZQ again, giving him SEVEN messages. Sure takes 'em nicely, so it must be SOME signal, to work through the interference present in the San Francisco Bay district. He said he can probably work me through anything. I took one message from him, and then after chewing the rag for over an hour, I heard 7YA, Boise, Idaho, very QSA on the one step I use always, asking 6ZQ to QSP me. Didn't need to be QSP'd, but told him to go ahead. He said that I was nicely QSA there. Took a message from him. 7YA is 2805 miles and Berkeley is 2355 miles from Wailuku, on the great circle. Saturday evening I worked Mr. Babcock again and also 6ZQ, 6ZF, Reedley, Calif., 6ZI, Oakland, Calif., and 7YA, exchanging messages with all of them."

The Saturday night that Dow describes above will remain for a long time in the memory of those who had the good luck to be listening in when 6ZAC commenced to call CQ. By Saturday many had been notified that Dow was on the air nightly, and all those

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ADDITIONAL DX AT 6XAD

1ARY—Burlington, Vt.
1BDU—Winthrop, Mass.
1BHW—Hartford, Conn.
1BLN—Westfield, Mass.
3AAG—Hilton Village, Va.
3AFW—Clarendon, Va.
3HS—Chevy Chase, Md.
3ARN—Chevy Chase, Md.
3CG—Newton, N. J.
3IL—Washington, D. C.
3ADX—Bywood, Pa.
3NB—Sarnia, Ontario, Can.
5BP—Houston, Texas.
5GI—Birmingham, Ala.
8BXX—Norwalk, Ohio.
8BIP—Syracuse, N. Y.
8NB—Rochester, N. Y.
8VY—Kalamazoo, Mich.
8HJ—Elmira, N. Y.
8CBJ—Lockport, N. Y.
8ZO—Columbus, Ohio.
8ARD—Cleveland, Ohio.
8AXN—Brocton, N. Y.
8BZY—Detroit, Mich.
8ACF—Washington, Pa.
8AXK—Cincinnati, Ohio.
8AMM—Webster, N. Y.
8FT—Troy, Ohio.
8IZ—Milan, Ohio.
8BOQ—Cleveland, Ohio.
8AGK—Lancester, N. Y.
8AXY—Fairmont, Va.
8AM—Detroit, Mich.
8BSF—Buffalo, N. Y.
8ANM—Pittsburg, Pa.
9DZI—Columbia, Mo.
9EA—Duluth, Minn.
9DSD—Hutchinson, Kans.
9DZJ—Great Bend, Kans.
9BTA—Ottawa, Ill.
9BFG—Clear Lake, Iowa.
9DWX—Chicago, Ill.
9BAD—Ellendale, N. D.
9AQE—Eldorado Kans.
9ARZ—Clear Lake, Iowa.
9BJI—Denver, Colo.
9AVP—Waukegan, Ill.
9IF—Giltner, Neb.
9DKY—Mason City, Iowa.
9BED—St. Louis, Mo.
9YAJ—Northfield, Minn.
9OX—Louisville, Ky.
9AVZ—Pierre, S. D.
9AOY—Chicago, Ill.
9FN—Kansas City, Mo.
9XT—Collegeville, Minn.

NB—The above records have been made since the publication of a former DX list, in the April number.—ASSOCIATE EDITOR.

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

M. C. A. Latour, Pat. No. 1,405,523; Feb. 7, 1922. Audion or lamp relay or amplifying apparatus.

This patent describes a scheme of connections for amplification by lamp relays 1, in which the ratios of transformation of transformers T_1, T_2 and T_3 are chosen so as to get the maximum amplification. These ratios are deduced mathematically in the patent. For good effects, these transformers must also be wound to have minimum losses and low distributed capacity. To eliminate "howling," the cores M_1, M_2 and M_3 are connected to a source so as to define their potentials.

J. B. Morrill, Pat. No. 1,406,996; Feb. 21, 1922. Electric wave ranging system.

A scheme is described for locating an object with respect to three fixed points. This is accomplished by sending waves from each point A, B, or C, each having its distinctive carrier frequency, modulated by A. C. generators 2. These modulated waves are received by the object, and the difference in phases between the modulations is used to determine the differences in the distances from A, B and C to the object. From this data it is possible to locate the object.

F. K. Vreeland, Pat. No. 1,407,103; Feb. 21, 1922. Receiving system for radio telegraphy and telephony.

A scheme for eliminating strays or statics in a receiving circuit is described. An element S is connected in parallel to the primary p of a transformer which serves to transmit the signals to an electrostatic receiver D. For heterodyne receiving a generator G may also be used to supply energy to the receiver circuit by way of transformer s_2, p_2. The element S is preferably an electrolytic cell which may be so arranged that only impulses beyond a given intensity can pass through. In this way the relatively weak signals must go through the circuit T, P, and T_1 while the strays are by-passed through S. The provision of circuits T and T_1 resonant to the signal frequency makes the device function still more satisfactory.

R. H. Marriott, Pat. No. 1,407,205; Feb. 21, 1922. Radio receiving system.

In order to neutralize atmospheric disturbances such as "static," two receiving circuits are used comprising antennae 1 and 10. The circuit including antenna 1, coils 15, 16 and 17 is tuned to signal frequency, and is coupled by coils 17, 48 to a detector circuit including the crystal 20 and telephone 23. The circuit including antenna 10, coils 15 and 45 is tuned to half the frequency of the signaling waves, but due to the unidirectional conductors 41, 44 and coils 42, 43 and 47, energy at this frequency is transformed into energy at twice the frequency and is made to oppose the energy received in coil 48. In this way the disturbances only are neutralized, because the antenna 10 does not respond to signaling waves appreciably, and therefore the energy transmitted through coil 47 represents only that due to atmospheric disturbances.

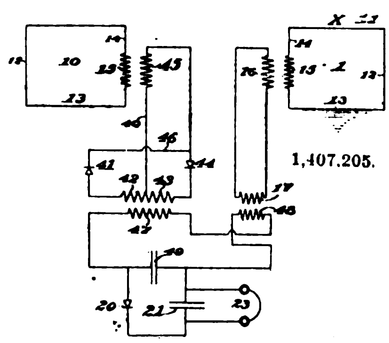
J. B. Bolitho, Pat. No. 1,407,245; Feb. 21, 1922. Amplifying device for use in wireless telegraphy.

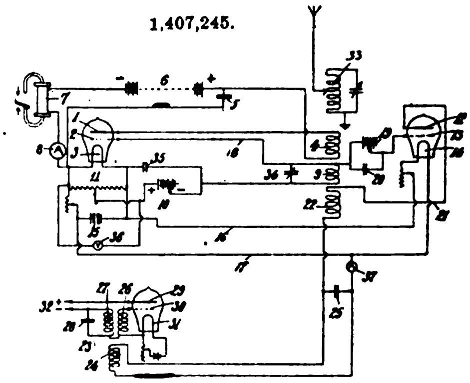
A detector and amplifier tube 1-2-3 is coupled to the antenna circuit and is so arranged that the grid voltage is almost at the point where it can oscillate. The received signals cause these oscillations to be initiated. However, an electrical quenching device is used to stop the oscillations periodically. This is accomplished by means of a source of A. C. such as the tube 29-30-31 of a frequency differing materially from that of the signaling wave. This source is connected in the plate circuit of still another tube 12-13-14, in which circuit there is also located a coil 22 coupled to and opposing coil 9. As the potential on plate 12 is varied by source 12-13-14, the coil 22 periodically quenches the oscillations by opposing the coil 9.

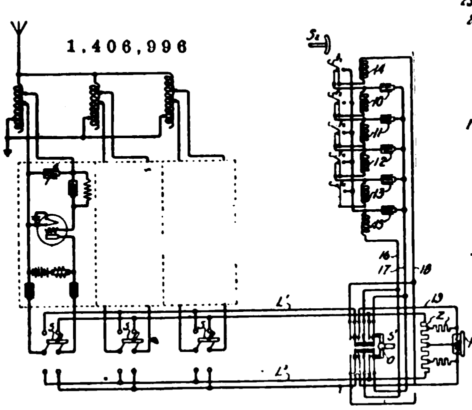
R. R. Beal, Pat. No. 1,410,730; March 28, 1922. Radio oscillation generator.

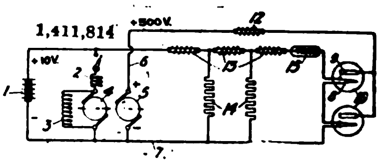
An arc generator is described, which consists of two members 5 and 6 hinged together at 4, between which there is a narrow arc chamber 22. Each member 5 or 6 carries a pole piece 8 or 16 and energizing coils for influencing the arc. The magnetic circuit is completed by the outer shells of members 5 and 6. The production of a hydrogen atmosphere is effected by dropping liquid hydrocarbon through cup 28 and passage 29 into

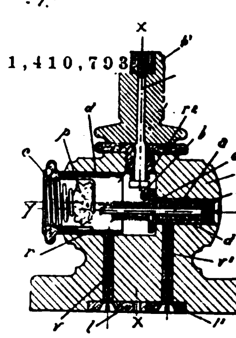
Continued on page 54

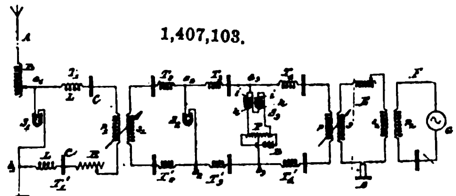


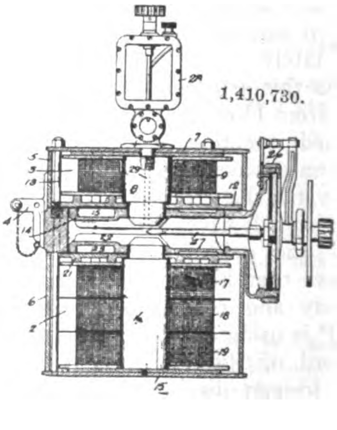


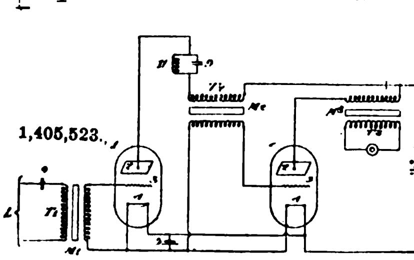


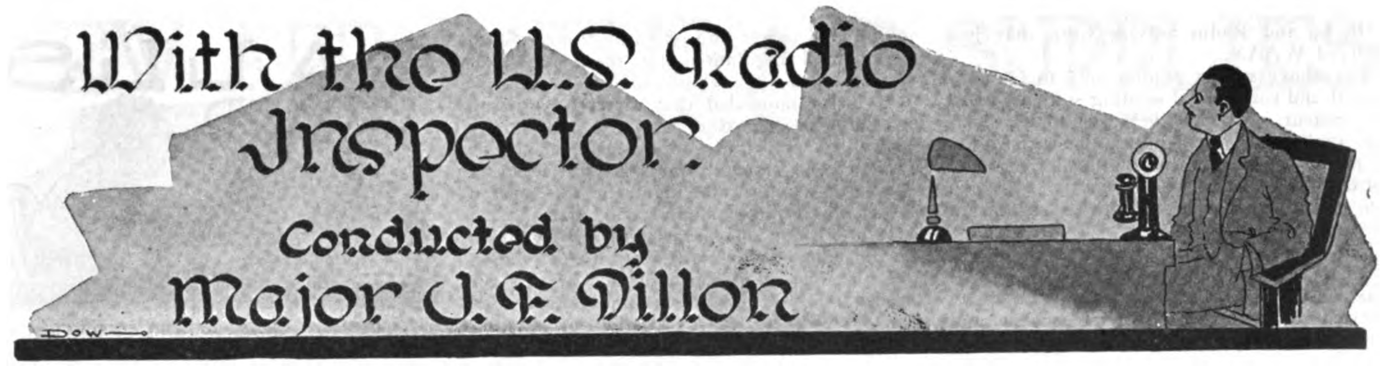












NEW NAVAL RADIO WEATHER REPORTS

Weather reports are now broadcasted twice daily from NPG, the San Francisco Naval Radio Station, in accordance with a new code system. The noon (75th meridian time) bulletin is on 4650 meters, C. W., the 10.30 p.m. bulletin on 1908 meters, spark.

The bulletins are divided into two parts, the first giving surface and upper air weather conditions observed at various Pacific stations, and the second giving observed pressure conditions, forecasts and storm warnings.

FIRST PART

The first part begins with the letters USWB (U. S. Weather Bureau), followed by the observing station key letters shown herewith, and concluded with two or more 5-unit groups of figures.

KEY-LETTERS AND STATIONS

Alaska[1]

DH	Dutch Harbor
EA	Eagle
JU	Juneau
NM	Nome
SK	Sitka
TN	Tanana
VZ	Valdez

United States

TAT	Tatoosh Island, Wash.
SE	Seattle, Wash.[2]
NH	North Head, Wash.
PD	Portland, Ore.
RO	Roseburg, Ore.
EUR	Eureka, Calif.
RB	Red Bluff, Calif.
SM	Sacramento, Calif.[2]
SF	San Francisco, Calif.[2]
FN	Fresno, Calif.
SLO	San Luis Obispo, Calif.
LA	Los Angeles, Calif.[2]
DI	San Diego, Calif.[2]
HL	Helena, Mont.
BS	Boise, Idaho
LD	Lander, Wyo.
WM	Winnemucca, Nev.
R	Reno, Nev.
SLC	Salt Lake City
MD	Modena, Utah
DV	Denver, Colo.
GJ	Grand Junction, Colo.
SA	Santa Fe, N. Mex.
PH	Phoenix, Ariz.
YU	Yuma, Ariz.
HO	Honolulu, T. H.

Canada

ED	Edmonton, Alberta
KA	Kamloops, B. C.
CY	Calgary, Alberta
SC	Swift Current, Sask.
PR	Prince Rupert, B. C.

[1] Alaskan reports included in a.m. bulletin are observations taken previous p.m.; those in p.m. bulletins are observations taken a.m. current date.
[2] Stations with which upper air observations are included in the p.m. bulletin regularly; and in the noon bulletin when obtained in time.

FIRST GROUP gives (1) three figures representing actual barometic pressure in inches and hundredths, except that first figure of full reading is omitted, i. e., 998 means 29.98 inches, 014 means 30.14 inches; (2) wind direction expressed in one figure, i. e., 0=calm, 1=north, 2=northeast, 3=east, 4=southeast, 5=south, 6=southeast, 7=west, 8=northwest; (3) force of wind (Beaufort scale) expressed in one figure as follows:

BEAUFORT SCALE

Scale No.	Designation	Miles Statute	Miles Nautical
0	Calm	0-3	0-3
1	Light Air	3-8	3-7
2	Light Breeze	8-13	7-11
3	Gentle Breeze	13-18	11-16
4	Moderate Breeze	18-23	16-20
5	Fresh Breeze	23-28	20-24
6	Strong Breeze	28-34	24-30
7	Moderate Gale	34-40	30-35
8	Fresh Gale	40-48	35-42
9	Strong Gale	48-56	42-49
[1]Ten	Whole Gale	56-65	49-56
[1]Eleven	Storm	65-75	56-65
[1]Twelve	Hurricane	75	65

[1]Note—The code does not admit of force in excess of 9 being sent. Therefore, the figure 9 will be used for all wind forces 9 to twelve inclusive.

For example, 99852 means 29.98 in. barometic pressure, wind from south, with force 8 to 10 miles per hour.

SECOND GROUP gives (1) state of weather at surface at 8 a.m. in one figure, i. e., 1=clear, 2=partly cloudy, 3=cloudy, 4=raining, 5=snowing, 6=thunder storm, 7=sleet or hail, 8=dense fog; (2) barometric tendency as to rise or fall in hundredths of an inch during two hours preceding observation indicated by one figure, i. e., 0=change of less than .04 inch, 1=increase of .04, 2=decrease of .04, 3=increase of .06, 5=increase of .08, 6=decrease of .08, 7=increase of .10, 8=decrease of .10, 9=increase or decrease of .12 or more; (3) clouds expressed in three figures indicating the tenths of sky covered, the kind of clouds and the direction of cloud movement, as follows:

	Amt. of clouds. 3rd figure. Prop. of sky covered	Kind of clouds. 4th figure.	Direction. 5th figure.
0	1/10 or less	1/10 clouds or less, kind not shown	no movement
1		upper clouds	north
2	2/10 to 3/10	stratus cumulus moving slowly	northeast
3		stratus cumulus moving rapidly	east
4	4/10 to 5/10	cumulus moving slowly	southeast
5		cumulus moving rapidly	south
6	6/10 to 7/10	stratus moving slowly	southwest
7		stratus moving rapidly	west
8	8/10 to 10/10	nimbus moving slowly	northwest
9		nimbus moving rapidly	

For example, in the second group 30855 means cloudy weather, pressure change less than .04 inch during preceding two hours, 8 to 10 tenths clouds, cumulus clouds moving rapidly south.

THIRD GROUP of five figures. The first figure, 3, identifies the group, the second figure gives the direction of the wind and the third figure the wind force at 250 meters elevation, the fourth figure the wind direction and the fifth figure the wind force at 500 meters elevation. For example, 35163 means observations at 250 and 500 meters, wind blowing from south with force 1 (3 to 8 statute miles per hour) at 250 meters, wind blowing from southwest with force 3 (13 to 18 miles per hour) at 500 meters.

FOURTH GROUP has same arrangement as third group for 1000 and 1500 meters.

FIFTH GROUP has same arrangement as third group for 2000 and 3000 meters.

SIXTH GROUP has same arrangement for 4000 meters except that has only three figures followed by XX.

SEVENTH GROUP. The first figure, 7, identifies the group, the second and third figures indicate the elevation in multiples of 100 meters, the fourth and fifth figures show wind direction and force, respectively at that elevation. For example, 71785 means at 1700 meters elevation wind blowing with force 5 (20 to 28 miles); 71954 means at 1900 meters wind blowing from south with force 4 (18 to 23 miles).

In all groups the letter X is substituted for missing data.

SECOND PART

The second part of the bulletin is in plain language and consists of a synopsis of general pressure distribution, wind and weather for ocean zones, storm warnings, and flying weather forecasts by zones.

There are two marine zones covered by this service, North Pacific Coast and South Pacific Coast. Aviation zone 13 comprises Oregon and Washington, 14 California, 10 Idaho and Montana, 12 Nevada, Utah and Arizona.

Similar weather information is transmitted from NPD, Tatoosh Island, Wash., on 1654 meters; NPE, North Head, Wash., on 2700 meters; NPW, Eureka, Calif., on 2650 meters; NPX, San Pedro, Calif., on 1851 meters; NPR, Dutch Harbor, Alaska, on 2250 meters; NPM, Honolulu, T. H., on 2250 meters.

HOW RADIO SIGNALS ARE ASSIGNED

To date the Department of Commerce has assigned 18,700 commercial radio call signals based on combinations of three international radio call letters, out of the whole alphabet assigned for this purpose to the civilized nations. All commercial transmitting stations in this country are licensed and given calls by the Radio Section of the Bureau of Navigation of the Department of Commerce, in accordance with the allotment of letters by the International Bureau of the Telegraphic Union at Berne, Switzerland.

To be exact, the United States may use all the three and four letter calls beginning with the letter N, all calls beginning with W, and combinations beginning with K, except from KAA to KBZ, which belongs to Germany. These are not all available for commercial use, however, as the Navy is assigned all calls starting with N, while the Army uses calls from WUA to WVZ, and WXA to WZZ.

In issuing commercial calls, the Radio Section divides the country into two sections, giving the eastern section the initial letter W, and western stations K. The three letters except for a few that have been cancelled, are very scarce today and doubling has begun. Westinghouse Electric, Pittsburgh, as an example, KDKA; and Radio Service Corp. has just received WAAX.

The above system applies only to Governmental and commercial sending stations, when an amateur, of which there are 16,000 sending, applies for a call, internation regulations do not prevail so the international letters are not used. For amateurs, the country is divided into nine sections, each with a significant numeral.

To designate special stations, such as experimental, technical schools and special amateur senders, the letters X, Y, and Z are inserted following the district symbol and preceding the other letters, as for example, 9ZF, Sioux City Radio Laboratory, Iowa, and 7XH, Oregon Agricultural College.

While we have but begun to assign calls, the system is capable of expansion, as mathematical calculations on "combinations" will prove, so that the 3 initial letters assigned us for international calls will "hold us for sometime" and the 9 Divisions of Amateurs call be subdivided if necessity demands it.

FINAL RECOMMENDATIONS FROM WASHINGTON RADIO CONFERENCE

The final recommendations from the Washington Radio Conference are much the same as the tentative recommendations as printed in April RADIO, with a few important changes as noted below. These recommendations are embodied in a bill to be presented to Congress and probably to be passed during the present session after which they will become effective.

In the final recommendations four bands are provided for government and public broadcasting, 1050-1500 meters, 700-750 meters 200 miles or more from the sea-coast, 650-700 meters 400 miles or more from the sea-coast, and 485-495 meters.

For private and toll broadcasting is alloted a band from 285 to 485 meters except for coastal regions where 285-315 meters and 425-475 meters must be kept open, and for border regions account should be taken of wavelengths used in neighboring countries. The band 100-150 meters is also allocated for this service.

The wave band from 525 to 650 meters is reserved for marine radio telegraphy.

A restricted special amateur wave of 310 meters is allowed for use by a limited number of inland stations where it is necessary to bridge large sparsely populated areas as to overcome natural barriers.

The band from 275 to 285 meters is for city and state public safety broadcasting and by special arrangement to private detective agencies.

Amateur telegraphy and telephony is assigned an exclusive band from 150 to 200 meters and from 200 to 275 meters in conjunction with technical and training schools where radio instruction is given. An amateur is defined as "one who operates a radio station, transmitting, receiving, or both, without pay or commercial gain, merely for personal interest or in connection with an organization of like interest."

It is recommended that damped wave stations be assigned the band of lowest wavelengths, interrupted or modulated continuous wave radio telegraphy stations the next band, radio telephone stations the next band, and finally unmodulated continuous wave radio telegraph stations the band of highest wavelengths. It is recommended that amateurs be permitted to carry on broadcasting within the wavelength band assigned by the Secretary of Commerce to amateur radio telephony.

The degree of public interest attaching to a private or toll broadcasting service is to be considered in determining its priority in the granting of licenses, in the assignment of wave frequencies, and in the assignment of permissible power and operating time, within the general regulations for these classes of service.

It is recommended that direct advertising in radio broadcasting service be absolutely prohibited and that indirect advertising be limited to a statement of the call letters of the station and of the name of the concern responsible for the matter broadcasted.

It is recommended that when all available wave frequencies in any geographical region are already assigned, no further licenses for broadcasting be granted in that region until cause arises for the revocation of existing licenses.

It is recommended that private or toll broadcasting stations transmitting time signals shall transmit only official time signals and with authorization from and under conditions approved by the Secretary of Commerce and that the transmission of signals of such character or wavelength as to deliberately interfere with the reception of official time signals constitutes grounds for the revocation of suspension of the transmitting stations or operator's license.

It is recommended that license requirements for the operator of a radio telephone transmitting station include a knowledge of radio transmitting and receiving apparatus and of the International Morse Code, sufficient to receive at a rate of not less than 10 words per minute.

CREDIT SHOULD BE GIVEN WHERE CREDIT IS DUE

It has come to the Editor's attention that the article on a "Stand-By and Tuned Continuous Wave Receiver," published on page 19 of the March, 1922, RADIO by R. E. Lake was apparently taken from an article on "Some Modern Vacuum Tube Circuits and Their Operation," by J. Scott-Taggert which appeared on page 25 of the October, 1919, issue of the Wireless Age.

NATIONAL RADIO CHAMBER OF COMMERCE OFFICERS

Plans for the functioning of the newly organized National Radio Chamber of Commerce, which was formed in New York recently, were drawn up at a meeting held by the association. The officers elected were: Alex Eisemann, of the Freed-Eisemann Radio Corporation, president; Charles Keator, of the De Forest Radio Telephone and Telegraph Company, first vice-president; William Dubilier, of the Dubilier Condenser Company, second vice-president; Frank Hinners, of the Home Radio Corporation, secretary, and Joseph D. R. Freed, of the Freed-Eisemann Radio Corporation, treasurer.

Functioning of the new organization will tend to remedy certain conditions which have arisen in the radio industry as a result of its tremendous growth within the last few months, the dispatch says. It will also group together manufacturers whose radio products are of such dependable character as to maintain favorable public opinion toward the radio industry.

The original group consisted of about fifteen manufacturers. To this body there will be added, by invitation, about twenty additional concerns whose business standing and whose products are known to be of high order. New concerns will be eligible after their apparatus has been passed upon by a board of five members. It is planned to exclude from the membership manufacturers who are now turning out radio apparatus which has been found to be untrustworthy, and which will eventually bring radio into disfavor on the part of purchasers of such undependable apparatus.

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY KHM, B. LIVESEY, LIHUE, H. T.

On April 5th at 8:30 p.m. heard 6gr calling 6lo; 6ajh calling 6ib. Also heard a C. W. calling 8bri. At 9 p.m. got 6ajh qsa calling 6aak and also got 6zf in qsa. 6zf was working and didn't hear him call. The arcs and khk bothered me a great deal.

On April 9th at 8:25 p.m. 8cl came in good and called 9zaf. Then I picked up a C. W. station at 9:50 p.m. and copied the following: "rr 2 hr to H S Shaw 1jk—tnx fr ur !!!! sined John L Reinartz 1qp." Steady qrn and khk busted him up considerable, but he was in good all the time.

BY 6OO, SAN FRANCISCO

5za, (6ak), (6ea), 6fh, (6gd), 6ka, (6ku), 6ky, (6lv), 6zf, 6zn, (6zx), 6zz, 6aat, 6alu, (6agp), 6agu, 6awp, (6bcd), 6beg, 6bes, 6bet, 6bfy, 6bir, 6bak, 6bik, 6bmn, 6bjd, (7dp), (7oz), 7na, 7zu, 8eu, 9kp, 9wd, 9wu, 9ps, 9pi, 9amb, 9ayu, 9xaq, 9dva, 9zaf, 4cb (Can.). v

6oo reported by 8bzy, Detroit, Mich.; 9dws, Champaign, Ill., and 9wd, Denver. C. W. 5 watts, radiation .72 on 195 meters (all C. W.).

BY 6AMK, LOS GATOS, CALIFORNIA

1bcg(cw), 4cb(cw), 5za, 6aab, (6aak), (6abx), 6abk, 6ack, (6adl), 6aei, 6ain, (6aik), (6ald), 6ali, 6amp, 6aox, 6aru, 6arn, 6asi, 6asq, 6aty, 6awi, 6aq, 6ax, 6bx, 6bic, 6bde, (6bfz), 6bgr, 6cu, (6en-cw), 6ea, (6eb), (6fh), 6gi, (6gt), (6gx), 6hy, 6ic(cw), 6jg(phone), (6ky), 6lc, 6lk, 6lg, 6lo, 6sy, (6to), 6tj, (6uo), (6vh), 6wg, 6zy(cw), 6zq, 7bk, 7ce, 7fz, 7gt, 7gk, 7hi, (7ke), 7kb, 7ly, 7mu, 7my, 7nz, 7nn, 7nq, (7ot), (7oz), 7nq, 7to, 7ya, (7ys), 7yl, 7zj, 7zv, 7zk, 7zs, (7mf), (7hf), (7iw), (7fi), (7tj), cl8, 9ax, (9bd), 9zn.

BY 6AHP, POMONA, CALIF.

Spark—5if, (5of), 5xb, 5xd, (5xu), 5yq, (5za), 5zad, (6oh), (6qr), (6uo), 6ot, 6sj, 6ya, 6zm, (6zz), (6zam), (6aah), (6afn), (6afp), (6abx), (6ajr), (6ark), (6ape), 6app, (6aru), (6asv), (6ath), (6atq), (6awh), (6bak), (6bar), 6baz, 6bbr, 6bfp, 6bft, 6bkr, (6ahq wkd. with 1/16 spk. coil abt. 50 mi.), 7bh, 7bk, 7bp, 7bx, 7ck, (7ch), 7ed, (7hf), (7ks), 7in, 7iw, 7jd, 7jw, 7ly, (7mf), (7mp), 7mu, (7ot), (7tj), 7om, 7vo, 7qn, 7qt, (7yj), 7zb, 7zq, 7zj, 7zp (7zt), 7zo, 7zm, 7zv, 7zu, (cl8), 9nr, 9aeq, 9aqe, 9xai, 9yah, 9dsd.

C. W.—1bcq, Can. ! 4cb, Can. ! 9bd, 5za (6cu), (6en), (6qd), (6qy), 6ef, 6hc, 6jd, (6ka) (6kh) and (6ky) cw and fone, (6mn), 6my, (6vm) cw fone, 6wv Colo. cw fone, (6za), 6zb, (6zz), (6bcd), 6abq, (6ahv), wkd. with receiving set cw, (6aif), (6zd), (zf), 6xac, (6zt), 6xh, 6xq, 6xaf, (6asv), (6awt), (6jq) cw and fone, 7tq, 7xf fone and cw, 8dr, 8aqz, 8ain, 8brl, 8bum, 8cfs, 9ji, 9nx, 9wd, 9aja, (9amb), 9ps, 9ayu, 9dva, 9bex, 9dtm, 9xaq, 9zaf, 9zac, 9bji 9dth, 9xm.

BY C. S. PERKINS, 347 SO. FREMONT AVE., LOS ANGELES

Spark—6bl, 6ca, 6dj, 6dt, 6gr, 6ig, 6ii, 6ik, 6im, 6io, 6lr, 6mc, 6nc, 6oz, 6qr, 6qx, 6ra, 6tc, 6tf, 6tj, 6to, 6tu, 6xl, 6zm, 6zq, 6zz, 6aad, 6aal, 6aan, 6acq, 6ajv, 6ajr, 6aor, 6awr, 7mf.

C. W.—6ku, 6tw, 6zz, 6awt.

BY 6ASN, BERKELEY, CALIF.

5ig, 6bv, 6gt, 6hr, 6ry, 6iv, 6kc, 6lc, 6ol, 6od, 6om, 6qr, 6zm, 6zz(cw), 6aak, 6aeh, 6aeg, 6ahq, 6akv, 6akl, 6ain, 6amn, 6avr, 6awl, 6bjv qra pse, 6zaq qra pse, 7bh, 7bk, 7gr, 7ke, 7mf, 7og, 7mw, 7ot, 7sn, 7wg, 7wo, 7ya, 7zm, cl8.

BY 9BD, BARRON HOTEL, VANCOUVER, B. C.

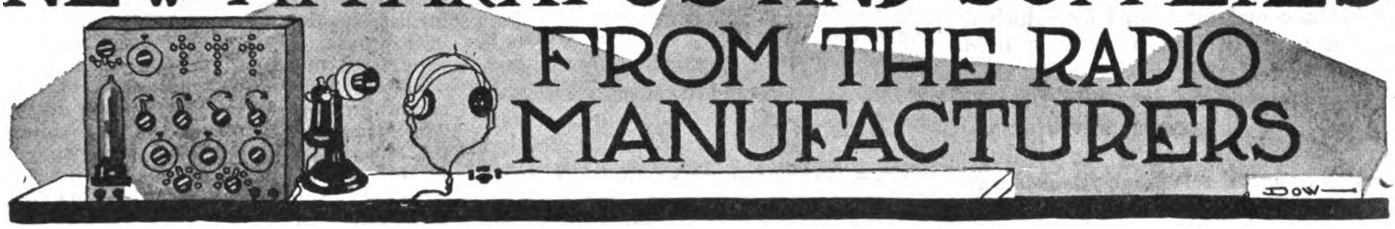
C. W.—(4cb), 4ua, 4ft, (5ct), 5za, 5xu, 6en, (6ka), (6zi), (6zf), 6bb, 6awt, 6akw, 6arb, 6asj, (6ku), 6xh, 6bes, 6vm, 6zg, 6bcd, 6zn, 6ky, 6nx, 6fh, 6alv, 6zx, 6zac, Mauii, T. H., 7na, 7mf, (7dp), (7we), 7nn, 7sc, 7xf, (7rn), cl8, (7qt), 9amb, 9ayu, 9zaf, 9wd, 9wu.

Spark—(6ark), 6as, (6ajr), 6bnn, (6aqu), (6ain), 6abx, 6ala, (6ib), 6ic, 6ex, (6ng), 6gr, (6vk), 6pm, (6lk), 6ol, 6zam, 6zq, (7bk), (7bh), (7ed), 7gj, 7jd, 7kb, 7qn, (7fr), 7to, 7oh, 7hi, 7iw, 7ys, 7ya, 7zm, 7zk, cl8.

All stations hearing 9bd on spark, C. W. or phone pse qsl if distance is over 500 miles. W. D. Wood, Barron Hotel, Vancouver, B. C.

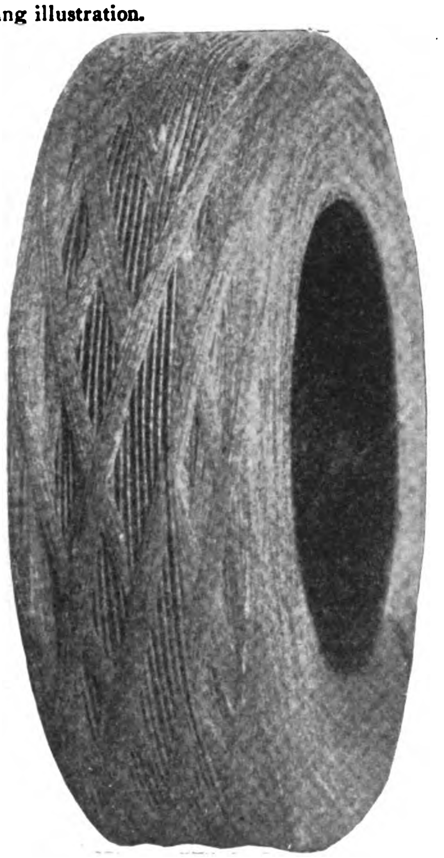
Continued on page 40

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



GIBLIN-REMLER NEW INDUCTANCE COILS

Thomas P. Giblin, the man who developed the honey-comb and the duo-lateral inductance coils for radio work, has developed a new type of coil which is claimed to be more efficient and compact than either of the others. This new coil is being made by the Remler Manufacturing Co. of San Francisco, who have also devised an improved form of mounting which is shown in the accompanying illustration.

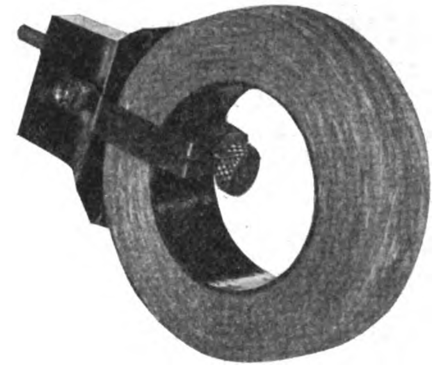


Giblin-Remler New Inductance Coil

The chief problem in the design of coils has been to secure maximum inductance with minimum capacity in a compact unit. The relatively high distributed capacity in the usual multi-layer form of winding is reduced in the honey-comb and duo-lateral coils by means of a lattice winding of copper wire with space or air cells between layers. But this likewise reduces the effective inductance.

In the new Giblin-Remler coil, cotton yarn is wound in the form of a lattice simultaneously with copper wire which is wound in parallel turns. The yarn separates the layers of wire by means of cotton and air cells, thus securing a maximum copper and insulator space in a given volume.

The new type of coil has a distributed capacity of 8.8 micro-microfarads as compared with 23 micro-microfarads for an equivalent honey-comb coil. This gives a greater tuning range for a given coil, greater selectivity and sharper tuning. It also materially reduces the high frequency resistance and is equally efficient on all wavelengths.



Improved Remler Coil Mounting

A NEW CRYSTAL SET

A neat and compact type of crystal receiving set is being made by the Radio Equipment Co., which has recently been formed at San Francisco with H. A. Fletcher as president, Syd Bramley as treasurer and H. A. Wadsworth as secretary. The set is attractively housed in a well-finished oak cabinet. It employs a crystal detector with variable inductance and fixed capacity; being designed for reception of 150 to 650 meter waves.

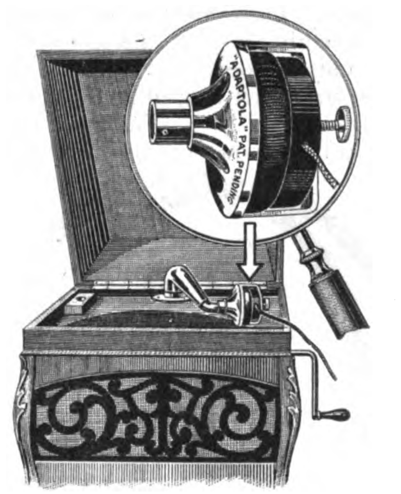
Reco Crystal Set

The Radio Devices Co., manufacturer of wireless equipment, has been formed with offices at 693 Mission St., San Francisco by B. F. McNamee and H. M. Johnson. Mr. McNamee is a well known radio engineer and author of a series of articles in RADIO. Mr. Johnson is an experienced designer and shop man. Special attention is to be paid to the building of radio devices and sets for special purposes and to the reconstruction and improvement of existing sets.

THE ADAPTOLA

The Adaptola is a convenient and efficient device invented by Bert B. Gottschalk of San Francisco, for converting at will any phonograph into a radio loud speaker. The phonograph manufacturers have perfected acoustical chambers which are superior to the usual type of horn for sound reproduction.

The device is attached to the phonograph tone arm after the reproducer has been removed. It holds any make of telephone receiver which is merely connected by a wire to the phone terminals of the radio set. It is being manufactured and distributed by the Radio Supply Co. of San Francisco.



The Adaptola

LARGE DISTRIBUTING COMPANY ORGANIZED AT INDIANAPOLIS

The Capital Radio Supply Company, with headquarters at Indianapolis, has recently been organized to take care of Indiana, Ohio and Kentucky. The officers of the company are: Harry C. Stutz, who is president of the H. C. S. Motor Car Company, president; N. C. Hildenberg, vice-president; C. P. DeVoss, secretary and treasurer; and Carl Kennan, manager. This company has a large dealer organization in the three states and represents many of the largest and best known manufacturers of radio equipment, including Grebe, Kennedy, Remler, King Am-pli-tone, Hipco Batteries, Brandes, Signal, Western Electric, and others.

NEW KELLOGG PRODUCTS

The Kellogg Switchboard and Supply Co. are making a head set which is claimed to be as efficient as it is light in weight and small in size. The shell is non-metallic and encloses all terminals. The cap is of the most approved design, the concave surface being the result of years of practical telephone receiver construction. When two people desire to use one set or one receiver each in listening, the head band is instantly removable and as equally easy to replace when desired.

This No. 59A head set is wound to 1200 ohms per receiver.

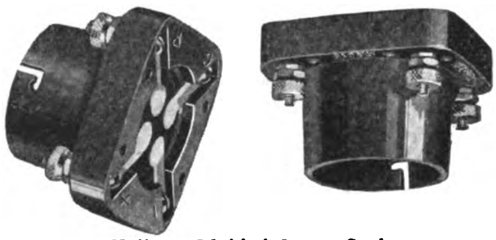
This company is also manufacturing and distributing molded lamp sockets to fit all standard four prong based vacuum tubes for radio work. These bases are in an attractive brown color with an extra heavy solid base 7/16 inch in thickness. Four German silver springs with rounded ends are firmly held in position in deep grooves and cannot touch the mounting surface. Plus and minus, grid and plate terminals are plainly marked in the mold at each binding post. These are double end nickel plated with hexegon, and knurled surface nuts. Connection can be made under the socket as well as from the top of the binding post. These sockets are 2-3/16 inches square with round corners

Kellogg No. 59A Head Set

and with total depth of 1-1/4 inches.

Of the same material, the Kellogg Company are turning out aerial strain insulators of various widths and lengths, drilled with suitable molds at ends for the antenna wire and supports. These insulators answer every requirement and are of great strength. The lengths are 2, 3, 4 and 6 inches, and they come in two styles, a flat bar and round rod with brass rings firmly embedded in each end. These insulators stand a direct pull of approximately 350 pounds.

For transmitting stations, the Kellogg Company is building a microphone or transmitter, which is exceptionally reliable for this work and which is a product of many years manufacture. The particular type for wireless work is known as the 21A. This microphone, of course, is of the type where the transmitter and receiver are mounted on one standard, similar to so called foreign style telephones, and exactly the same in general construction as the regular Kellogg microphone or "grabaphone" as it is known to the telephone trade.



Kellogg Molded Lamp Socket

MEETING THE DEMAND FOR RADIO

It is announced by the Radio Corporation of America that the April production of vacuum tubes reached 150,000. The production schedule for May calls for a total delivery of 175,000 vacuum tubes. The program will reach 200,000 or more in June, according to public and trade requirements.

Crystal detectors served the purposes of most amateurs in the early days. The great demand for vacuum tubes is a development of the past three months, due entirely to the sudden popularity of broadcasting. Although machines play a part in the major processes of manufacture, tubes are still largely made by hand. Hand work plays a far more important part in making vacuum tubes than in any other piece of electrical apparatus with which the public is familiar. Manufacture of the delicate vacuum tubes used as detectors, transmitters and amplifiers, has been subject to the usual difficulties in bringing about quantity production.

During the first eleven months of 1921 the factories produced for the Radio Corporation of America an average of 5000 tubes per month. This rate of production, small as it seems now, was gradually producing a surplus. Then suddenly in one or two territories broadcasting jumped into popular favor over night. On December 30 the production schedule was increased to 40,000 tubes per month. In January of this year the Radio Corporation of America pushed the schedule to 60,000 per month—a figure largely in excess of the demand at that time.

The present concerted demand, due to the further expanison of broadcasting, came early in February. On February 3 the factories were asked to do everything in their power to reach 75,000 vacuum tubes—to try to reach it during that month. They did their utmost. They came close to the production goal, and the following month, March, they not only reached 75,000, but bettered it by several thousand. April calls for 150,000 and May for 175,000.

In the event that no surplus results from the present expanded program, facilities will be further increased. It is easier to increase production now than it was four months ago, because it is easier to increase the size of a large and well trained organization than to build a new one. Technically trained forces are required in the factories, which are working with skill and energy.

ANNUAL REPORT RADIO CORPORATION OF AMERICA

The corporation's operating account for 1921 shows gross income from transoceanic communication, $2,138,625; from sales, $1,468,919; from marine service, $533,298—a total of $4,160,844. The operating and administrative expenses, depreciation of plant and cost of sales totalled $3,762,231. Other income amounted to $28,186. The net profit, applied against amortization of patents, was $426,799.

The corporation's balance sheet shows assets of $35,712,084, as follows: Plant and equipment, $12,702,086; patents, patent rights, contracts, goodwill, etc., $16,584,845; stocks of subsidiary and associated companies, $598,000; current assets, $4,910,923; deferred charges, $916,228. The liabilities are: Preferred stock ($5 par value), $19,779,870; common stock (no par value), $12,039,607; current liabilities, $954,471; deferred liability, $620,000; reserves for depreciation, $2,318,135.

The K. & L. Electric Company has opened a broadcasting station at 427 Olive Street, McKeesport, Pennsylvania. The particulars of this station are as follows: Call letters, WIK; wavelength, 360 meters; schedule of operation, Sunday, 1:30 to 2:30 P. M. and 6:30 to 7:00 P. M.; and 6:30 to 7:00 P. M. daily; and 9:30 to 10:30 Tuesday and Thursday evenings; range 500 miles.

The General Apparatus Company, Inc., New York City, manufacturers of G. A. Standardized parts and supplies since 1918, will now be known as The Sleeper Radio Corporation.

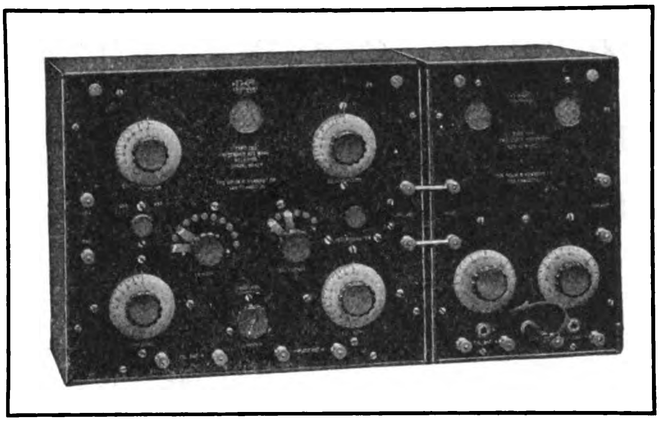
The Radio Store of Paul F. Johnson

KENNEDY EQUIPMENT

▼▼

Type 220
Regenerative Receiver
with Type 525
Two stage amplifier

▼▼



KENNEDY EQUIPMENT

▼▼

All Kennedy
Regenerative Receivers are
Licensed under
Armstrong U.S. Patent
No. 1,113,149

▼▼

The Maximum of Quality and Value in Modern Radio Receivers

For those who want Radio amusement, news, market and weather reports, and educational features, Type 220, we believe is the best buy on the market. It tunes with high efficiency over a range of wave lengths of 175 to 3,100 meters.

Kennedy Receiver Type 220 is an intermediate-wave regenerative receiver, designed for those who want a range of wave lengths somewhat more comprehensive than provided by the ordinary short-wave instrument. Due to its careful design it operates with remarkable effectiveness over a tuning range of 175 to 3,100 meters.

Without doubt this receiver represents the greatest concentrated quality value in radio receivers on the market today. Those who seek amusement, music, news, market and weather reports, and educational features **"out of the air"** will find great satisfaction in the use of this receiver.

Maximum effectiveness, with a high degree of selectivity on all wave lengths within its range is assured by the design of this receiver, which makes use of the accepted principles of the best radio engineering practice in the elimination of resonance in unused inductance sections; the avoidance of the possibility of high resistance contacts in electrical circuits; the exclusive use of inductively coupled circuits, and the employment of the necessary precautions for minimizing energy losses.

Write for latest bulletins describing Kennedy Quality Radio Equipment

THE COLIN B. KENNEDY COMPANY
INCORPORATED
RIALTO BUILDING SAN FRANCISCO

CALLS HEARD

Continued from page 36

BY 6ASJ, 929 60th ST., OAKLAND, CALIF.

Spark—(7bb), (7ga), (7sg).

C. W.—5za, (6alu), (6awp), 6bcd, 6bes, (6bkd), (6cu), (6gd), 6jd, 6ku, 6xad, 6zac 6zf, 6zz, 7dp, 7na, (7nn), (qt), 9acu, (9amb).

BY ASA S. KELLER, MONROE, WASH.

Spark—5ak, 5cn, 6ajr, 6ark, 6gr, 6km, 6tu, 6va, 7acg, 7acn, 7as, 7bb, 7bf-dalite, 7bh, 7bk, 7cu, 7ed, 7fi, 7fr, 7ge, 7gj, 7hd, 7iw, 7iy, 7jd, 7jf, 7jw, 7kj, 7ly, 7mf, 7mu, 7nn, 7nw, 7nz, 7ot, 7oz, 7tg, 7to, 7wg, 7yl, 7ys, 7zv.

C. W.—(Can.) 4cb, 4is, 5ct, 5la(?), 5wn, 5za (not verified yet), 6aat, 6adm, 6aib, 6ak, 6aw, 6awp, 6awt, 6bcd, 6bge, 6en, 6fh, 6gy, 6ka, 6ki, 6ku, 6nx, 6oo, 6tw, 6vm, 6xad, 6zf, 6zi, 6zx, 7bs-dalite, 7dp, 7hi, 7hm, 7hs, 7mf, 7na, 7nc, 7nf, 7nn, 7qt, 7rn, 7sc, 7we, 7zu, 9amb, 9ayu, 9bbf, 9bji, 9pi, 9ps, 9wu, 9xaq, cl2.

Fone—6ku, 7rn, 7zu.

BY 7VX, GEORGE FREEMAN, 5411 SOUTH L ST., TACOMA, WASH.

Spark—6ak, 6as, 6cc, 6ex, 6fh, 6fn, 6gf, 6gr, 6gx, 6ib, 6ic, 6im, 6iv, 6km, 6lc, 6ld, 6ng, 6st, 6tu, 6vk, 6vx, 6zq, 6zu, 6abu, 6ajh, 6ajr, 6akt, 6ala, 6alu, 6amk, 6aqu, 6arc, 6ark, 6avd, 6awh, 6abk, 6bnn, 6zam, 7cd, 7cn, 7cu, 7ed, 7ge, 7gj, 7gq, 7hf, 7iw, 7jd, 7jf, 7kj, 7ly, 7mf, 7mp, 7nc, 7nn, 7nw, 7nz, 7oh, 7ot, 7ox, 7oz, 7to, 7ve, 7vo, 7vz, 7wg, 7ya, 7zk, 7zm, 7zv. Canadian—4cb(cw), 5ak, 5cn, 5ct, 5do, 9ax, 9bd.

C. W.—7rn, 7nf, 6ak, 6cu, 6ea, 6en, 6gy, 6ka, 6km, 6nx, 6oo, 6xh, 6zf, 6zx, 6aat, 6akw, 6arb, 6awt, 6bes.

BY 6OL, R. M. WHITE, 1509 SO. BRAND BLVD., GLENDALE, CALIF.

Worked—5za, 6ah, 6ak, 6ar, 6as, 6cp, 6ex, 6fh, 6gf, 6gr, 6gt, 6gx, 6hc, 6ib, 6ic, 6im, 6km, 6mz, 6ng, 6oc, 6oh, 6pj, 6po, 6pr, 6qk, 6qr, 6qt, 6sk, 6tc, 6tu, 6uq, 6vk, 6vx, 6wg, 6xh, 6zb, 6zi, 6zu, 6zx, 6zz, 6aah, 6aak, 6abk, 6abm, 6abw, 6ada, 6aeh, 6aei, 6afp, 6agf, 6aid, 6aih, 6ajh, 6ajr, 6akl, 6ang, 6aph, 6aqu, 6ark, 6arw, 6atq, 6aud, 6auu, 6avx, 6bgl, 6biu, 6bjv, 6bnn, 7mf, 7to.

Heard—5of, 5xd, 6bm, 6fk, 6gk, 6no, 6to, 6tv, 6vz, 6aau, 6abx, 6acr, 6acw, 6afn, 6afy, 6ahv, 6aif, 6ain, 6alv, 6anr, 6st, 6ath, 6atu, 6aty, 6auc, 6aup, 6avb, 6awh, 6bcj, 6bcz, 6zd, 6zam, 7ed, 7bk, 7bp, 7cn, 7gj, 7in, 7iw, 7jd, 7ke, 7kb, 7ks, 7mu, 7tj, 7zt, 7zv.

BY 6AKC, 515 CLAYTON ST., SAN FRANCISCO

One tube, c s spider webs—5pg(cw), 5za(cw), 6ea, 6eb(spk-cw), 6cv(cw), 6cw, 6en(cw), 6ff, 6gi, 6ka(cw), 6kc, 6ks, 6lc, 6lu, 6mh, 6mk, 6od, 6ol, 6sk, 6vo, 6wk, 6aak, 6aau, 6abm, 6abx(spk-cw), 6acr, 6acu, 6acy, 6aeh, 6aei, 6agf, 6agp, 6ahw, 6aic, 6aif, 6ail, 6aio, 6aix, 6ajr, 6akl, 6ald, 6ale(cw), 6alf, 6ali, 6alu(cw), 6amf, 6amq, 6aod(cw), 6aoe, 6ape, 6aqp, 6arc, 6ark, 6asv, 6aum, 6avr, 6awp, 6zr, 6zu, 6zn(cw), 6zs, 6zz (cw), 7ba, 7bp, 7bk, 7cc, 7cn, 7op(cw), 7gj, 7hf, 7iw, 7ke, 7kj, 7mf, 7mu, 7nn, 7oz, 7tj, 7tq(cw), 7ya, 7zj, 7xh, 7zt, 7zp, cl8.

BY GEORGE & CHAS. C. WHYSALL, 8CMI (EX-6TV)

1gm, 2aje, 2aaf, 2bml, 2el, 2fp, 2xj, 3ajd, 3abb, 3arn, 3alu, 3bfu, 3eh, 3jo, 3zo, 3zx, 4ag, 4bi, 4bw, 4fd, 4gl, 4gn, 5aby, 5da, 5do, 5fo, 5gi, 5hk, 5jf, 5mo, 5nd, 5pe, 5sm, 5xu, 5ye, 6zz(cw) on 375, 8axn, 8ait, 8bdu, 8cno, 8cke, 8ea, 8ft, 8lb, 8mz, 8rq, 8sp, 8vq, 8xak, 8yu, 8za, 8ze, 8zo, 9aou, 9aiu, 9asj, 9ayw, 9azf, 9awz, 9atn, 9aqu, 9afk, 9amq, 9aul, 9afn, 9byc, 9cao, 9cba, 9dzi, 9dug, 9dhz, 9dcx, 9dfx, 9day, 9dsd, 9dmj, 9lf, 9ug, 9uh, 9vl, 9yb, 9yc, 9zj, kyw, kdka, woh, wgy, wjz, wwj, wubc.

BY 8AGO

(1ii), 1qp, (1rd), 1xm, 1ze, 1azw, 1bua, 1cak, (1cmk), 2bg, 2fp, (2nz), 2sq, 2wi, 2wt, 2xq, (2zk), 2zs, (2aab), 2ajf, 2amo, 2aqh, (2ayv), 2awl, 2bak, 2bea, (2beb), (2beh), (2bfz), 2bgt, 2bnc, (2btj), 2byw, 2ccd, (3ba), 3bz, 3ca, 3cc, 3cg, (3em), (3fm), (3fs), 3gh, 3hg, 3hj, (3iz), 3jj, 3km, 3lr, (3qv), (3qz), (3vw), 3xl, (3zv), (3aad), 3aag, 3aay, (3adx), 3anj, (3aln), 3apq, (3aqh), (3aqr), 3aso, 3asw, (3bfs), (3bfu), 3bhl, (3blf), 3btk, 4as, (4az), (4bf), 4bq, 4by, 4dq, (4eu), 4ft, (4gl), 4ii, 4kc, 4xd, 4ya, (4zc), (4ze), 5da, 5ek, 5fv, 5ho, 5jb, 5nz, 5pm, 5uu, 5wo, 5za, 5aam, (6bo), 6zz, (6xad), (8bk), (8bo), 8bu, (8ge), 8gw, (8hj), (8ih), 8iq, (8kh), 8pc, 8qb, (8se), 8vj, (8vy), (8uk), 8wy, 8zg, 8zz, 8aan, (8adg), 8adm, 8agz, 8aii, (8aim), 8ais, (8amd), 8amf, 8anc, 8aqz, (8ari), 8ark, 8arw, 8avd, 8avo, (8awm), (8awp), 8awy, 8axk, 8bbd, 8bca, 8bei, 8bey, 8bfx, 8bgv, 8blt, 8blw, 8box, (8brm), 8bun, 8bux, (8bxa), (8bzv), 8cjx, (8cld), 9bp, 9ct, (9dv), 9ei, 9fm, 9fz, 9hw, 9hy, 9if, (9il), (9io), (9iz), (9ki), (9kp), 9le, 9lq, 9ps, 9pw, 9qe, 9sl, 9so, (9uc), 9wa, 9wk, 9xi, 9ze, 9zg, 9zl, 9aap, 9aas, 9aau, (9aav), 9aay, 9aeq, 9aja, (9ajh), (9akd), 9amd, 9amu, 9ane, 9aoa, 9aqa, (9ark), 9arn, 9asd, (9ate), 9ayh, (9bed), 9bjb, 9blc, 9blo, (9brl), 9dam, 9dax, 9dcf, 9dof, 9dun, (9dzq), 9axi, 9zae; Canadians: (3bp), (3iz), (3fo), 9al.

Continued on page 45

Become a Radio-trician

Learn at home the greatest profession of today and the future. Become a master of radio installation, operation, maintenance repair, mechanics, design, inspection, salesmanship and invention.

THE world is aflame with Radio. Never before in the history of the country has an industry leaped to the forefront as rapidly as this great, new science. Hundreds of thousands of radio receiving sets are in operation—tens of thousands of sending stations will be erected—and this enormous craze is permanent. Even today manufacturers are months behind their orders! Improvements are being made every day which must increase the demand for radio equipment to even *greater* proportions than now.

Men of foresight, men of vision know what this means. Never before has there been such an opportunity. Radio-tricians are needed today everywhere. More and more will be needed as the demand for radio installation, radio operation, radio maintenance, radio repair, radio salesmanship becomes greater and greater.

Wherever you go, there are hundreds of radio sets to be installed—wherever you go, thousands upon thousands of dollars worth of radio equipment is being sold—wherever you go, there are radio sets to repair; and if you seek adventure, there are radio sending stations calling to you from ships and land stations all over the world.

The Pioneer School

The National Radio Institute has a record of over 8,000 students. It is the pioneer school. It teaches every phase of radio from the ground up. It teaches by means of actual practice, actual assembling of a radio outfit, actual operation of radio equipment. It teaches by problem and principle so that National Radio-tricians are in demand everywhere.

Here is a profession which is paying enormous earnings to men all over the country today—a profession that will make hundreds of men wealthy—a profession far more lucrative than that of any other technical or mechanical employment you can secure.

What will you do?

The world is aflame with radio. What are you going to do to "cash in" on the demand for men, for equipment, for experience? Are you going to sit idly by wondering what it is all about, or are you going to make the most of this, the greatest opportunity presented to men of ambition in 50 years?

Write at once for the complete catalog to the National Radio Institute. This is the turning point in your life. Upon your decision *this instant* may depend your entire future. Mail the coupon, or write a letter NOW—*for your own sake!*

NATIONAL RADIO INSTITUTE
Radio Headquarters
Dept. 1086 N. W., Washington, D. C.

NATIONAL RADIO INSTITUTE, *Radio Headquarters*
Dept. 1086 N. W., Washington, D. C.

Please send me your book telling how I can become a Radio-trician through your Home Study Course, in my spare time. I am enclosing 10c (stamps or coin) to cover cost of packing and mailing.

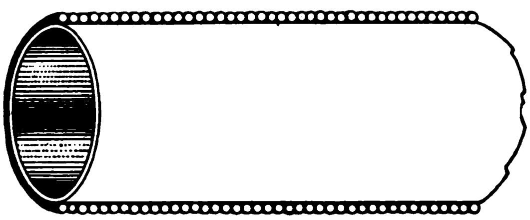
Name ....

Address...................... City............... State..........

GIBLIN-REMLER

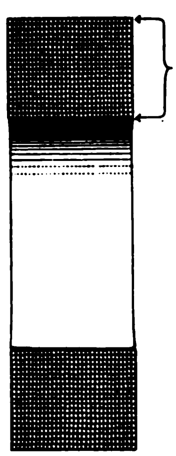
A NEW COIL DEVELOPMENT

1



Assume that the above single layer coil consists of 1000 turns and that the capacity between turns is Y. Then 1000 Y is the total self capacity of this inductance.

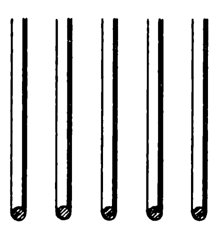
2



20 layers high
50 turns per layer
20 x 50 = 1000 turns

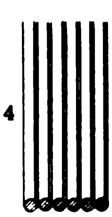
Reduce the length of coil 1 by winding a multi-layer compact inductance of 1000 turns (20 layers of 50 turns). The inductance will be greater than coil 1 due to the greater mean diameter of the turns. The capacity between turns is still Y, but an additional capacity between layers equal to 50 x Y (the mean of the number of turns in each two layers) has been added. This increase in internal capacity makes the coil unsuited for use as an inductance.

3

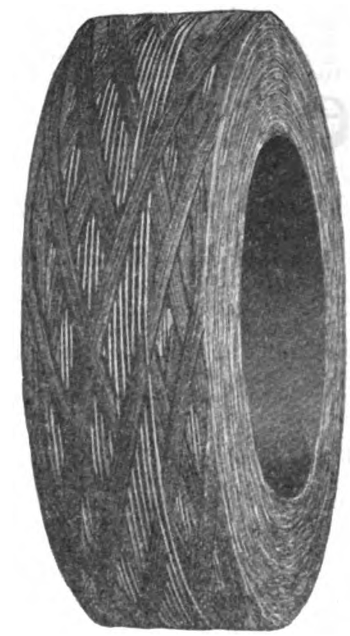


The capacity between layers and between turns is reduced by spacing, but this results in a loss of inductance.

4



Maximum inductance is obtained by winding the turns close together. This is the method used in the new Giblin-Remler Inductance, combined with a new method of separating the layers.



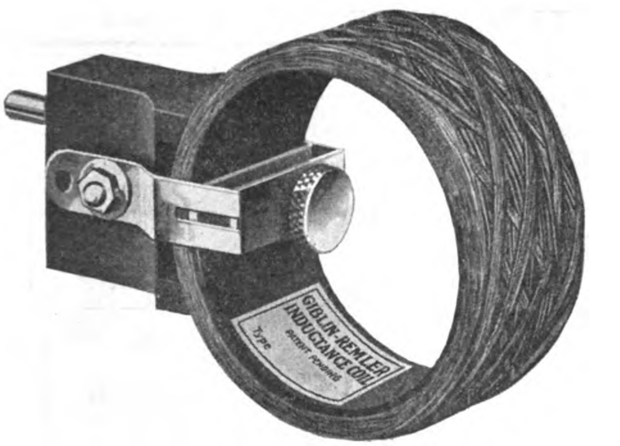
GIBLIN'S NEWEST AND GREATEST DEVELOPMENT OF A COMPACT INDUCTANCE COIL

THOMAS P. GIBLIN, originator of the Honeycomb and Duo-Lateral Coils has been working for years to produce an even more efficient inductance coil. Success has at last been achieved in the Giblin-Remler Inductance Coil.

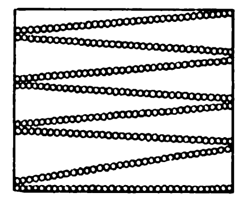
REMLER RADIO MFG.
248 FIRST STREET, SAN FRANCISCO, CALIF.
E. T. CUNNINGHAM, General Manager

INDUCTANCE COILS

INTERCHANGEABLE WITH ALL COIL MOUNTINGS



Made by an entirely new process, Giblin-Remler Inductance Coils are infinitely more effective in operation and superior in workmanship to any coil on the market today. Its performance for concentrated inductance cannot be approached—it is equally efficient on all wave lengths. The self capacity of the new Giblin-Remler Inductance is 100% less than any previous compact inductance — this low self capacity gives selectivity and sharp tuning for a given coil. This is especially advantageous to the amateur who usually has an antenna of low capacity. The high frequency resistance is lower than any previous type.



In the new Giblin-Remler Coil *Cotton Yarn* is wound into the form of a lattice and simultaneously the wire is wound into the coil in parallel turns. The cotton yarn separates the layers of wire with cotton and *air cells.* The air cells are extremely important in reducing the high frequency resistance. This method of winding gives maximum copper space and insulation space in a given volume. The insulation between layers is greatest at the points of maximum potential difference.

Giblin-Remler Inductance Coils are patentable—they are manufactured by patented machinery. You can purchase them from any authorized Remler Dealer.

Order Giblin-Remler Inductance Coils at once from your nearest dealer—or send direct to us. Learn how remarkably they will improve the performance of your set.

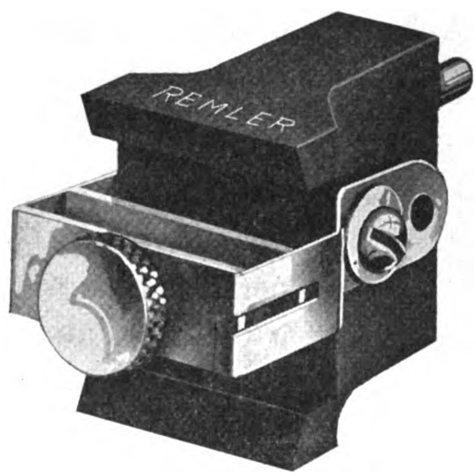
Type and Number of Turns, Mounted	Price, Mounted	Type and Number o Turns, Unmounted	Price, Unmounted	Inductance in Millihenrys at 1000 cycles Accuracy ½%.	Natural Wave Len th In Meters, Accuracy ½%.	Distributed Capacity, in micro-micro-farads, Accuracy 1%	Wave Length Range in Meters using Condenser of .001 max. and .00004 mfd. min.		High Frequency Resistance in Ohms at Wave Length Shown			
							Minimum	Maximum	200	500	1000	2000
RG 20M	1.50	RG 20U	.70	.030	39	14.3	63	334	......	1.1	......	......
RG 25M	1.50	RG 25U	.70	.041	47	15.2	75	389	......	1.5	......	......
RG 35M	1.50	RG 35U	.70	.083	87	25.4	128	550	......	3.5	......	......
RG 50M	1.60	RG 50U	.80	.169	114	21.6	185	785	......	8.8	4.4	......
RG 75M	1.65	RG 75U	.85	.377	163	19.8	266	1170	......	28.3	12.1	6.2
RG 100M	1.70	RG 100U	.90	.666	217	19.9	358	1550	......	80.3	26.8	12.6
									1000	2000	5000	10000
RG 150M	1.75	RG 150U	.95	1.503	281	14.8	512	2320	69.8	23.8	7.1	......
RG 200M	1.80	RG 200U	1.00	2.68	374	14.7	690	3110	......	50.6	12.5	......
RG 250M	1.90	RG 250U	1.10	4.20	424	12.1	860	3880	......	87.5	19.9	......
RG 300M	2.00	RG 300U	1.20	6.11	494	11.2	1030	4680	......	141	29.3	13.8
RG 400M	2.10	RG 400U	1.30	11.04	618	9.7	1380	6300	......	......	54.6	22.3
RG 500M	2.30	RG 500U	1.50	17.50	747	9.0	1730	7900	......	......	93.1	34.9
									2000	5000	10000	20000
RG 600M	2.40	RG 600U	1.60	29.2	1024	10.1	2260	10250	......	111	43.8	......
RG 750M	2.65	RG 750U	1.85	39.0	1249	11.3	2660	11850	......	......	64	......
RG1000M	3.40	RG1000U	2.50	71.6	1620	10.3	3570	16000	......	......	123	......
RG1250M	3.80	RG1250U	2.90	108.0	1930	9.7	4380	19700	......	......	......	......
RG1500M	4.40	RG1500U	3.50	159.8	2300	9.3	5300	23800	......	......	......	......

These tests have been made by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.

COMPANY
154 W. LAKE ST., CHICAGO, ILL.
Apparatus That Radiates Quality

THE NEW REMLER COIL MOUNTING

SIMPLE TO MOUNT. TIGHTENING BAND BUILT INTO MOUNTING. ELIMINATES FIBER BAND. MOLDED BAKELITE. INTERCHANGEABLY USED WITH REMLER COIL AND PANEL TYPE PLUGS.



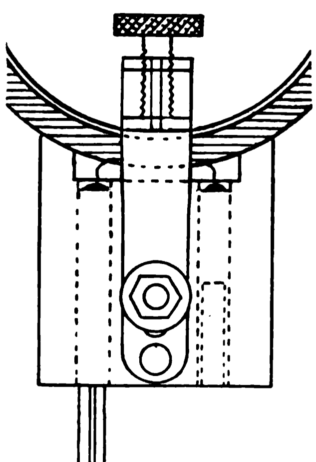
The plug terminal is slotted twice at right angles, insuring smooth, easy plugging.

The tightening band is nickel plated. Three holes provide the necessary adjustment and prevent any slipping.

The plug is molded bakelite, buffed finish. The contour is shaped to the coil.

The solder terminals are countersunk, eliminating possible injury to coil winding.

The slot in the tightening band holds the pressure plates in alignment.



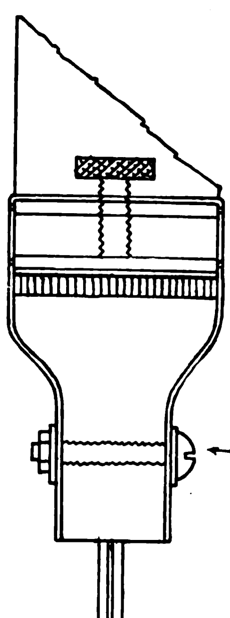
The plug and jack terminals are interchangeable with all standard plug and panel mountings.

The tightening band is securely held to the plug.

The lower plate absorbs the pressure on the coil.

The upper plate applies tension to the tightening band parallel to the sides of the coil.

A turn of the thumb screw separates the pressure plates and securely clamps the coil to the plug.



This new Remler Coil Mounting with its improved and original features is built especially for the new Giblin-Remler Coils. The plug can be used interchangeably with all Remler coil and panel type plugs.

The metal tightening band—an important Remler feature—eliminates the annoying fibre band and assures perfect tightness at all times. By simply turning the thumb screw the coil is rigidly fastened to the coil contour of the bakelite plug. There is no fibre band to become damp and stretch or to loosen the coil from its mounting.

Built complete by Remler, every operation is checked to insure a smooth working, simple operated plug—a plug with a Remler Guarantee.

PRICE

No. 48—20 to 750 turn coils...........70c
No. 49—1000 to 1500 turn coils........80c

Amateurs:—Write for catalogue and name of nearest Remler dealer.

REMLER RADIO MFG. COMPANY

248 First St.,
San Francisco, Calif.

E. T. CUNNINGHAM,
General Manager

154 W. Lake St.,
Chicago, Ill.

CALLS HEARD

Continued from page 40

BY 5TC, BOX 1557, FT. WORTH, TEXAS

Spark—5aby, (5ao), 5fo, 5hk, (5hz), 5jb, 5jd, 5jf, 5kc, (5kp), 5py, (5ra), (5tg), (5sm), (5ue), 5xa, 5xu, 5yg, 5zl, 5zs, (8zo), 8ft, (9abv), (9acn), (9ams). (9apk), (9apn), (9aqz), (9arg), (9avx), (9avz), 9ayl, 9ayw, (9azh), (9dsd), 9drn, 9wi, 9wt.

C. W.—1bcg, 2bef, 4by, 4gl, 4zc, 5bm, 5la, (5oi), (5pb), 5xb, 5za, 6bes, 6ale, 6xad, 7zu, 7zm, 8aqo, 8avy, 8axb, 8bdo, 8uc, (9aog), 9bjb, (9blc), 9dky, 9dsm, (9dta), 9dzq, 9io, 9km, 9of, 9wq, (vry qsa) 9zl.

Fones—6wv, bb5, woh, 5za, 5hl, 5xu, 9zaf, 9bnd, 4cb, wrr, 5ir.

BY 6ADR, 2319 ASHBY AVE., BERKELEY, CALIF.

Spark—(6fh), 6gt, 6gd, (6hv), 6ic, (6iv), (6ke), 6lk, 6od, (6wg), (6aak), (6aeh), 6agk, (6ahf), 6ahq, (6ain), 6aio, (6ajh), 6ajr, (6akl), (6amn), 6ark, (6avd), (6awx), (6baj), (6bdz), (6bmp), (7bj), 7bh, (7bk), 7ed, 7hn, (7hf), 7ke, (7kj), 7gj, (7gq), 7gt, 7mf, 7mu, 7ot, 7oz, 7tq.

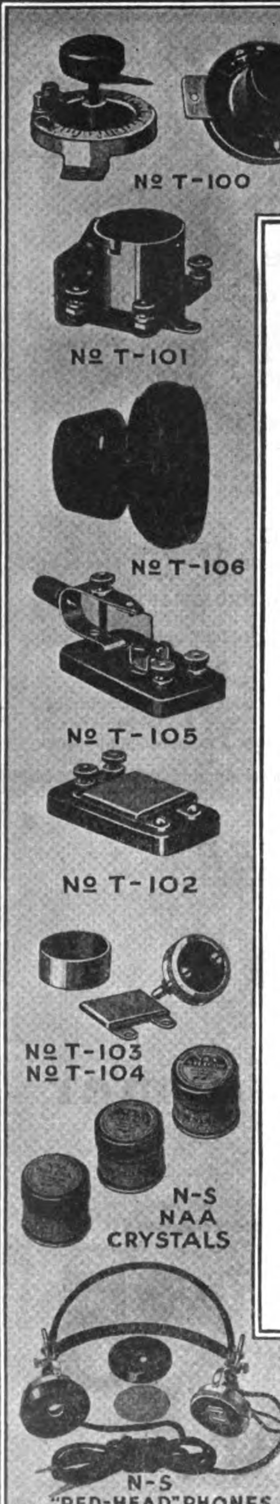
C. W.—5za, (6cu), 6en, 6jd, 6ka, 6gv, 6gd, (6bes), 6za, 6zz, 6xad, 6zac, 7rn, 7nf, 7qt, 7we, 7xf(chopper-voice), 8agz, 8aim, 9anf, 9amb.

Anyone hearing 6aor pse. QSL. All cards answered promptly.

Continued on page 52

Teagle

MADE IN U.S.A.



Introducing Seven *Better* Radio Instruments

15 years of direct contact with the radio field has enabled us to develop these products. Each has new and unusual features that place it far ahead of common types—not one is a rushed-on-the-market experiment.

HERE THEY ARE

No. T-100 Reversible Rheostat all metal type for table or panel mounting. For use with any detector or amplifier bulb—smooth action, perfect contact, substantial pointer with insulated knob.
—a *better* rheostat
Price $1.00

No. T-101 V. T. Socket—Mechanical features that make it the only socket on the market that is genuinely rigid and strong when used for panel mounting and yet perfectly adapted to table or base mounting. All metal with Bakelite contact support.
—a *better* socket
Price 75c

No. T-106 Adaptaphone—Converts the sound chamber of phonograph into a loud speaker. Made of high-grade rubber. Will not scratch or mar parts of phonograph. Not necessary to remove cap from receiver. Will fit all phonographs except the Brunswick.
—a *better* adapter
Price $1.00

No. T-105 Crystal Detector—New and ingenious design provides every adjustment to facilitate proper contact with the crystal. Contact wire can be moved to any point on crystal. Pressure can be easily regulated. Contact wire instantly renewable.
—a *better* crystal detector
Price $1.00

No. T-102 Stopping Condenser—Heavy metal plates of novel design form substantial case for condenser. Mica dielectric, capacity .00029 MF. Highly nickeled and polished, mounted on insulating base. Can be removed for panel mounting.
—a *better* stopping condensor
Price 75c

No. T-103 Grid Condenser, of similar design as above. Proper capacity for grid circuit in V. T. Hookups.
—a *better* grid condenser
Price 40c

No. T-104 Moisture-Proof Variable Grid Leak—arranged for front of panel mounting in connection with Grid Condenser. Nickeled and polished cover.
—a *better* grid leak
Price 60c

—and better than ever the famous

N-S "Red-Head" Phones—3000 ohms. A triumph in Radio Receiver design. Beauty of design and ruggedness of construction coupled with a supreme sensitiveness are features that make "Red-Heads" the ideal telephone receivers for radio work.

Price with Cords $8.00
—and

N-S NAA [Arlington Tested] Supersensitive Crystals, individually tested and packed in convenient metal boxes. Galena, Silicon or Goldite, price each 25c. Same mounted in cup, 40c each.

Number yourself among our thousands of friends and customers who know the reliability and accuracy of N-S Radio Products.

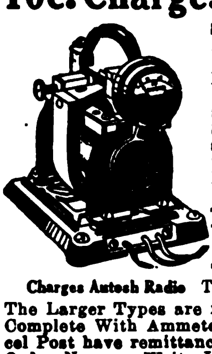
Send for Bulletin B which describes these products in detail

Dealers: Write for our very attractive proposition.

IMMEDIATE DELIVERY

The Newman-Stern Co
Teagle Radio Division
CLEVELAND - OHIO

10c. Charges Your Storage Batteries AT HOME WITH AN F-F Booster



Charges Autosh Radio

So You will never have to give up in disgust when working a distant station. Is it not gratifying to feel your Batteries will never fail & to be always ready to "Listen In" & receive all Radio Broadcasting, never having to tell Friends Your Batteries are dead. The F-F Battery Booster is a rugged Charging Apparatus, unfailing in its ability to deliver service day and night; requiring no skill to operate; charges automatically and operates unattended. Screw Plug in lamp socket, Snap CLIPS on Battery Terminals and watch the gravity come up. AMMETER shows amount of current flowing. Everything Complete in Compact Self-Contained Portable CHARGING UNIT. F-F BATTERY BOOSTERS are Automatic FULL WAVE MAGNETIC RECTIFIERS with Infusible Carbon Electrodes, for 105-125 Volt 60 Cycle A. C. These Types Last a Lifetime. PRE-WAR PRICES:

Type 6 Charges A 6 Volt Battery at 6 Amperes $15 Type 12 Charges 12 volt Battery at 5 Amperes $15
Type B Charges 2 to 100 Volt Radio B Batteries $15 Type A-B Charges Both A & B Batteries $20
Type 1612 Charges 12 Volt Batteries at 7 Amperes....................$24
Type 166 Charges 6 Volt Batteries at 12 Amperes....................$24
Type 1626 Combination Type Charges Both 6 and 12 Volt Batteries at 12 and 7 Amperes..........$36

The Larger Types are recommended for Large Batteries, or where time is limited. Shipping Weights Complete With Ammeter & Clips 12 to 15 lbs. Send check for Prompt Express Shipment. If via Parcel Post have remittance include Postage & Insurance charges, or order us to ship Type desired C.O.D. Order Now, or Write Immediately for FREE Descriptive BOOSTER & ROTARY Bulletins 33 & 33A.

FRANCE MFG. CO. General Offices and Works: CLEVELAND, OHIO, U. S. A. Canadian Rep.: Battery Service&Sales Co., Hamilton, Ontario, Can.

Tell them that you saw it in RADIO

"M. P. M."
NATURE'S FINEST

SUPER-SENSITIVE
HIGHEST TEST
(NOT OBSOLETE CUBE)

DETECTOR-CRYSTAL
(DIRECT FROM MINE)

Notice:—Fully-as-good-as-a-tube when used with new Crystal-Amplifying Inductance, and keeps your Set cut in at all times without battery or cost.

Insist on "M. P. M." AT YOUR DEALER, or MAIL $1 Bill, M. O., or Check for LARGE BOX, absolutely guaranteed, to

Million Point Mineral Co.

San Francisco Office—1254 Clay St.

*Dealers:—If you want to handle the **Best Mineral on Earth,** write for attractive trade proposition.*

Pacific Radio Exchange

439 Call Building
SAN FRANCISCO

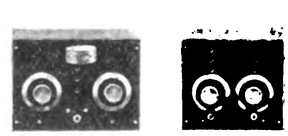
Manufacturers and Jobbers

Write for trade proposition

"PARADEX"
Vacuum Tube Receiving Set

"PARADIO"
Crystal Receiving Set

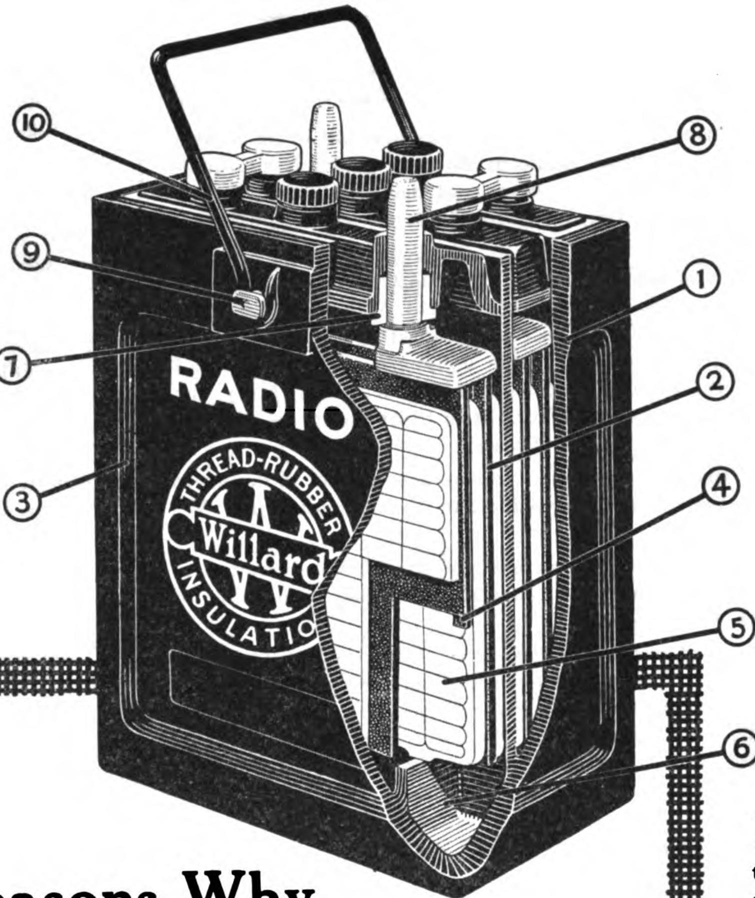
Latest Concert Receivers



Receiver Amplifier

Illustration shows the two units of this improved concert receiver. Units can be purchased together or separately. Highly polished mahogany cabinets with hinged tops. Connections are all made at the back, doing away with the unsightly connection posts in the front. Receiver, $35.00; Amplifier, $45.00. Complete set with batteries, aerial, phones, and all equipment, $150.00. We carry a complete line of standard radio equipment. Write us for literature.

LEVY ELECTRIC COMPANY
1230 Polk Street San Francisco



The Willard All-Rubber Radio "A" Battery (shown here) is designed especially for radio use.

Ten Reasons Why The Willard All-Rubber Radio "A" Battery is Better

These reasons, back of the success of this specially designed battery, are as definite as those responsible for the success of the Willard Threaded Rubber Battery, which is now standard original equipment on 195 makes of cars and trucks. Ask for particulars from your dealer or at the nearest Willard Battery Station.

The Willard Radio "B" Battery is a 42-volt rechargeable storage battery, with leak-proof glass jars and Threaded Rubber Insulation. Assures freedom from frying and hissing ground noises.

WILLARD STORAGE BATTERY COMPANY
Cleveland, Ohio

Made in Canada by the
Willard Storage Battery Company of Canada, Limited, Toronto, Ontario

Willard THREADED RUBBER BATTERY

1 The rubber case is made in one piece, thoroughly insulating the battery from cells to ground and from cell to cell, and effectively preventing all ground noises.

2 Plates are insulated with Threaded Rubber Insulation, which by reason of its uniformity allows every part of each plate to do an equal share of work.

3 Battery is shipped in absolutely Bone-Dry condition so that it is brand new when you get it.

4 Insulators are made with special heavy ribs to meet the special requirements of the radio battery.

5 Plates are extra heavy to provide current at steady voltage for considerable periods.

6 Sediment chambers are large to eliminate all possibility of short circuits at plate bottoms.

7 Posts are sealed by soft rubber gaskets, so that solution cannot seep out between post and cover.

8 Terminal posts are high to permit easy grip of battery clamps.

9 Brass knobs sunk into the sides of the rubber case provide a firm hold for the handel.

10 Handle made of a heavy rod furnishes easy means of carrying the battery.

10 WATT C. W. SET

Continued from page 17

struction considerably easier. In connecting the two coils together in the center tap care should be taken that the winding will be continuous in one direction around the core.

No description will be given as to the construction of the cores of the transformers, as the method is familiar to all amateur radio men and the dimensions are clearly shown in the drawings. The iron used should be a good grade of transformer iron if full efficiency and rated output of the transformers is expected. These transformers when properly constructed will have a capacity of approximately 50 watts each.

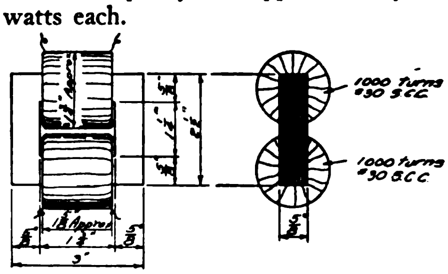


Fig. 10. Smoothing Choke

The method of mounting the transformers can be seen from the drawings and no lengthy description is needed. The object in making the mountings of this type with the terminal panels on top was to have a transformer which would take up the least amount of space possible on the base of the set and to use up some of the extra space below the inductance and behind the tubes.

Each transformer is provided with two binding posts for the 110 volt side and three for the secondary side, the middle post of the three being the center tap of the transformer.

The coils of the smoothing choke are made up in much the same manner as the high voltage secondaries. They are each wound with 1000 turns of No. 30 S. C. C. copper wire. If the builder purchases about two pounds of No. 32 S. C. C. copper wire for the high voltage secondaries he will undoubtedly have some left over which can be used for the smoothing choke coils if desired. As was the case with the high voltage secondaries, these coils need not be wound in layers.

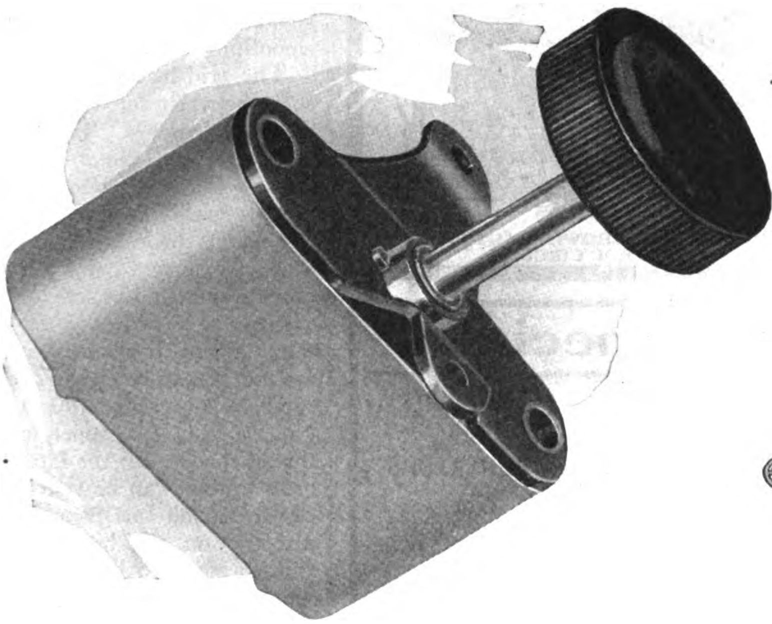
The mounting of the choke can well be of the type similar to the transformers. Four binding posts should be provided for connections to the coils. By this means three values of inductance can be obtained, the inductance of one coil alone, twice this inductance when both coils are in series and about one-half the inductance of one coil when they are connected in parallel. The purpose of this choke is to smooth out the current supplied to the tubes and if made large enough would make the

Continued on page 50

Bradleystat

REGISTERED U. S. PAT. OFF.

PERFECT FILAMENT CONTROL



Price $1.85

at all radio dealers. Add 10c postage when ordered from

Allen-Bradley Co.

288 Greenfield Ave., Milwaukee, Wis.

THE STORY OF THE BRADLEYSTAT

About the time when Marconi startled the world with his famous wireless message across the Atlantic, a series of experiments were under way in the city of Milwaukee to prove a new idea for controlling electric motors in steel mills. Little did these intrepid experimenters dream, at that time, that this idea would some day revolutionize current control in the giant field of RADIO, which then was born.

The new idea was to eliminate wire- wound rheostats for current control, and use carbon discs under pressure. Everyone said it could not be done.

That was over twenty years ago! To- day, graphite compression rheostats from the electric furnaces of the Allen-Bradley Company are used in every industry, on battleships, in mines, and every place where electric current must be under precision control.

The latest contribution to RADIO is the Bradleystat, the result of twenty years experience and research. It controls the filament current of your ½ to 1 ampere receiving tubes and your sending tubes up to 2½ amperes, as no other type of rheostat can. The control is so perfect, so stepless, so noiseless that wire-wound rheostats seem crude in comparison. For your own satisfaction and delight, insist on the Bradleystat.

10 WATT C. W. SET

Continued from page 48

signals approach very close to the characteristics of a tube set with d.c. supply. However, the larger the choke the greater will be the drop of voltage across it and a greater terminal voltage will be required at the transformer terminals. With the above transformer and choke the voltage impressed on the tubes is between 400 and 500 volts. As each tube is working only one-half of the total operating time and neither tube is working when the key is up, it is possible to work the tubes now on the market up to about 750 volts in this circuit without any noticeable harm. If the builder should desire he may dispense with the smoothing choke entirely.

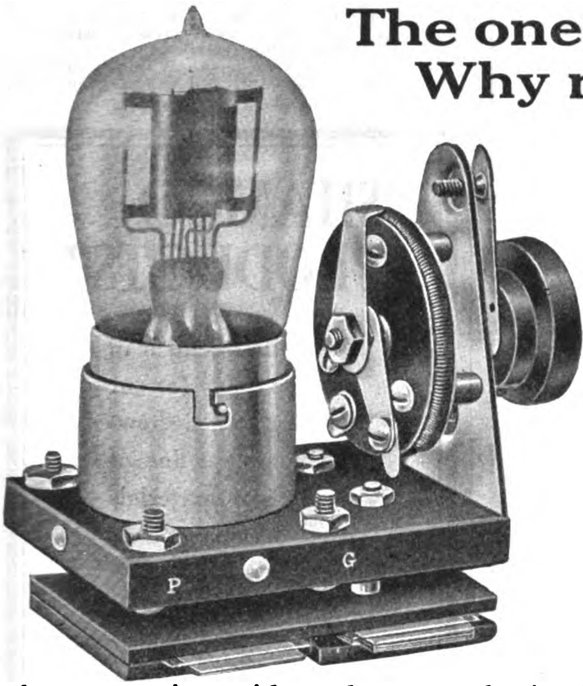
The grid leak is mounted on the tube shelf between the two sockets, and the grid condenser C_2 is mounted directly below on the under side of the tube shelf. The two condensers C_3 and C_4 are preferably mounted on the back of the panel toward the outside edges at some convenient point as shown in the photographs. The condensers C_5 and C_6 can be mounted directly on top of the filament transformer. The chokes L_3 and L_4 can be either 250 turn honeycomb coils or about 400 or 500 turns of No. 26 S. C. C. copper wire wound on thread spools. In the latter case a small brass bracket can be fastened to one end of the spool for fastening the chokes directly on the binding posts of the transformer. All wiring of the set should be of the rigid bus bar type and should not be smaller than No. 14 bare copper wire.

As to the actual methods of operation the builder is referred to the many articles that have appeared in this and other magazines on the subject. More can be learned in a half hour of experimenting with the various adjustments than can be learned by reading pages of written description. It may be noted, however, that a critical adjustment of condenser C_1 will be necessary for every change in the position of the aerial or plate taps.

The entire set can be constructed at moderate expense and the results that can be obtained will well repay the builder for his efforts in constructing it.

Condensers in series reduce the effective capacity of a circuit whereas condensers in parallel increase it. Consequently a variable air condenser is placed in series with an aerial to decrease the capacity so as to tune to shorter waves and is connected in parallel with a coil of wire or another condenser to increase the capacity and thus tune for longer wavelengths.

QUALITY



The one thing you pay for in the end
Why not get quality when you buy

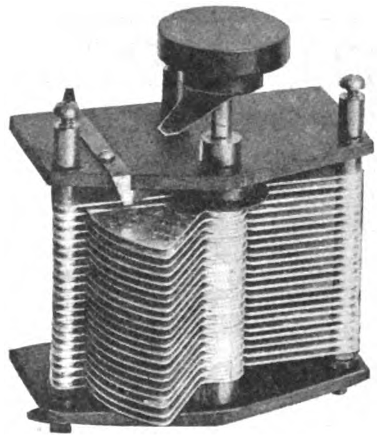
Your First Radio Instruments
Buy
Wireless Shop Apparatus
AND BE ASSURED OF THE QUALITY

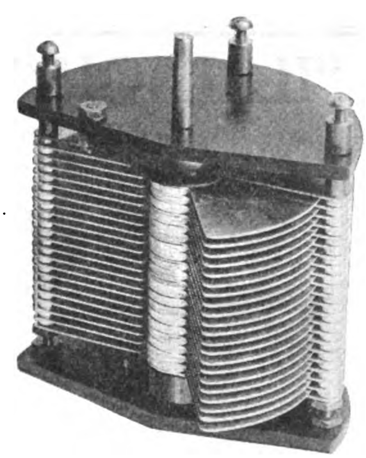
NO. 40 WIRELESS SHOP DETECTOR UNIT

A complete detector control, designed for back of panel mounting. By using this new unit it is very easy for the novice to build up a receiving set. All that is necessary is to drill three holes in your front panel, mount the unit and wire it to your tuner. Unit consists of socket for tube, rheostat, mica grid condenser and mica by-pass condenser. The bulb is not included. And the price is so low that you cannot afford to assemble the separate instruments yourself. A knob and pointer is supplied. Price (postage extra) $5.00

The No. 40 detector unit and No. 41 amplifier unit is fully described in our bulletin No. 3, which will be mailed for the asking.

Variable Condensers





When you buy a variable condenser, you want the product of a real instrument shop. Of the many different instruments used in radio work, the variable condenser and head receiver are two that must be made right, by men that know, and have passed through the experimental stage. "Wireless Shop" variable condensers have an enviable reputation for "QUALITY", and this reputation has been honestly earned by strictly high grade material and workmanship. We have been manufacturing variable condensers for nearly eight years, and have developed a special line of equipment for performing each and every manufacturing operation required. "QUALITY" not "PRICE" is our slogan. The "PRICE" is as low as is consistent with "QUALITY". The 23 plate, No. 230, sells for $3.60. The 43 plate, No. 430, for $5.25. Twelve other sizes are fully described in our bulletin No 1. Ask for it.

THE WIRELESS SHOP
A. J. EDGCOMB

1262 West Second Street **Los Angeles, California**

CALLS HEARD

Continued from page 45

BY 6AKW, R. F. D. NO. 1, LANCASTER, CALIF.
6pj, 6gr, 6aau, 6avs, 6aud, 6tu, 6amk, 6to, 6ald, 6aim, 6ajr, 6bam, 6ark, 6ib, 6ak (cw & voice), 6vk, 6ng 6zx, 6zam, 6zj, 6ex, 6cc, 6apl, 6bip, 6zaa, 6za, 6zt, 6abu, 6arj, 6zz(cw), 6zi, 6im, 6ku, 6ic, 6ada, 6gf, 6ala, 6gy, 6atu, 6fh, 6xwi, 3ha(cw), 4cb(cw probably Canadian), 4dm, 5za(cw), 5cn, 5sk, 7nn, 7zm, 7ly(cw), 7wg, 7mp, 7jd, 7mf, 7xb(cw), 7cs, 7zj, 7nw, 8bx, 9amb(cw), 9ayu(cw), 9dva(cw), 9dzj(cw), 9ps(cw), 9dh(cw), 9bji(cw).
QSL if you pick up my C. W. sigs. Just got station in operation April 5th at present location.

Continued on page 56

RADIO PATENTS

Continued from page 34

chamber 22. Passageways 15 and 23 are also provided for a cooling medium.

A. Bonnefont, Pat. No. 1,410,793; March 28, 1922. Crystal detector for wireless telegraphy.

The crystal p is entirely enclosed in a base member s, but may be rotated from the outside by means of the cap c. The sensitive exploring point is the end of spring r, wound around the sleeve e slidable on shaft a, and urged toward the crystal p, by spring r_1. The point is moved up and down by rotation of a crank arm t which carries the crank pin b engaging the collar of sleeve e. By rotating this shaft t, the sleeve e may be also slightly rotated due to the knurling on pin b, and in this way a sensitive point may be readily obtained. Furthermore the crystal p itself rotates about an axis non-concentric with respect to shaft a, and this makes possible a large variety of adjustments.

H. M. Stoller, Pat. No. 1,411,814; April 4, 1922. Power system for radio apparatus.

A power tube system suitable for such work as with airplanes is described, in which there is minimum weight. The power tubes 10 receive their filament current from a storage battery 1. This battery also operates a motor generator set 4-5, for supplying the plate circuit with high voltage. To eliminate the effect of the low amplitude audio frequency current due to the brushes and commutator of machine 4, filter circuits comprising choke coils 13 and resistances 14 are used in the filament heating circuit. By proportioning the impedances and resistances properly, the A. C. is substantially eliminated.

NEWS OF BROADCASTING STATIONS

Continued from page 29

KWH—Los Angeles Examiner, Los Angeles, Calif.
KOQ—Modesto Evening News, Modesto, Calif.
WAAQ—New England Motor Sales Co., Greenwich, Conn.
WAAE—St. Louis Chamber of Commerce, St. Louis, Mo.
KOE—Spokane Chronicle, Spokane, Wash.
WAAN—University of Missouri, Columbia, Mo.
WAAS—Georgia Radio Co., Inc., Atlanta, Ga.
KPO—Hale Bros, Inc., San Francisco, Calif.
WAAP—O. W. Taylor, Wichita, Kan.
WAAB—Times Picayune Pub. Co., New Orleans, La.
WWZ—John Wanamaker, New York, N.Y.
WAAV—Athens Radio Co., Athens, Ohio.
WAAW—Omaha Grain Exchange, Omaha, Nebraska.
WBAB—Andrew J. Potter, Syracuse, N.Y.
WAAX—Radio Service Corps, Pitts., Pa.
WAAY — Yahrling-Raymer Piano Co., Youngstown, Ohio.

THE EMPORIUM BROADCASTING STATION

The Emporium broadcasting station at San Francisco is on the seventh floor of the large department store. The antenna is of the four-wire T type 80 ft. long, supported by two 60 ft. steel pipe poles. A cage type lead-in is used. The transmitting set, part of which is shown in the accompanying photograph, is of five watts capacity. The oscillating circuit is the Colpitts, while the Heising system of modulation is used. The normal radiation is 1½ amperes on 360 meters.

A standard type of regenerative receiver and two step are used. The room is specially constructed for the broadcasting of orchestra numbers and other special features of public interest. The broadcasting range, as reported under ordinary circumstances from out of town stations, is 185 miles daylight, while close to 700 miles have been covered on tests at night.

A counterpoise consisting of 3000 ft. of wire is used for the ground. This counterpoise is 200 ft. long and 20 ft. wide.

Desert Power and Water Company, Kingman, Arizona, has established a radio apparatus sales department in charge of James H. Davidson, radio engineer, formerly in the navy service. Because of the distances of Arizona points from present broadcasting stations only equipment of the better class with ample range will be handled. It is expected radiophones will be in great favor at the many semi-isolated mines and mining camps of Northern Arizona and the installation of a broadcasting outfit at Kingman is anticipated.

The *Record,* at Fort Worth, Texas, has installed a 200-watt radiophone for broadcasting press, weather and concerts.

The Hatfield Electric Co. has opened a broadcasting station at 531 North Meridian Street, Indianapolis, Ind. The call letter is WOH. Regular programs will be broadcasted from this station every Monday, Wednesday and Saturday evenings at 8:30, central time.

THE CLASSIFIED ADS ON PAGE 94 WILL INTEREST YOU!

CALLS HEARD

Continued from page 52

BY 7BS, 605 BOYLSTON N., SEATTLE, WN.

Can. 4cb, 5za, 6en, 6gy, 6jd, 6ki, 6xh, 6xad, 6xw, 6zf, 6zi, 6aif, 6bla, 7nf, cl3.

BY 6AME, BOX 218, RIVERBANK, STANISLAUS CO., CALIFORNIA

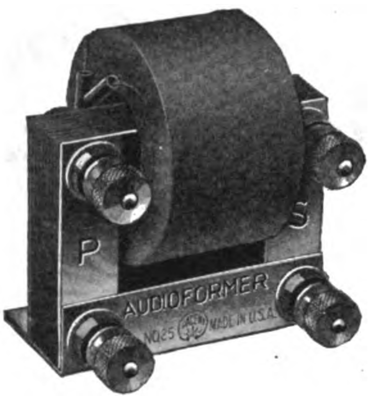
On one tube—5zq, 8agz, 8cld, 8de, 8sp (Fairmont, W. Va.), 8uj, 8xm, 8xv, 9ak, 9bji, 9kp, 9zaf (fone and cw), 9zj, 9zy, 9ax (Can. spk.), 9bd (Can. spk. and cw), dd5(fone), vlj.

On choke coil one step—5ak(spk.), 5if(spk.), 5xb(spk.), 5xd(spk.), 5yq(spk.), 5za(spk., cw and fone), 5zz, 8aav, 8aim, 8agu, 8bf, 8bfx, 8box, 8caz, 8cgx, 8ib, 8jl, 8in, 9aik, 9aja, 9akd, 9alu, 9amb, 9aqa, 9aqu, 9ayu, 9ayv, 9avz(spk.), 9awm, 9bac, 9bex, 9bbf, 9bik, 9dtm, 9dva, 9dvb, 9dvt, 9dzj, 9fm, 9io, 9ix, 9ji, 9jr, 9nx, 9pi, 9wd, 9wu, 9xaq(spk. and cw), 9yak(spk.), 9yal (spk.), 9zac, 9zal(fone), va2, cl3, cl8(spk. and cw), bf2, nof(Washington, D. C.).

Would like QRA from the above stations who have not received my QSL.

More New Pacent Radio Essentials

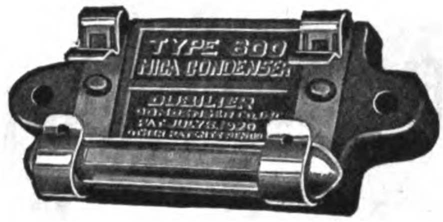
Pacent Audioformer



Here is the smallest and most efficient audio-frequency transformer on the market today. It is being manufactured especially for the reception of radio telephone music and speech and is so designed as to give maximum efficiency at all audio-frequencies. The Pacent-made Audioformer will make music worth listening to.

Catalog No. 25
Pacent Audioformer Price . $6.00

Dubilier Type 600 Condenser

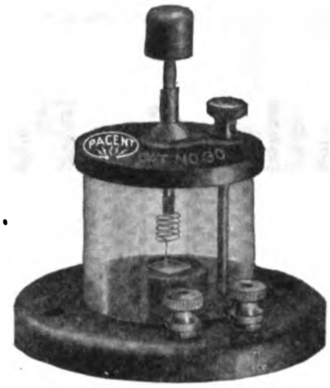


This condenser manufactured by the Dubilier Condenser Company by the superior Dubilier process can be secured for your receiving equipment. The Dubilier Type 600 Condenser has accommodations for a grid leak, yet the condenser costs less than a grid leak or a condenser purchased separately, and is provided with Fahnestock connectors. Use Dubilier Condensers.

Capacities up to 0.005 mfd.
Price $0.75

Capacities over 0.005 to .01 mfd.
Price $1.00

Pacent Crystal Detector



The Pacent Crystal Detector is perfect in construction and reasonable in price. It is dust-proof, rust-proof and fool-proof. Has moulded top and base with glass cover. Crystal instantly accessible. All parts heavily nickeled and highly polished. A truly beautiful instrument incorporating every feature a good detector should have. Pacent-made and Pacent-stamped.

Catalog No. 30 Crystal Detector Stand.
Price. $1.50

Ask your dealer to show you these and other Pacent Essentials.

150 Nassau St.——Pacent Electric Company, Incorporated——New York City
LOUIS GERARD PACENT, President

MEMBER OF RADIO SECTION, ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES

ELMCO Apparatus

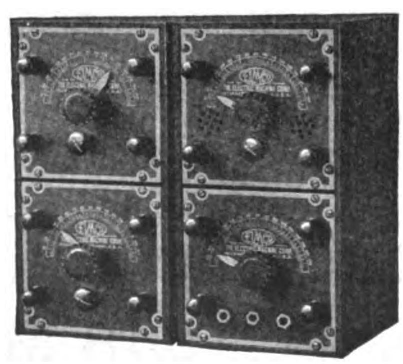
Elmco—No. S-1 Tuner, and A-3 Detector, and Two-Stage Amplifier . . **$100.00**

Elmco—No. S-1 Detector and Two-Stage Amplifier 60.00

Elmco—No. S-1 Tuner 40.00

Elmco Crystal Detector, receiving set complete 28.00

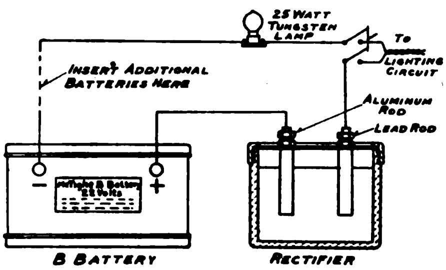
Write for Catalog No. R-1.



The Electric Machine Corporation

Indianapolis, Indiana

The McTIGHE STORAGE "B" BATTERY



The McTighe Storage "B" Battery is of the alkaline type, is the most satisfactory source of plate potential, and can be charged from your lighting circuit for less than one cent. Can also be charged from farm lighting systems.

In ordinary service a one hour charge will last for several weeks.

The Battery is furnished in a 24 volt unit in an attractive case.

It is noiseless, and cannot be injured by accidental short circuit, overcharging or by standing idle.

Descriptive leaflet on request.

PRICES

Battery	\$4.00
Rectifier	1.50
Rubber Filler	.25

F. O. B. Irwin, Pa.

ECONOMIC APPLIANCE COMPANY
Successors to McTighe Battery Co.,
Irwin, Pa.

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PROMPT DELIVERY

ALL SIZES UP TO 5 H.P.

We Specialize In Small Motors & Generators

ALL PHASES AND FREQUENCIES IN STOCK AT ALL TIMES

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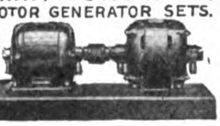
WIRELESS, TELEPHONE GENERATORS
500 VOLT - 100 WATT - 3400 R. P. M.
FOR MOUNTING MOTOR GENERATOR SETS.

\$28.50 EACH



WRITE FOR CATALOG

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, Etc., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of "RADIO," published monthly at San Francisco, California, for April, 1922.

State of California,
City and County of San Francisco—ss.

Before me, a notary public in and for the State and city and county aforesaid, personally appeared H. W. Dickow, who, having been duly sworn according to law, deposes and says that he is the business manager of the "RADIO," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Pacific Radio Publishing Co., Inc., 465 Pacific Bldg., San Francisco, California.

Editor, Arthur H. Halloran, Berkeley, California.

Managing editor, none.

Business Manager, H. W. Dickow, San Francisco, California.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Arthur H. Halloran, Berkeley, California.
H. W. Dickow, San Francisco, California.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities, are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. W. DICKOW,
Business Manager.

Sworn to and subscribed before me this 22nd day of March, 1922.

(Seal) MARTIN EDELMAN.
(My commission expires April 7, 1922.)

Hook Up With a WIZARD BATTERY

A special made "moisture proof" "B" battery of guaranteed long life—a veritable power house. As high in quality as it is low in price.

No.	Size	Wgt., Lbs.	Volts	Price
1623 Plain	2x3⅜x2½	1	22½	\$1.00
1623 Variable	2x3⅜x2½	1	22½	1.20
1625 Plain	4x6⅝x3	5	22½	1.85
1625 Variable	4x6⅝x3	5	22½	2.25
1626 Plain	8x6⅝x3	10	45	3.75
1626 Variable	8x6⅝x3	10	45	4.15
1630 Variable	3x6 x2⅜	2¾	27	1.80
1632 Variable	5x6 x2⅜	3¾	45	2.80

At your dealer or write direct

WIZARD BATTERY CO.
173 Lafayette Street, New York City

AT LAST—
A Real Book On RADIO

Just off the press!

A concise, non-technical treatise on Radio for the Layman.

Simple language, diagrams and everything. One that you can really understand.

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NOVO
Vacuum Tube "B" Batteries
FOR
Wireless Sets

22½ to 100 Volts

19 Different Sizes
Plain and Variable

FULLY GUARANTEED

Noiseless in Operation

Write for catalog and prices

Novo Manufacturing Co.

424 W. 33d St. NEW YORK
531 So. Dearborn St. CHICAGO

THE CONQUEST OF OUGLAMUCK

Continued from page 19

"No," I replies, weakenin', "I s'pose not."

"And now," resumes Hell-Fire, relieved-like, "since it's all settled that you're takin' th' job, just sit down here an' I'll give you th' dope on buildin' th' station. Th' transmitter is a five-kilowatt Hellkum Special——"

"Then I quit right here!" I announces, startin' to get up again. "Th' set at KVI is also a Hellkum Special—an' I been fixin' an' fightin' around with it from th' day I arrived to th' day I left. Th' only way to operate them Hellkums is with a sledge-hammer."

"But this is a latest improved Hellkum Special," explains Hell-Fire, soothin'-like. "It's got twice as much junk on it as th' old type, an' ya see that makes it twice as easy to run."

"Well," I replies, a little mollified, "seein' it's that way——"

"It's a real easy rig to install, too," says Hell-Fire, producin' a blue-print th' size of a windjammer's mainsail, which has a lot of geometry problems an' Egyptian hydroglyphics drawed all over it. "Here's a simple little plan of th' power-house and transmitter-room. You see, after ya put up th' power-house accordin' to th' buildin'-plans, all ya hafta do is to put in this concrete foundation for your main alternator, an' another for your direct-current excitin'-generator; then over here a couple more concrete beds for th' spare alternator an' exciter, an' down here in th' center is th' fifth an' heaviest foundation to set your diesel engine on. Ya don't hafta worry if all these different bed-bolts in th' concrete should happen to get a thousandth of a inch or so out'a place, because most of your belts will stay on, even if th' machines are out that much.

"There is a synchronous-gap mounted out on th' end of th' alternator-shaft, and th' transmitter-panel goes up alongside th' alternators; then you are all through, except for buildin' th' separate receivin'-shack, which stands over here fifty feet away from th' power-house; an' there are fourteen lines of conduit to put in between th' two shacks, carryin' wires for th' generator rheostats an' meters on th' control-panel alongside your operatin' desk, an' six push-rod switches to change wave-lengths without leavin' th' receivin'-shack, an' a water-coolin' system for th' diesel-engine, an' a fuel-oil heater to set up, an' a distant-control automatic break-in key, an' th' receivin' apparatus, an' a few other similar little trifles.

"Then you are all ready for business, only of course you hafta put up th' two hundred-an'-fifty-foot wireless-masts, an' guy 'em to stand th' hundred-mile gales that blow all th' time on

Ouglamuck, an' hang up a couple aerials, one fer short an' one fer long waves. Ya see, there ain't nothin' to it, because everything is already done on these drawin's—all ya hafta do is follow them."

By this time Hell-Fire has me swamped in a flood of plans an' blueprints enough to build a couple of Panama Canals, an' more comin' to view every minute.

"Yes, it's real kind of you to build th' station on this cloudburst of scratch-paper," I agrees, dazed-like. "It don't leave me hardly nothin' to do a'tall. What kind of a joint is Ouglamuck—where is it, anyway?"

"Why, don't ya know where Ouglamuck is!" exclaims Hell-Fire, surprised-like. "It's up in th' Berin' Sea, four-hundred miles beyond th' last uninhabited island in western Alaska. It's s'posed to be a swell place—lots 'a snow an' rocks, an' everything. You'll like it fine."

AN' this is how it was that after pitchin' an' divin' for fourteen days in a blindin' snow-storm, with foamin' white mountains of sea-water breakin' over us an' freezin' on the spars an' riggin' till the *"Pirate King"* turns into a solid chunk of white, snow-caked ice, I finally hears th' anchors go rumblin' down one stormy night, an' gets out in the gray, gusty morning to find th' schooner lyin' in the middle of a little bowl-shaped harbor surrounded by high rolling snow-covered hills, which swept back a few miles to the bases of three stupendous white-coned volcanoes all straight in a row, the middle one twice as high as the other two and with steely frozen clouds hangin' around its crater. On th' inner side of the harbor squatted a bunch of white-painted buildin's an' a small wharf—th' codfish company's diggin's—an' about a mile back up on th' hill ground straggles a few old tumble-down shanties an' round, dome-shaped dugouts of a Siwash village, all half-buried under the frozen white snow-drifts.

As I stands out on th' poop-deck of th' *"Pirate King,"* watchin' th' schooner come alongside th' ice-crusted ramshackle wharf, which snuggles out along th' foot of a high snow-streaked black cliff, a jagged hundred-pound rock comes tumblin' down th' face of th' bluff, whishes along past my ear, clearin' me by about a quarter of a inch, an' lands with a heavy scrunch square on top of my suit-case, squashin' it out flat as a pancake.

Gatherin' up th' remains of my tooth-paste an' safety-razor, I climbs up onto th' wharf, where a considerable convocation of hard-lookin' codfish snailers an' clam-faced Siwashes silently sizes me up with a bunch of unwelcome stares.

"Don't notice th' rocks," chirrups one insignificant-lookin' hyena-faced little gink, who I later learns goes by th' confidence-inspirin' cognomen of Double-Cross Picketts, as another descendin' slab of granite brushes th' snow off of my mackinaw an' busts a plank in th' wharf. "Some of 'em is kinda detached up there."

"Yeh—easy to push over, huh!" I retorts, returnin' generously th' friendly butcher-knife glares of my supercordial reception committee.

"Here comes Big-Gun Beardsley," whispers one of th' gang, in a awed tone, like it was th' emperor of Japan. "He's comin' to clean him up."

Followin' th' fearful-like glances of th' assembled assassinators, I observe comin' down th' hill toward th' wharf what seems to be a steam-hammer-fisted cross between a grizzly-bear an' a rusty shotgun, who is staggerin' around under th' crushin' weight of a cast-iron bullet-slinger with a handle like a ocean liner's crank-shaft an' a barrel like a German howitzer. Comin' swaggerin' out on th' wharf, like a Russian-Fin battleship in a beam sea, when he sees me, he stops still an' begins curlin' up his lip like a mad-dog. Th' friendly Ouglamuckites immediately proceeds to form a circle around th' two of us; an' so settin' down my pancaked grip, I cheerfully waits to see what is comin' next on th' bill-of-fare of hostilities.

"An' so you're th' fishtail-faced wireless engineer who's gonna be th' superintendent 'a Ouglamuck, eh!" he snarls, in a tone like somebody tryin' to grind up iron spikes in a coffee-mill. "You're th' lightnin'-catchin' freak who's gonna tell us snailers what t' do who been pullin' codfish before you even knowed where Alaska was at, are you—you donkey-eared son of a stale bakin'-powder biscuit!" With his face bucklin' up into th' lovin' expression of a chunk of shell-shot armor-plate, he reaches down on his hip for his ninety-calibre gunpowder-burner.

Now, if I'd been a greenhorn fresh from th' States, right then my heart would'a swallowed my liver, an' I'd 'a dropped dead on th' spot; but you see, I'd already been in this country of dis-lawfulness an' unorder long enough to learn a thing or two about these brimstone-belchin' gunpowder artists. Stoopin' down an' grabbin' hold of th' big rock that had been pitched down th' bluff at me, I rises up an' busts this trouble-huntin' maniac on th' side of his bean with it.

"Urrumph!" croaks Mr. Beardsley; an' disconnectin' himself from his high-power Krupp, he reclines gently downward onto th' wharf with th' squashy *ka-plunk* of somebody droppin' a rotten canteloupe.

"Wow—he hit Big-Gun Beardsley!" howls one of th' codfish snailers, like he couldn't believe his eyes—an' th' whole circle of was-gonna-be attendants to my funeral instantly evaporates in all directions.

Removin' Big-Gun's belt, I buckles it on; then pickin' up th' dethroned emperor of Ouglamuck's howitzer, I advances up th' hill an' takes possession of th' office. There ain't nothin' much in it to take possession of, however, because, as th' looney-lookin' tradin'-store clerk explains, th' bookkeeper had took a notion to quit a couple days before an' burned up all th' books an' company correspondence. Alaskan codfish-station bookkeepers always burns up their books when they quit—it simplifies matters a lot for their successors.

Locatin' th' company superintendent-shack, I throws out all th' pots, dishes, an' old clothes I finds in it; an' when Big Gun comes to life, I orders him to pack his truck into one of th' fishermen's shacks—which he does with a dazed, stupified-lookin' expression, like he couldn't decide whether he was only sufferin' from a mince-pie nightmare or gone plumb cuckoo.

A little later, Double-Cross Picketts comes breezin' in like he is after somethin', but when he sees me, he seems to change his mind.

"Excuse me," he splutters, startin' to back out, "I didn't know you were goin' t' live here."

"Well, I am—an' I'm gonna stay here, too!" I barks. "Where's Big-Gun's squaw?"

"Big-Gun's squaw," he repeats, stutterin' like he was so rattled he'd forgot his own name. "Why, she—she's visitin' her Siwash relations down to Unalaska Island——"

"When Mrs. Big-Gun gets back," I says, givin' Picketts a hard, straight look in th' eye that sends him grabbin' fer th' door-knob, "you can tell her that so long as her old man acts decent, he is fisherman straw-boss—but from now on I'm th' guy who's runnin' this here camp. Get me!"

"Yezzir!" says Picketts, turnin' th' color of skimmed milk; an' he excuses himself out'a th' door.

THE next day, I chooses a site up on the hill above the codfish company's building for th' new wireless station. I decides where to set the two masts, lays out the positions of the different sets of mast-guy anchors, and marks off the foundations of the power-house and receivin'-shack. But when I goes to start th' codfish snailers to work packin' lumber an' gear up onto th' hill from th' wharf, I runs against a snag.

"We ain't here to work—we only fish," th' bunch in th' bunk-house informs me, very respectful-like, but with all th' indignity of a assembly of crown princes. "Th' Siwashes up in th' village does all th' common work."

I tries to argue with 'em, but I soon sees they'd sooner be shot than work; so I hikes up to th' Aleute settlement on th' hill. I discovers th' village priest, a old chimpanzee-faced grasshopper with forty years tobacco-juice coagulated in his whiskers, out in front of his ramshackle, saggy-roofed shrine, busy shinin' up an old brass ship's bell set up on a post alongside th' one-hinge door. I ascertains there are thirty-five employable braves in th' village; an' after spendin' three hours convincin' th' old soul-merchant that *wirelessuck* is absolutely disconnected with th' devil, I finally gets him to agree to his bucks workin' on th' station.

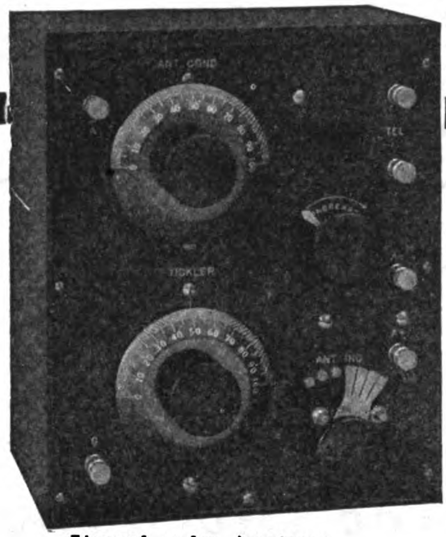
Early next mornin' the natives report for work—an' no radio engineer ever had a classier construction-gang than my thirty-five flat-faced fish eaters with their super-intellectuality of solid granite. I sets one crew to packin' lumber an' other materials up from th' wharf, details another detachment to begin drillin' up on th' hill in preparation for blastin' out holes for the mast-guy anchors, an' puts a third division to clearin' away th' snow an' makin' ready for th' power-house an' receivin'-shack foundations.

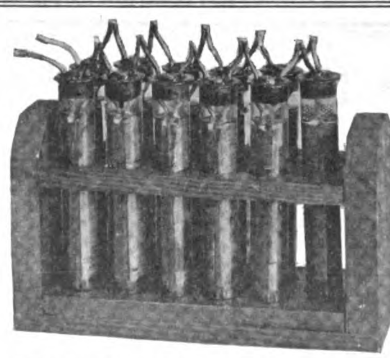
Just when everything is gettin' nicely started, there suddenly begins a slow, imperative clanging, like a city fire-alarm, up in th' native settlement; an' lookin' toward th' village, I sees that old tobacco-whiskers is out bangin' on his bell. With th' first *clang,* all my Siwash construction-crew drops their drills an' shovels, or whatever they had in their hands an' strikes out for th' village—an' with th' last *dong,* they are all enveloped in th' dog-house shrine. There is no more work that afternoon. The next day th' same performance takes place again. Th' third day I am gettin' pretty infuriated — an' then Double-Cross Picketts comes along an' offers to explain it.

"It's old Two-Bits, th' priest," says Double Cross. "He's s'posed to have some kind of a mysterious spirit roostin' with him up there in th' salmon-eaters' temple; an' when this here spirit tells him to, he calls in all th' Siwashes by whangin' on th' bell an' collects a quarter apiece from 'em—then th' services is over till th' next time. But they can't work no more th' same day."

Thankin' Double-Cross for this information, I hikes up th' hill to see old Two-Bits.

"Hereafter, when that spiritualistic quarter-snatcher 'a yours starts naggin' ya, it'd be a lot more convenient fer both of us if you'd just breeze down to th' office an' take a check fer th' whole amount," I suggests, politely—and old





Two-Bits agrees that it would.

Five weeks later, I runs the cement for my generator and engine foundations. The power-house is pretty well along now, but no roof on yet. Th' temperature is stickin' around thirty below zero; and as freezin' will ruin freshly-run concrete, I sets up an old cook-stove over the cement forms an' details a couple of Siwashes to carry a red-hot fire, to keep th' place warm.

Late that night somebody comes thumpin' an' hammerin' on my shack, raisin' such a infernal racket that sleepy an' tired as I am, I have to get up. Goin' shiverin' to th' door, who does I find outside but old Two-Bits.

"Check!" he chirrups, comin' directly to th' point, an' stickin' out his mitt.

"Say, look here, you pestilential old flea, ya been down to th' office twice already today fer a check!" I barks. "Ya better send that confounded graft-grabbin' spirit 'a yours off to th' country fer a rest!" With this I slams th' door shut in his face an' jumps back between my blankets. Half-an-hour after, as I doze off to sleep, I seems to hear th' distant ringin' of a bell—an' in th' mornin', when I struggles out through th' icy wind to th' power-house to have a look at my cement foundations, I finds th' stove cold an' deserted, th' concrete forms froze an' busted, and my templets which it took me two weeks to line up all warped to th' devil.

Spoutin' a Mississippi River of cusswords, I catapults up to th' village; an' draggin' old Two-Bits like a squeakin' weasel out of his hole, I bangs his bewhiskered nut against his blasted bell until I figures I've bumped his trouble-raisin' spirit humbug out of him so complete that it'll take it five years to get admittance back into his belfry again.

The following week, I have th' five foundation molds remade, th' templets reset; and I runs th' cement again. That night I wakes up to find another cold snap comin' on. I gets up right away an' beats it out to th' power-house to fire up th' cook-stove myself, not carin' to take any more chances on th' peanut-brained Siwashes. Besides, a couple of cases of th' high-percentage dynamite I was usin' to blast out th' holes fer th' mast-guy anchors had disappeared mysterious-like durin' th' day, an' somehow I was feelin' a uneasy presentation of impendin' devilment.

About one o'clock in th' mornin', as I was sittin' dozin' by th' red-hot stove in th' power-house, th' whole island is suddenly shook by a terriffic jarrin' *w-h-o-o-m!*—an' then rocks an' boards comes rainin' down with such a crashin' racket that I wonders if all three of th' Ouglamuck volcanoes have blowed up together. It was too dark then to see what really had happened, but in th' mornin' when I looks out, I discovers

that th' superintendent-shack I have been livin' in has completely disappeared out of existence—th' place where it had stood lookin' like a shell-hole in Flanders.

Steppin' out to have a closer look, th' first citizen I runs onto is Big-Gun Beardsley.

"I never done it! I never done it!" he yelps, backin' away, his face turnin' th' color of a dirty blanket. "Honest, I never done it!"

"Who's accusin' ya?" I inquires, gently quietin' him down with a convenient chunk of lava-rock.

WHILE waitin' for th' concrete-work to set, I prepares to raise the two masts. After three days of heavin' an' pullin', gettin' up a pair of heavy fifty-foot shear-legs, a screechin' hundred-mile gale comes whoopin' over th' island an' leaves our work about as conspicuous as a couple of frankfurters five minutes after you've given 'em to a hungry kyoodle.

Th' second pair of shear-legs goes sailin' off into th' Bering Sea th' same way, but th' third time, I gets them to stay long enough to set up th' mainmasts —two sawed timbers twenty inches square and ninety feet long. This accomplished, I prepares to send up th' sixty-foot topmasts, which are also sawed timbers, a foot square, and fitted to be spliced to the mainmasts with heavy iron clamps.

We starts up th' first topmast, with a tackle rigged, of course, so that all heavin' is done on the ground; and when th' topmast begins to rise above the mainmast-head, I details four gangs of Siwashes to slack away th' four sets of stays as th' timber goes up, so as to keep it perpendicular. Siwashes get dizzy when they are elevated more'n twenty-one inches off'n th' earth; so while they heave on th' tackles and slack off th' stays, I have to camp all alone on th' mainmast-head to keep everything workin' smooth.

At last the topmast has come up nearly into place—and then while I am roostin' up there ninety feet above th' world, with that heavy topmast-timber swayin' up into th' clouds above me, what does I hear but th' slow, dismal *dong dong dong* of Two-Bits' infernal bell—and instantly all my mud-headed Siwash riggin'-crew lets go of tackles, stays, foot-ropes, an' preventers, an' goes gallopin' off to answer th' call of th' quarter-collector, leavin' me an' my wireless-pole to start swingin' down through space with th' graceful, breath-catchin' swoop of a shootin' star.

Almost before I can realize what is happenin', th' whole world rises up an' hits me in th' back—an' th' next thing I know, I feels myself in a dim, far-away dream, bein' carried down th' hill

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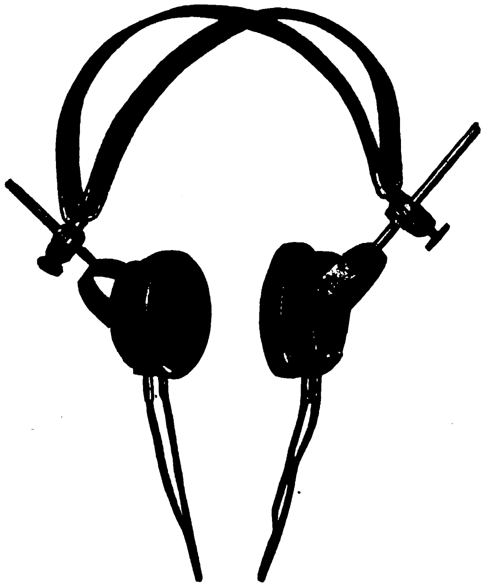

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UP—513, .25 "	UP—522, 1.75 "
UP—514, .30 "	UP—523, 2.00 "
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by th' sourdoughs. After while they lays me down on th' snow; an' then I can faintly hear Big-Gun Beardsley an' Double-Cross Picketts arguin' whether to take me to my shack or bury me right away.

"Th' ground's froze too hard— we can't dig it," I hears Double-Cross sayin', like somebody a thousand miles away. Finally they lugs me into my shack an' leaves me there.

Some time in th' night, I comes to, to find a lantern burnin' alongside me an' old Two-Bits standin' over me with a dried bear-paw in one hand an' a rusty fish-head in th' other, industriously spielin' off some kind of a Siwash incantation racket. When he sees me blinkin'at him, he leaves off his black magic an' drops down on th' floor.

"Me no ring bell!" he blubbers, over an' over. "When him ring, me sleep—me no know who ring!" He is shiverin' like a sick cat, an' I can see he's tellin' th' truth. Afterwhile he goes away with his salmon-head an' grizzly-paw medical equipment, and I falls into a good sleep.

In th' mornin' I gets up feelin' all right, except for a slight pain in th' back like I'd been kicked in th' pants by fifty thousand army mules. A little unsteady, I perambulates up to th' company cook-house an' strolls in just as th' codfish snailers are settin' down to breakfast. They all seem to be discussin' my defunction real rejoiceful-like—until they sees me steppin' toward my seat at th' head of the table. For about fifteen seconds there is a dead silence in that cook-house shack that would have made th' stillness of th' tombs of Egypt sound like a scandal in a boiler-shop—then synchronously decidin' not to bother about eatin' any breakfast, they gracefully displaces themselves out of th' ham-an'-eggs hang-out, takin' most of th' window-sashes with them as they go—all except Big-Gun Beardsley, who couldn't leave because he'd fell over flat on th' table, with his face stuck in a pot 'a mush.

After this, there follows a few days of peace. Then one afternoon a little sail-boat drops into th' harbor; an' pretty soon Double-Cross Picketts brings me some news.

"Spitzka Tillafagafanouck, th' Siwash queen 'a Attu Island has heard about ya, Unkillable," he informs me. "She's come t' give ya th' once over, an' if she likes your looks, she's gonna marry ya."

"Looks like there's always somethin' interestin' goin' on round this unpeaceful island, don't it?" I comments.

"She's nicknamed Th' Husband-Snatcher," resumes Double-Cross, cheerful-like. "She's buried a man reg'lar every winter fer th' last twenty-eight years, besides a few odd ones in between

—an' now she's out scoutin' after another victim——"

"Lissen, Picketts, I ain't scared of no darned female on earth," I commences to orate—an' then I sees somethin' approachin' in our direction that freezes me cold. Comin' down th' trail is a Siwash battle-axe so ugly that—well, Shotgun Sykes over at Unga is married to a old squaw so horrific-lookin' that when Shotgun sends a photo of her to his aged parent back in Pennsylvania, th' old man keeled over dead when he saw it—an' Shotgun Sykes' old hag is pretty as a handful 'a orange blossoms alongside of this female nightmare which appears to have struck Ouglamuck Island.

"A-a-a-h, you *wirelessuck!*" she clicks, gazin' at me with th' sweet, amorous smile of a Rocky Mountain wild-cat fixin' to jump on a chipmunk; "u-m-m-m—fine man!" Her snappin' tar-black lamps nails me fast to th' spot, like a squab pigeon hypnotized by a rattlesnake, an' I can't budge or speak till she goes away.

"You're done fer, you're done fer," doles Double-Cross Picketts, like a funeral chant. "You're absoposilutively done fer—nobody she made up her mind to marry has ever got away from her."

"Who's afraid 'a that old buzzard-faced eater of rotten salmon!" I sputters, breakin' out of my trance an' tryin' to act indifferent-like, though th' cold shivers are still playin' leap-frog up an' down my back-bone.

"Wait—just wait," jangles Picketts, like a chime of weddin' bells.

But I don't wait. Both the masts are up and well-guyed by this time; and now, pitchin' th' parts of th' diesel-engine together, I belts it up to one of th' small direct-current generators, an' hangin' up a bunch of big mazda-lamps with some rough grape-vine wirin', I makes my workin' hours from six o'clock in th' mornin' to midnight. I had been kinda thinkin' of stayin' at Ouglamuck an' holdin' down th' superintendent berth for a while, but now my ambition has got converted into a desperate intention of gettin' this confounded wireless-station to workin' long enough to locate th' nearest floatin' craft, an' then to beat it off th' blasted island before that blood-curdlin' combination of a toothless rhinoceros an' a devilfish gets her deadly tentacles around me an' drags me down into th' black sea of squawtrimony. You may think it wasn't nothin' to get such frozen feet about—but if you ever have a Queen Tillafagafanouck come sailin' after you——

A few days later, as I finishes settin' up th' main alternators an' begin assemblin' th' transmitter-panel, I observes that all th' squaws an' dirty-faced kids up in th' village are embellishin' th' walls an' roof of th' soul-savin' hang-out with fresh green spring-alder branches. That night, while I am toilin' by electric light, throwin' condensers, synchronous-gap, and sendin'-transformer into workin' relations, all of a sudden I feels somethin' like a cold steel blade stickin' me in th' back, an' jerkin' around quick, I finds th' Queen 'a Darkness is standin' in th' door, smilin' at me as beautiful as a starvin' timber-wolf.

"Me marry you," she slithers, with th' caressin' tenderness of a female gorilla, as I stands froze to th' spot with the rotary-gap disk in one hand and a crescent-wrench in th' other. "To-morrow night!"

That evening I don't stop work at midnight. In fact, I never stop no more at all. After that it's just one wild dash, slingin' together receivin'-gear, audions, aerial-switch, sendin'-key, voltmeters, rheostats, lead-in, all flyin' around in one mad tangle of wires, tape, an' tools. As darkness comes again and I sees all th' village turnin' out dolled up in their Sunday's-best fur-hides an' beginnin' a bonfire parade beatin' on pots, kettles, an' dish-pans, I have already throwed the transmitter into some kind of tune an' got hold of th' government Bering Sea patrol, *"Seals Protector."*

"Come full speed fer Ouglamuck!" I whoops on th' key, th' minute I makes connection. "There's a fleet of fifteen Jap seal-poachers showed up ten miles off th' island—make a dash before they get away with every fur-seal in th' place!"

Of course this is a big lie, th' only Jap in sight bein' Fried-Beans Mino, th' codfishermen's cook, but I figures that anything is justified in such a emergency as this. Before I can hear th' cutter's answer, a dark, icy chill slowly settles over th' shack like the cold dead breath of th' Arctic; an' glidin' in through th' door with th' slipperish stealth of a scaly poison snake comes Queen Tillafagafanouck, dressed in flowin' Siwash weddin'-robes of red-fox fur, and a wreath of green alder sprigs droopin' around her cranium.

"Come!" she commands in a blood-freezin' yowl, like a bloodhound at th' throat of a escaped convict. "Me marry——"

But I never hears th' rest, because I crashes out through th' window like I was th' projectile of a German seventy-mile gun, an' makes one headlong leap down th' half-mile trail to th' beach, intendin' to grab a dory or a rowboat, or a piece 'a plank, or anything—but down at th' wharf, I finds Double-Cross waitin' in a power-boat with th' engine runnin' an' all set to go.

"You're a friend in need, Picketts!" I pants, as I swoops aboard in one flyin' dive. "Shove off!"

Early next morning, we meets th' *"Seals Protector"* twenty miles off th'

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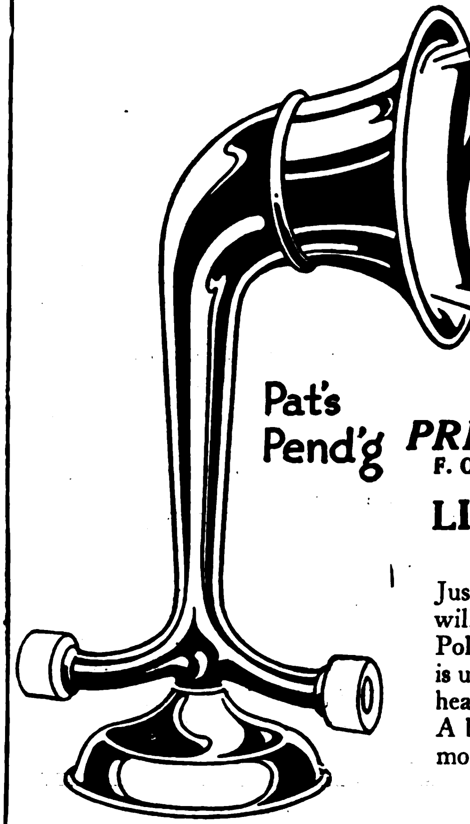

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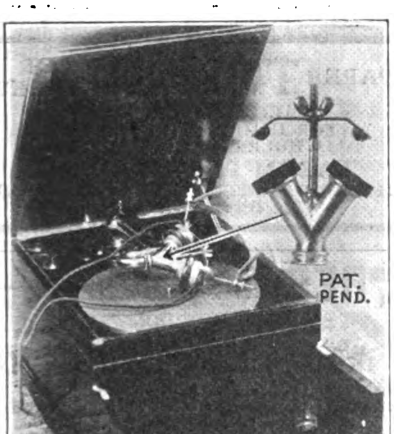

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island. Bidding good-bye to my one best friend, Picketts, I gets aboard; and when I feels th' good old ship's deck under me, I collapses with pure relief. Th' next day, when th' cutter is already half-way to Unalaska, I starts explainin' things to th' captain.

"I downed that fire-belchin' fish-boss, Big-Gun Beardsley, easy enough," I says, "but when that Queen Tillafa-scratchalot——"

"Big-Gun Beardsley!" exclaims th' grizzled old skipper of th' *Seals Protector,"* surprised-like. "Big-Gun Beardsley is not the fish-boss at Ouglamuck — he's only a common ornery Alaska bad-man. The boss's name is Picketts—Double-Cross they call him. Queen Tillafagafanouck is his wife."

"Well, of all tha——" I begins—but it's no use puttin' down what I said after that, because I know th' editor won't print it, anyway.

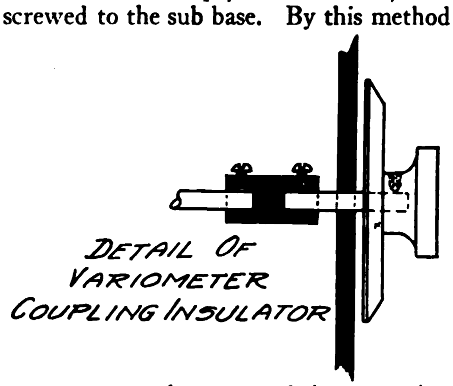
N. B.—The falling of the wireless-mast related above—except that the real cause of the accident is still a mystery—is a true incident, which happened to the author while constructing the radio station at Pirate Cove, Alaska (KOXN). I actually fell over seventy feet onto frozen ground, and regained consciousness several hours later uninjured, except for a blood-blister under one finger-nail—to the vast chagrin of some of my sourdough friends. The inhabitants of the Shumagin Islands regard my escape as a miracle—which it undoubtedly was. *V. G. M.*

200-5000 METERS REGENERATIVE RECEIVER

Continued from page 19

on how to make a bank winding, so this will not be treated here.

With the coils completed and tested for use, the panel grained and finished and condensers mounted, proceed to mount the variometers, then the coils. The photos show the method of mounting the coils; thin sheet brass angle strips were bent to shape, holes drilled, and screwed to the sub base. By this method



any part may be removed for attention at any time. The variometers and coils set about 1½ in. back of the panel. The ¾ in. insulator bushings break up the shafts on these and coupling, which helps in getting rid of hand capacity effect. The copper shield is cut to have each unit, except the main primary and secondary coils, covered, a strip being left to connect each section of the shield. The photo shows how the main coils are related in the assembly, but the panel drilling will take care of that.

The circuit used is one of the earlier Armstrong's—fones in the filament line, with a switch on the audion control to shift the fones to the plate line. The long waves require, for a sure fire effect, the fones in filament line. On the short waves this will also do nicely and is very sharp in tuning, but there seems to be some advantage on concerts, etc., by having the fones in the plate line. A fixed mica by-pass .001 condenser may be used.

The wiring diagram should be followed strictly—there is an advantage in so doing. The plate variometer as well as the grid are both in the lower legs of the circuit, and the coupling ring is next to grid.

In operating, for 200 to 375, we switch out the secondary condenser, and of course the secondary coil. Also, the primary switch is placed on short, which gives us essentially the standard variometer short wave set, and it is operated accordingly. Fones may be on long or short, but short will probably be best.

For 600 to 1200 meters we may leave the fones still on short. The third tap of secondary coil is brought in, as well as the secondary condenser, to about 10 points. The primary is advanced to tap 5 and condenser 50. It will be found that the set now operates as before, only on 600 meters, the feed back of plate variometer on the coil giving good regeneration at about 50 points. The grid variometer is turned to zero. Or, the grid variometer may be used as a condenser, placing the condenser at zero, but leaving it in the circuit. This will give us variometer tuning on 600. The difference in signals will be very slight, speaking well for the secondary coil, of which three taps are in use. Or, a third way is to cut out the secondary coil entirely and tune with the combination of secondary condenser and grid variometer. The first method is preferred by the writer.

The coupling may be used either side of the vertical at about 15 degrees from vertical, which is rather loose, and with proper plate variometer in use, extremely sharp. The coupling dial is set on, so that 50 points marks the coupling ring at right angles to the primary.

Passing on thru the various waves from 752 to 1900 meters, the coupling will be better in the vicinity of 45 points, or left of vertical.

With all the secondary coil in use, and practically all the primary, for waves

2000 to 3000, there will be some feed back between the two main coils, and now the coupling must be on the other side of center, or about 65 to 70. In effect, it loosens or uncouples the two main coils.

On arc stations 3000 to 5000, the coupling will be near 50, and fine whistling click points may be obtained by varying coupling.

These click points may be found on any wave in the range of the set by having the coupling at approximately the settings given and causing the bulb to oscillate by overdose of tickler. By swinging the primary or secondary condensers if on long, or the primary condenser and grid variometer if on short, one may readily tell how near the circuits are in resonance, and more important, how sharply tuned, as when the silent point in shifting the condenser, covers several degrees, it may, by changing coupling whichever way needed, be made so sharp as to make one degree throw the circuits off resonance if a spark is wanted, or cause an arc to amplify nicely at the spill over point.

The coupling is very important, and makes a big difference in sharpness and amplification, provided the circuits are in resonance and the tickler is brought to near the spilling point. If, however, no attempt is made to take advantage of loose or proper coupling and the plate is carelessly tuned, much of the amplifying properties will be missed. The point to keep in mind is to make the set do on all waves as it does on the short end, and it will do it with good amplifying factor.

NAA, for instance, is tuned as follows: We know his secondary setting is all the secondary coil, and condenser 25. We also place our primary on 11th tap, put the condenser in shunt to 10 degrees and bring tickler to about 60, where it will spill, or should, if fones in filament, and bulb and batteries in good shape. If the coupling should be at 45, immediate increase of signal strength will be noticed by changing to 60. The primary condenser, or secondary, should be moved a shade, to see if a point can be found which will give the natural spark tone, which would indicate resonance. If now we are sure we have the exact tuning point, after several trials we advance tickler gradually and also coupling. The tickler may stand five degrees, anyhow keep it just under spilling, and advance the coupling. At about 70 degrees the signal will have an increase in amplification of about four times over the start.

By using a special 27 plate or slightly larger secondary condenser, the range of receiver may be increased by also loading the primary. Under no circumstances would I increase the dimensions of the secondary coil, as it is right. I

have successfully loaded the set up to POZ, but this is another matter, and could be done in various ways. It speaks well for the circuit and the plate side, however, to carry oscillations up to this point without changing filament. I leave filament rheostat at one point for all waves.

The circuit used has been used by me for the past five years and is economical on filament battery, easy on the tube (I have an old tube which must have lasted its natural life about four times), and very sure in results. It is far superior to any circuit I know of, and I have tried all of them. The so-called ultra audion is similar, but not the same.

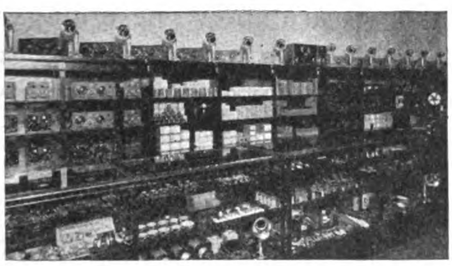
In closing would say that the beginning of primary winding should go to the aerial post. The beginning of the coupling ring winding, when it is turned full inductive close coupling in the primary core, should go to the grid post, and the end of winding, which would be the part of ring outside of primary coil, should go to the grid variometer. With this polarity and the coupling ring turned right angles, or 50 points on dial, then turning to left or toward zero, will close couple inductively, and turning to right or towards 100, will loose couple, by means of reversing the winding terminals, in the case of long waves, though it would close couple again on short waves, 50 to 100, but with reversed terminal effect.

The coupling values given apply to the wiring being done as stated in this paragraph. Needless to say, the variometers should be studied and dials put on so that the inductive value increases turning to the right. And in the case of the plate variometer this must not only obtain, but the polarity of terminal to plate must be such that a feed back effect on the longer waves is obtained when the secondary coil is put into the circuit. Primary and secondary switches increase to left.

With close attention to details, perfect mounting of switches so that perfect contacts are made, and especially in operation, see that the contact is good on the first tap of secondary coil, when this is to be thrown out of the circuit (as otherwise, by reason of end of coil being

shorted to switch, the whole coil effect would be in when not wanted), I think the experimenter who will construct one of these receivers will be more than pleased, and with increasing interest with experience in operating and finding the fine points of merit which exist, and which have proven themselves time and again. In fact after some experience one can lay down rules for operation which will prove the best for the various waves and exact calibration, which will minimize the seemingly many things to do in tuning.

The set is just as easily handled on any wave as the standard 200-600 meter set, and if carefully made, together with good audion control, batteries up in voltage, etc., no troubles will be had in operation. No need to change audion controls, fone or grid condensers, if right for the tube in use.



Interior of Salesroom

MODIFY RADIO REGULATIONS

Continued from page 20

ings shall not come nearer than four (4) inches to electric light and power wires unless separated therefrom by a continuous and firmly fixed non-conductor that will maintain permanent separation. The non-conductor shall be in addition to any insulation on the wire.

Lead-in-wires shall enter building through a non-combustible, non-absorptive insulating bushing.

PROTECTIVE DEVICE

c. Each lead-in-wire shall be provided with an approved protective device properly connected and located (inside or outside the building) as near as practicable to the point where the wire enters the building. The protector shall not be placed in the immediate vicinity of easily ignitable stuff, or where exposed to inflammable gases, or dust, or flyings of combustible materials.

The protective device shall be an approved lightning arrester which will operate at a potential of five hundred (500) volts or less.

The use of an antenna grounding switch is desirable, but does not obviate the necessity for the approved protective device required in this section. The antenna grounding switch if installed shall, in its closed position, form a shunt around the protective device.

PROTECTIVE GROUND WIRE

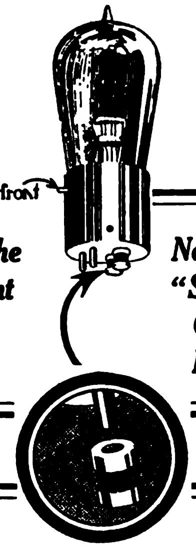
d. The ground wire may be bare or insulated and shall be of copper or approved copper-clad steel. If of copper the ground wire shall be not smaller than No. 14 B. & S. gage, and if approved copper-clad steel it shall be not smaller than No. 17 B. & S. gage. The ground wire shall be run in as straight a line as possible to a good permanent ground. Preference shall be given to water piping. Gas piping shall not be used for grounding protective devices. Other permissible grounds are grounded steel frames of buildings or other grounded metallic work in the building and artificial grounds such as driven pipes, plates, cones, etc.

The ground wire shall be protected against mechanical injury. An approved ground clamp shall be used wherever the ground wire is connected to pipes or piping.

WIRES INSIDE BUILDINGS

e. Wires inside buildings shall be securely fastened in a workmanlike manner and shall not come nearer than two (2) inches to any electric light or power wire unless separated therefrom by some continuous and firmly fixed non-conductor making a permanent separation. This non-conductor shall be in addition to any regular insulation on the wire. Porcelain tubing or approved flexible tubing may be used for encasing wires to comply with this rule.

Continued on page 92



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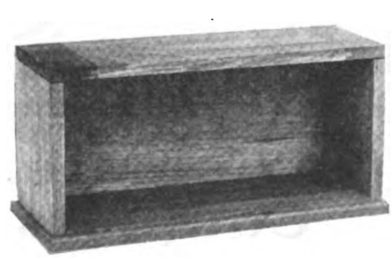

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NEW DX RECORD

Continued from page 33

possessing efficient transmitting sets were primed to cover what would be to them a record distance. Hence, at one time the writer heard no less than eight stations, from CL8, at Camp Lewis, Wash., to 6ZZ, at Douglas, Ariz., all frantically calling 6ZAC. And Dow was kept busy answering them, one after another and clearing whatever traffic they had for him. At times his signals were so loud that with the aid of a two step amplifier and an ordinary loud speaker, they could be copied in any room of a five room house, which will give some idea of how well Dow was getting across. On this same Saturday night, one of his tubes became defective and he has been working the coast ever since on ONE 50 WATT TUBE, with about the same signal strength, the only difference being that the note is rough and not so easy to read as when both tubes are in the circuit.

Wonderful work has been accomplished by Atlantic and Pacific Coast amateurs in the past, using a group of 5 watt tubes, or one or more 50 watt tubes, but it is thought that Dow has set the pace for real DX, where the calling station calls three times, signs his own call the same, and receives immediate answer from the distant station. Records made only as the result of continuous calling for fifteen minutes at a time cannot be considered remarkable feats with C. W. at the stage of development which it now enjoys, and only serve to cause unnecessary interference. With a chain of efficient C. W. stations scattered at distances of 1000 miles, across the continent, and Dow's station at Wailuku, we can expect New York-Honolulu relays as a nightly occurrence, with a minimum of interference, and the maximum of interest.

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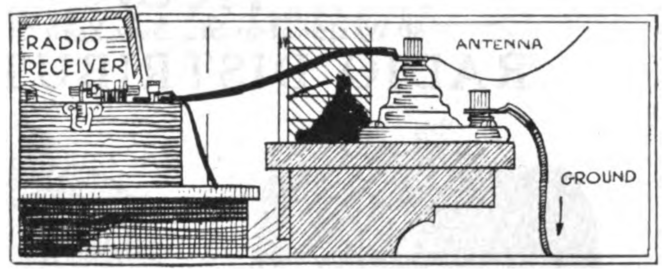

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50c pays for a lump of "Cascade" Galena—enough for 6 or more detectors. Also supplied in bulk or granules. Discount to dealers.
HARRY G. ALLEN CO.,
908 E. Post St., Seattle, Wn.
Distributors for Kilbourne & Clark Radio Equipment

A POSTAL CARD

Will Bring Our Latest
RADIO FOLDER
THORDARSON ELECTRIC MFG. CO.
513 S. Jefferson St. CHICAGO

BRONX RADIO EQUIPMENT CO.

Manufacturers of Quality

VARIOMETERS
VARIOCOUPLERS
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RHEOSTATS
CRYSTAL DETECTORS
INDUCTANCE SWITCHES
BAKELITE PANELS, SHEETS AND TUBING
TRANSFORMERS
DIALS
PLUGS
JACKS
LIGHTNING SWITCHES
GRID CONDENSERS
SOCKETS—Single, double and triple
SWITCH POINTS
BINDING POSTS
SPAGHETTI
WIRE—Bare copper and D. C. C.

Dealers' and Distributors' Propositions Open

IMMEDIATE DELIVERY

Manufacturers and Distributors
687 Courtlandt Avenue Bronx, N. Y. C.

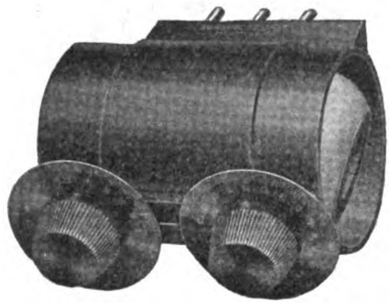
HAVE YOU SUBSCRIBED?

YOU CAN SAVE A DOLLAR BY MAILING US YOUR SUBSCRIPTION TO "RADIO" BEFORE JUNE 30TH.

SHIP OWNERS RADIO SERVICE INC.

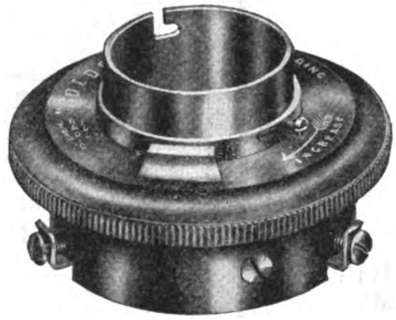
80 Washington St., New York City

RADIO DISTRIBUTORS



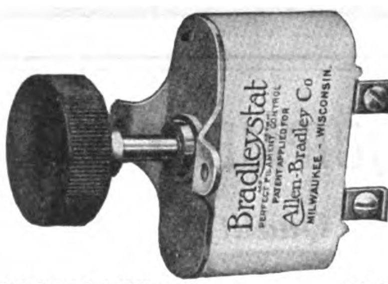
SORSING "TUNIT" . . $15.00
PAT. APPLD. FOR

The "Tunit" is a balanced primary attachment for use with the standard triple coil mounting, allowing ultraefficient reception on wave lengths from 160 to 600 meters.



"SOCOSTAT" $2.50

Combination Rheostat and Socket for table or panel mounting. The knurled disc will fit through a panel slot. The socostat is a space-saver.



"BRADLEYSTAT" $1.85

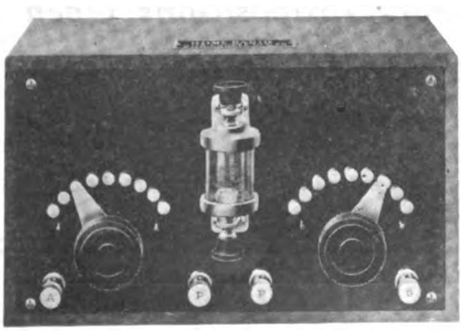
A self-contained, Vernier adjustment rheostat operating on the graphite disc principle. Ideal for multi-tube control in Radio—frequency circuits. Will carry up to 2½ amperes on 6 or 12 volt circuits.

"FRAMINGHAM" RHEOSTAT, $1.00

The only rheostat incorporating a panel brushing to give rigidity. The detail of construction and design makes this a highly desirable instrument. For table or panel mounting.

Purchase from your dealer

IMMEDIATE DELIVERY!



Special Glass Enclosed Dust Proof Detector.

Super Sensitive Crystal Set in Woods Metal.

Formica Panel.

Bakelite Knob.

Handsome Appearance.

Size 5½x9½x3.

DEALERS:—Write for Our Proposition

D. H. McGORKLE MFG. CO.

319 12th ST. OAKLAND, CALIF.

MODIFY RADIO REGULATIONS

Continued from page 87

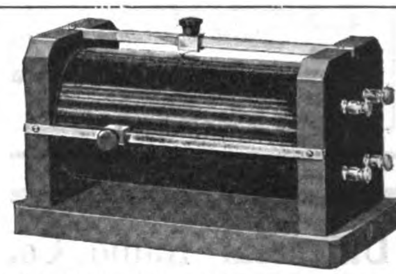
RECEIVING EQUIPMENT GROUND WIRE

f. The ground conductor may be run inside or outside of building. When receiving equipment ground wire is run in full compliance with rules for Protective Ground Wire, in Section d., it may be used as the ground conductor for the protective device.

BY 6ZD (OLD 6APP) AT 1258 W. PIERCE ST., PHOENIX, ARIZ.

Spark—5aa, 5by, 5az, 5if, 5lc, 5oh, 5pd, 5pp, 5qa, 5xa, (5xb), (5xd), (5xj), 5xt, (5xu), 5yi, 5yo, 5yk, 5yl, 5yn, 5za, 5zc, 5ze, 5zf, 5zj, 5zl, 5zr, 5zs, 5zu, 5zw, 5zx, 5zaa, 5zab, 5zae, 5zaf, 5zag, 5zak, 5zai, 5zam, 5as, 6bm, 6dw, 6eb, 6er, 6ex, 6fi, 6fh, 6jw, 6jy, 6ka, 6kc, 6hc, (6hy). 6if, (6gp), (6lc), 6le, 6mh, 6ny, 6nl, 6od, (6oh), (6ol), 6ot, 6pj, (6pp), 6pr, 6po, 6qt, (6qr), 6rs, 6sj, 6su, 6tf, 6vx, 6vm, 6vz, 6wz, 6zk, 6zu, 6zx, (6zz), 6zaa, 6zal, (6zam), (6xh), 6aau, 6abh, 6abw, 6abx, 6ael, 6aeh, 6acn, 6adn, 6afu, 6aif, 6afp, 6agf, (6agp), (6ain), 6ajf, (6ajr), 6ajl, (6ajh), 6akl, 6alv, 6amk, (6ama), 6ang, 6aor. 6ape, 6aph, 6apo, 6ark, 6ask, (6ath), 6auc, 6aud, 6avn, 6aso, 6asj, 6if, 6aoi, (6atq), 6baj, 6bbo, 6bgg, 7bh, 7bk, 6ck, 6fi, 5iw, (7jd), 7jw, 6ln, 7ly, (7mp), 7mu, 7gp, 7ry, 7tj, 7vo, (7ya), 7yg, 7yj, (7zm), (7za), (7zt), (7zv), 7zu, (7zs), 9aeg, 9dsd, 9dze, 9wu, 9zx, 9zn, 9zt.

C. W.—4as, 4by, 4gl, 4xf, 5an, 5ci, 5dz, 5ek, 5hh, 5sb, 5za, 5xj, 5xu, 5zac, 5zag, 5zak, 6ak, 6eb, 6en, 6gr, 6jd, 6jf, 6ka, 6ky, 6rr, 6xad, 6xaf, 6sh, 6za, 6zaf, 6zb, 6zt, 6zq, 6zz, 6aat, 6ale, 6alu, 6aoz, 6avy, 6awt, 7zu, 9amb, 9bji, 9zyu, 9ble, 9dtm, 9dth, 9dva, 9nx, 9wd, 9zaf, 9xaf,



LAMB Tuning Coils. Two nickel sliders and rods; four nickel binding posts. Coil contains about ½ lb. No. 22 enameled Magnet Wire. Mounted in hard wood ends and base. Price $3.00. Code word, ACE.

F. JOS. LAMB CO.

1940 Franklin St. Detroit, Mich.

Radio Head Phones

World's Largest Distributors of

RADIO HEAD PIECES

We represent 30 manufacturers, showing 75 types and designs, priced from $5.00 to $15.00. Following is a partial list of manufacturers:

Manhattan	Levering
Thompson	Everett
Frost-Fones	Electric
American	Leich
Connecticut	Electric
Western	Elmwood
Dictagraph	Holtzer-Cabot
Cory	

Phones on hand for immediate shipment. Ask us for the phone you want. **Special**—100-ohm single receivers made by old reliable telephone maker. List—$2.50. **Agents Wanted Everywhere.** Get literature and discount sheet.

D. E. POLCZYNSKI & CO.

26 Capitol Bldg.—1550 Broadway
Detroit, Michigan, U. S. A.

★ ★ RADIOADS ★ ★

A CLASSIFIED ADVERTISING SECTION READ BY 60,000 BUYERS

The rate per word is five cents, net. Remittance must accompany all advertisements. Include name and address when counting words.

ADS FOR THE JULY ISSUE MUST REACH US BY JUNE FIRST

TRANSMITTING APPARATUS

BARGAIN: 650 volt motor-generator, new windings and commutator, with filter coils and rheostat, $50.00. Honeycomb receiver, complete with DeForest mounting, short wave coils, socket, rheostat, variable condensers, etc., $25.00. D. Skilling, 2960 Linden Ave., Berkeley, Calif.

FOR SALE: Type E. Thordarson ½ K. W. Transformer $15; Benwood gap 10 point, aluminum case, 3450 R.P.M. ⅛ H.P. Westinghouse induction motor complete $30; Murdock O. T. $3.50. Carl Schneider, 76 Caselli Ave., San Francisco.

FOR SALE: ½ kilowatt spark, $45. Will sell separately. Leonard Tate, 807 6th St., Anacortes, Wash.

FOR SALE: 5 watt radiophone transmitter less tube and batteries, $30.00. Uses three 22½ B batteries for plate. Good for 5 to 10 miles voice. Also radio supplies of all kinds. Amateur Radio Shop, 15 Napa Road, Vallejo, Calif.

MOTOR GENERATOR FOR SALE. 1.5 KW capacity, 120 cycles, two bearing machine, ECK make, in good condition. Motor 110 V D.C. Shaft extended for synchronous rotary gap. Price F.O.B. San Francisco, Calif., $65.00 cash. D. B. McGown, 1247 47th Avenue, San Francisco, Calif.

FOR SALE: 1 KW Acme transformer, with protective chokes, new condition—$25.00, rotary gap, 24 studs spark thru type, 8" Micamite disk, 1/12 HP induction motor, 1740 RPM (new) $25.00, glass plate oil immersed condenser, about .006, $10.00. Also have key, and hotwire ammeter (0-2.5, Roller Smith). E. D. Barrett, Merced, Calif.

Two .004 special high voltage (40,000) Dubilier condensers, suited for United "coffin"—$15.00 each; good condition. D. B. McGown, 1247 47th Avenue, San Francisco, Calif.

For sale—Victor Motor Generator, runs on D. C., generates both D. C. and A. C., $35.00. Write for particulars. A. E. Davies, 1327 Grove St., Berkeley, Calif.

RECEIVING APPARATUS

PLANS FOR HOOK-UP, full instructions for wiring, tuning and receiving, cost of parts and other valuable information sent on receipt of 25 cents. This information will save you many dollars and much time. Indispensible to the amateur. Get lectures and concerts free by owning your own. Wavelength 150 to 20,000 meters. Radio Engineers, B 354, Hornell, N. Y.

DO YOU want complete regenerative, honeycomb, tuning and detector unit including 2 tubes, phones, B battery, slightly used, for $70! Write C. Graham, E. 1643 Wellesley Ave., Spokane, Wash.

TESTED GALENA CRYSTALS. From our own mines. Shaped and tested at the mine in best standard hook-up, direct to user. A real crystal, not a pinhead. Twenty-five cents postpaid. Five for $1.00 to group buyers. Ozark Crystal Co., Box 1, Morrellton, Mo.

FOR SALE—Universal Amplifying Transformer, mounted, $4.50; new Remler Cam Switch, $2.40. M. Howe, Canton, N. Y.

FOR SALE:—Regenerative Receiver, Grebe C. R. 5 type, $35.00. Also receiver with two step Grebe C. R. 9 style. Jay Tapp, 126 E. Anaheim St., Long Beach, California.

HAVE QUANTITY SALESMAN'S SAMPLE REGENERATIVES for sale half price. Just the set you want. Wonderfully efficient. Made of best materials by master craftsmen. Encased in beautiful grained leather covered cabinet. Easy to operate; no capacity effects. A wonder for CW and phones. Equals a Paragon. Will be placed on market soon, retailing at fifty-five dollars; will sacrifice samples at $24 each. This is a bargain. Every one in excellent condition; like new. Fully guaranteed. Grasp this opportunity—order one today—now! (Photo free.) Master Engineering Company, Department R, Omaha.

RADIO MADE EASY. Illustrated book in pain English, containing impartial advice for purchasers, rules for erection of equipment, location of broadcasting stations, wireless code, etc., 30c cash. National Radiophone Co., Patton Bldg., Milwaukee, Wis.

Variocoupler and variometer parts for immediate delivery: Variometer rotors (large size) 60c. Variometer sides per paid 60c. Variocoupler 3½" Rotors 50c. Postpaid. A-1 Woodworking Company, 1338-42 San Julian St., Los Angeles, California.

MURDOCK PHONES. With each pair of No. 56 type Murdock Phones we will give as premium one Dubilier mica by pass condenser, suitable for either regenerative or crystal circuits. No. 56 Phones 2000 ohms $5.00 each. 3,000 ohms $6.00 each. Twelve hour service or your remittance returned. Postpaid and insured. The Kehler Radio Laboratories, Dept. R, Obilene, Kansas.

Radio Receiver, intermediate wave complete with detector and amplifier, $110. Short wave regenerative receiver with detector, $40. Compact crystal receiver, $20. Other good values in new and used apparatus. R. Watson, 160 32nd Av. Phone Bay View 793. San Francisco.

For Sale—Custom built Type CR8 receiver with antenna condenser & Series Parallel switch, Remler Variometers & Variocoupler, completely shielded no body capacity, Chelsea Loading coil & Variable Grid Leak built in. Tuska dials. Panel Gordon engraved. Will work loud speaker on one stage. Cabinet 6x21". $180.00.

For Sale—Custom built three stage amplifier, Filament control jacks, Filament ammeter, Radio Corp. Transformers, Paragon rheostats and dials, Panel Gordon engraved Cabinet 6x14". Will work a Magnavox. $135.00.

For Sale—150-25,000 Meter receiver and two stage amplifier. Gordon engraved Panel, complete with 17 QSA coils and stand. Cabinet 6x10". A Beautiful instrument and it works. Jack & pug controls. $150.00. Two Stage Amplifier, with jacks, $45.00. Hyman, 1708 West 23d Street, Los Angeles, Cal. All letters answered.

VARIABLE CONDENSERS: Plates 4c, Rotary Washers 10c dozen, Stationary 5c, Shafts 25c, Supporting Rods 5c, Tops and Bottoms 25c pair, Knobs 15c. Parts for 23 Plate—$1.85; 43—$2.85. Assembled $1.00 extra. Panel and Table Mounting Types. Dials 35c. Gravenstede, 84 Hancock Avenue, Jersey City, New Jersey.

Representatives wanted in every locality to handle standard makes of receiving equipment. We teach you how to install, furnish selling plans, etc. Only small capital required. National Radiophone Co., Patton Bldg., Milwaukee, Wis.

"Here's your chance!" Receiving set com-plete consisting of large variocoupler in neat box, detector, 3000 ohm phones, phone condenser, and large variable condenser. Only $30.00. Don't rush. Chas. Arthur, Rosemont, Pa.

MISCELLANEOUS

SELLING OUT. Below cost two 60 ft. poles and aerial complete, $17, delivered within 20 miles. Write Pierce, 1915 E. Villa, Pasadena.

FOR SALE: Cash only—All new—Paragon RA-10 $58.00, Paragon 10 Watt phone set $59.50, Motor generator $56.50, 1 K.W. D103 Dubilier condenser $40.00, Jewell 0-10 thermo Ammeter $11.00, used 1300 watt transformer $29.75, 1500 watt $32.75, Amrad 1 K.W. Gap $19.75, J-Ray Gap $27.75, R. Stewart, No. 5 Kron Flats, West Lafayette, Indiana.

Salesmen wanted calling on radio trade to handle our line of insulators and condensers, and Vernier attachments. Also our new Projector. M. M. Fleron & Son, 113 N. Broad St., Trenton, N. J.

NAME PLATES and DIALS for RADIO AP-PARATUS: Decalcomania (Transfer Process) and Etched Metal. Highest quality of work, reasonably priced. Prompt Delivery. Mail me your specifications and a quotation will be submitted by return mail. Robert W. McKnight, 723 Pacific Building, San Francisco.

OUR AGENTS ARE CLEANING UP ON PHOENIX DEPENDABLE APPARATUS. WRITE PHOENIX RADIO AND PARTS CO., CINCINNATI, OHIO.

WANTED—A few Western Electric VT-1's, VT-2's and head sets for use in our laboratory. Must be perfect. State quantity and lowest price. Reading Radio Shop, Box 6, Reading, Massachusetts.

7 Strands No. 22 tinned antenna wire 75c per hundred ft.; unassembled detector panels with all parts and formica panel $3.75; DeForest home sets each $30.00; Clapp-Eastham H. R. $32.00; Westinghouse $120.00. Will swap for Grebe apparatus 350 volt motor-generator set, and a Westinghouse set complete. Write for other bargains. If it's radio, we have it. Henry Kulikowski, Ansonia, Conn.

FOR SALE—Kennedy Receiving Set with cab-inet, three stage amplifier, Magnavox, aerial wire (800 feet), batteries, tubes, everything complete for $225. Address all communications to T. S. Boro, Jackson, California.

WANTED—Radio Apparatus and parts of all kinds. Send bulletins, net price lists and delivery sheet. Dealers with surplus stock write giving all information. A. E. Hancock Co., Radio Dept., Austin, Texas.

For radio frequency amplifiers: 50,000 ohm Lavite resistance units, $0.40; .01 or .015 mfd. Signal Corps condensers, $0.40; D. P. D. T. key switches, $0.90; Telephone plugs, $0.45; universal jack, $0.40. Bargain list for stamp. Western Instrument Repair Co., 314 N. Fairfield, Chicago, Ill.

PATENTS

PATENTS ON RADIO—My special experience and compilation of patents and literature enables me to advise inventors and manufacturers on radio inventions and patents. JOHN B. BRADY, Ouray Building, Washington, D. C., formerly with Radio Division, Navy Department, and Secretary, Government Radio Board, Investigating radio patent situation.

INSTRUCTION

BKUMA YRLSBUG—TWO HUNDRED be-ginners tell how memorized wireless code in thirty minutes to two hours. Booklet, 10 red stamps. Dodge. Box 220, Mamaroneck, N. Y.

TELEGRAPHY—(Morse and Wireless) and Railway Accounting taught thoroughly; big salaries; great opportunities. Oldest, largest school. All expenses low—can earn large part. Catalogue free. DODGE'S INSTITUTE, Hass St., Valparaiso, Indiana.

RADIO BOOKS

"Arc Radio Manual," published by the engi-neers of the Federal Telegraph Company of San Francisco, and written in simple, interesting manner. Well illustrated with diagrams and photographs of the various types of arc radio apparatus used on shipboard and in shore stations. Price $2.50 per copy, postpaid in the U. S. For sale by Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

"License Quiz Book," for passing the U. S. Government radio examinations. The most popular selling radio book. Contains 106 pages of radio information. 80 illustrations. 250 questions and answers. Deals with every new radio development. Price $1.00 per copy, postpaid anywhere in the U. S., or given free with a one year subscription to "RADIO." Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

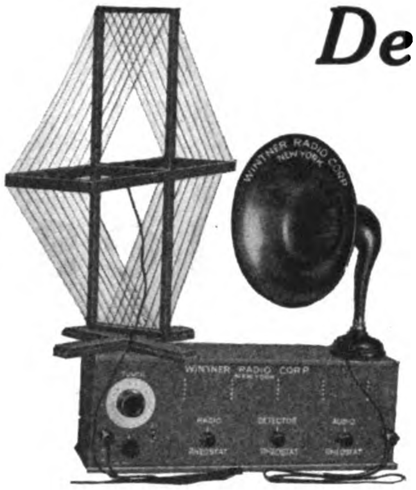
Build your own Radiophone. Instruction book ten cents. Radio Service Institute, No. 2000 14th Street, Washington, D. C. —3t

Remember—

You paid the news dealer 25c for this copy of "RADIO." Twelve issues will cost you $3. Subscribe at the $2.00 a year rate before June 30th and save a dollar.

Dealers, We Are Ready!

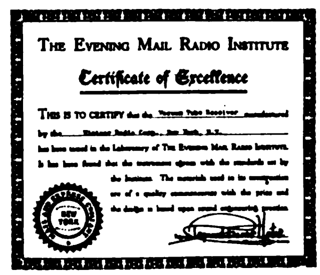
Immediate Delivery On All Parts



Our products endorsed by the foremost talent in the art. Every article laboratory tested and certified. Complete sets and sundry parts. Attractive discounts to dealers and distributors. Jobbers please write. Radio Fans have your dealers write for information.

LABORATORY CERTIFIED RWC

WINTNER RADIO CORP
115 W. 30TH ST. - N.Y.C.
Manufacturers and Distributors



WINTNER RADIO CORP.

115 W. 30th Street, New York City **Telephone Watkins 0373—0374**

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DOES IT FINE

6 volt; 5 amp; 60 cycle

UNRESERVED GUARANTEE: Your money back, if YOU WANT IT

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Postpaid, anywhere

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THE RIGGS MFG. CO., Urbana, Ohio

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WIRELESS
Music Receiving Outfits
For Auto, Camping Trips or Home Use

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Colin B. Kennedy Long Wave Type 110. Intermediate Wave 220. Short Wave Receivers No. 281, also 2 Stage Amplifiers to match. Radio Shop New Model Receiver $70.00; 2 stage $55.00. Clapp Eastham Receivers $40.00; 2 Stage $35.00. Magnavox R-3 $45.00. Large stock Amplifier Transformer $5.00. 3 in. dials $1.00. Jacks. Turney Spider Web Magnet Wire, all sizes. Flexible Antenna Wire for Portable Sets. Variable Condensers, 23 and 43 Plate. Signal Apparatus, Remler Parts, Detector and Amplifier Tubes, Radio Books. Connecticut, Brandes, Liberty, Kellog and Baldwin Phones. B Batteries, 23V, 43V, 90V and 108 Volts.

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GOULD, The Light Man

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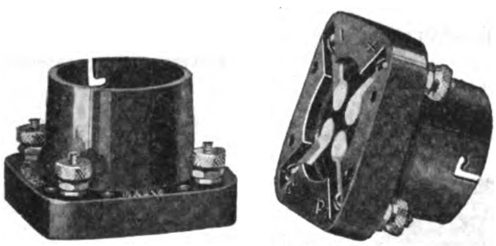
$1.00 Brings you a copy of the *second* edition of the License Quiz Book. Every radio experimenter needs a copy. Limited supply on hand. Send us your order today.

For Sale by "Radio," Pacific Building, San Francisco

Kellogg Wireless Supplies

THE KELLOGG SWITCHBOARD & SUPPLY CO. have been making high grade, sensitive telephone receivers and apparatus for the past twenty-two years.

The result of our experience is built into our wireless receiver, making it unusually sensitive, durable, light in weight, and of neat design.



Kellogg Lamp Socket

KELLOGG LAMP SOCKETS

Kellogg molded lamp sockets fit all standard four prong vacuum tubes.

Extra heavy solid base 7/16 inch thickness. Four German Silver springs with rounded ends, firmly held in position in deep grooves. Cannot touch mounting surface. Double end, nickel plated binding posts, hexagon and knurled surface nuts. Binding posts plainly marked for wiring. Connection can be made under the socket as well as above.

Kellogg sockets are 2 3/16 inches square with round corners, with a total depth of 1¼ inches.

Kellogg No. 59A Head Set

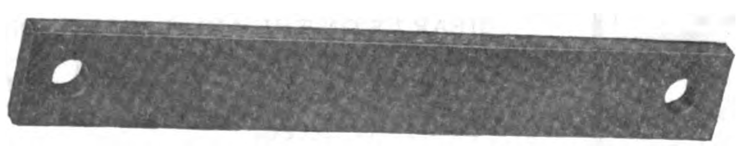
Kellogg Strain Insulators

Kellogg No. 1 strain insulators are made of Kellogg Bakelite, 1 inch wide and 6 inches in length with suitable holes drilled at the ends for the antenna wire and support.

Kellogg No. 3 strain insulators consist of a Bakelite rod in which are firmly inserted metal end rings. These insulators stand a direct pull of approximately 350 pounds.

Nos. 4, 5 and 6 are the same as No. 3 except the length.

The lengths are: No. 3, 3 inches; No. 4, 4 inches; No. 5, 4 inches; and No. 6, 6 inches.

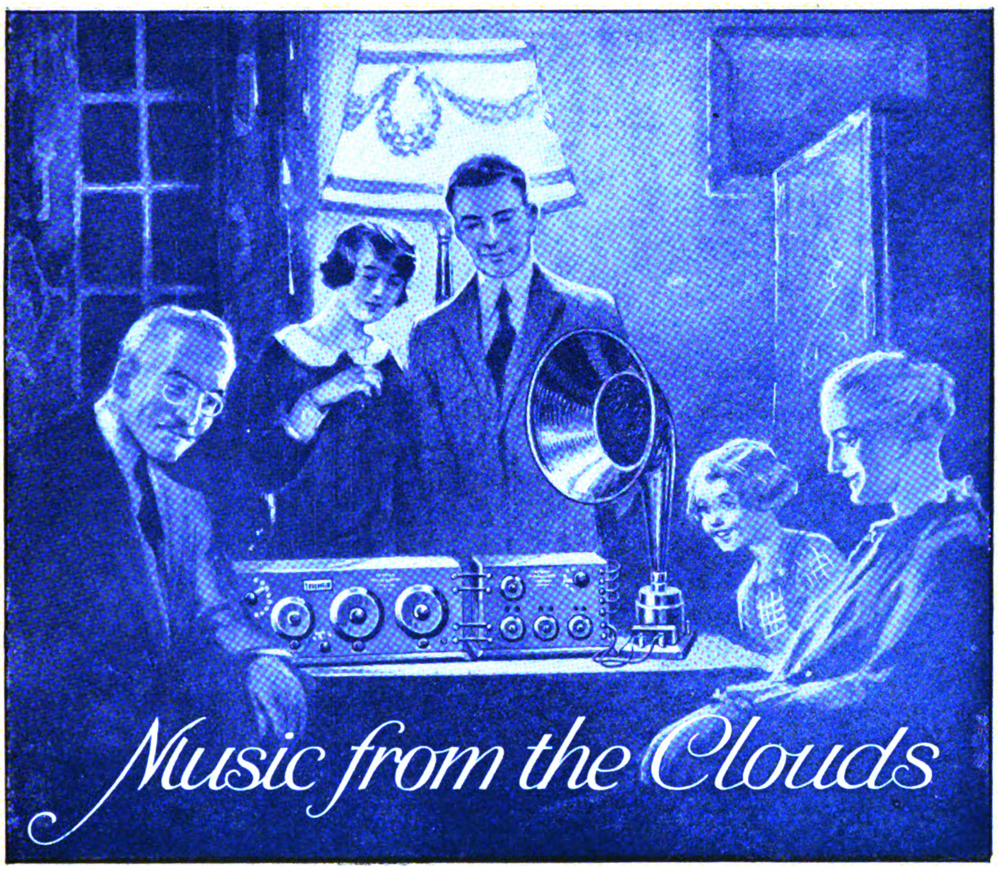


Kellogg Insulator

KELLOGG SWITCHBOARD *and* SUPPLY COMPANY

MANUFACTURERS OF STANDARD TELEPHONE EQUIPMENT

CHICAGO, ILL.



FOR those who want the ultimate in wireless telephone receiving sets, Continental has assembled this complete outfit—"unexcelled for radio telephone reception." This is a set that anyone can use to entertain a group of friends. It is also an outfit which, in the hands of an expert, produces record-breaking results. Tested, proven units are combined to form a complete installation without a weak link. The entire installation, ready for erection, includes every item of equipment, as follows:

Paragon RA Ten Regenerative Receiver	$75.00
Paragon DA 2 Vacuum Tube Detector and Two-Step Amplifier	65.00
Radio Magnavox	45.00
1 pr. of Western Electric Phones	15.00
3 Vacuum Tubes	18.00
4 Eveready "B" Batteries	12.00
1 6-volt 60-80 ampere hour storage battery	17.50
1 General Radio antenna series condenser	5.50
Continental No. 3 antenna equipment	20.00
	$273.00

The heart of this splendid set is the world-famous Paragon R. A. Ten, for which Continental is the exclusive wholesale distributor. Ray-Di-Co., 1547 N. Wells St., Chicago, and The Benwood Co., 13th and Olive Sts., St. Louis, are sales agents in the middle west.

CONTINENTAL RADIO AND ELECTRIC CORP.

6 WARREN STREET NEW YORK CITY

"New York's Leading Wireless House"

Mail Order Department and Executive Offices, 15 Warren St., New York

They do in—

—In Alaska
2500 miles north

—In Hawaii
2200 miles west

—In New York
2600 miles east

—In Porto Rico
3000 miles southeast

can YOU hear KZY Rock Ridge?

If you miss any of the feature programs of Rock Ridge Radio Station, (KZY) Oakland, California, you are missing a real radio treat.

On 360 meters wave length, Rock Ridge broadcasts special music daily between 3:30 and 4:30 P. M., Pacific time; press reports, sport bulletins and farm news daily between 6:45 and 7:00 P. M., Pacific time; a special sermon and sacred music each Sunday between 11 and 12 A. M., Pacific time, and other appropriate entertainment each Sunday between 3:30 and 4:30 P. M., Pacific time.

Under favorable weather conditions, these concerts and other features are heard from Alaska to Cuba, and from New York to the Hawaiian Islands. Can you beat the distance records shown above? Write us when you hear Rock Ridge. We are always glad to correspond with listeners-in.

Atlantic-Pacific Radio Supplies Co.

638 MISSION STREET
SAN FRANCISCO, CALIFORNIA

Operating (KZY) Rock Ridge Station, Oakland, Cal.

EASTERN OFFICE AT
5 KIRK PLACE, NEWARK, N J.

Abbott-Brady Printing Corp., S. F.

July, 1922

25 Cents

RADIO

B6

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Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08 and others issued and pending. Licensed only for amateur or experimental uses in radio communication. Any other use will be an infringement.

The trade mark GE is the guarantee of these quality tubes. Each tube is built to most rigid specifications.

CUNNINGHAM TYPE C-300 GAS CONTENT DETECTOR

—*it gives clearest reception for all makes of Home Receiving Sets*

CUNNINGHAM Detector Tubes are built in the great General Electric Laboratories to the most rigid specifications. Years of research work and study, combined with the most scientifically accurate mechanical equipment in the world has made it possible to manufacture these quality tubes that give such remarkably effective results.

The pleasure that your Home Receiving Set will give you depends largely on the CLEARNESS OF RECEPTION of messages, concerts, etc.—therefore, be sure to get CUNNINGHAM TUBES for YOUR set.

For further particulars see or write your nearest dealer; or write us direct.

E. T. Cunningham

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San Francisco, Calif.

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154 West Lake Street
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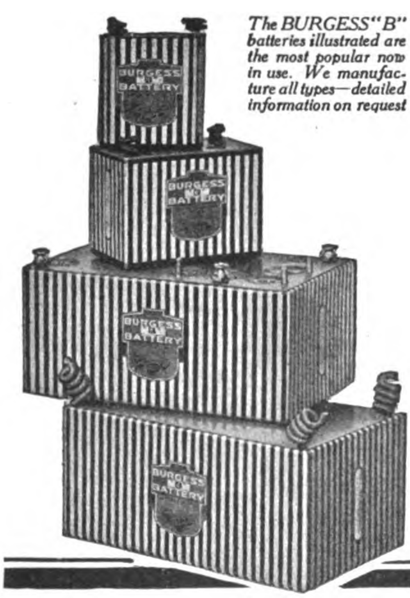

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RADIO

Established 1917 as Pacific Radio News

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July, 1922 **RADIO** Vol. 4 No. 7

Radiotorial Comment

IN the course of a recent address, General John J. Pershing expressed his wonderment that the United States was able to achieve victory in the World War, *considering its unpreparedness*. And he strongly made appeal for a sufficient standing force to protect the nation in the future.

On the same date Rear Admiral W. S. Sims also made a speech—in another part of the country, before the graduating class of the Naval War College. He, too, preached a powerful sermon for preparedness. He charged that the nation has ever been UN-prepared in time of emergency *and deplored public indifference in the matter*. Such results can only result in the lowering of the morale of the people, he said. A great many lives were lost in the late war because no branch of our fighting forces was prepared. "The inevitable consequences have been, and now are," he declared, "that once the object of the war is attained, the public loses all interest and forgets the sacrifices entailed by having been unprepared."

Two very much to the point statements by two men at the top of the two branches of our offense and defense! Two truthful statements!

We were discussing citizen radio with the mother of an amateur operator, and a good one. We endeavored to point out that, in case of need, her son—because of his radio knowledge—would be of great service to his flag, adding that it was our ambition to foster citizen radio in every way possible—to this end—as well as that of the all-around development of the youth of the nation.

With a sniff of contempt, this mother retorted that she "did not intend my boy for the Army." We gently made remark that, *IF* the necessity arose, in the future—the same sort of necessity that presented itself not so long ago—"my boy" would have to give his services, in *some branch* of the services, whether she liked it—or no!

Bringing the matter down to a fine point: we have, in this great nation of ours, the finest type of young manhood in the world! Ambitious, keen, resourceful, independent, enthusiastic young manhood! A very great many thousands of "my boys" are first rate radio operators and students. A very great many of them, for one reason and another, have not the opportunities of study, nor the books, nor really any of the facilities at hand for their rapid development! Bless their hearts, these lads dig it out for themselves, as best they may—all the more credit to them!

BUT: When the War Department creates training schools—summer—when it conducts various courses of study—when it *tries* to interest citizen radio, and to *help* its progress—is it not a short-sighted policy to let these advantages slip by—unheeded? If the call comes, and "my boy" MUST go—is it not better for him to step in to the branch of the Service where his abilities and his *worth* are at once recognized—rather than to do "K. P."—or be shuffled with a lot of others as one shuffles a pack of cards, and—take what he "draws"—nine times out of ten an uncongenial position, where his real value is wasted?

This seems to us a logically sane question!

The U. S. is divided into so-called "areas," with a commander over each. Inquiries addressed to the headquarters of each area will be given prompt attention, and enrollment blanks forwarded—that are necessary for the application to the training camps. The Government pays all the expenses—the student being required to bring but his personal, more intimate, apparel—even his uniform being supplied on his arrival at the camp.

We are unhesitating in the remark that it is folly to cast aside the chances for a Signal Corps—and an Army—training, that the Government offers to ALL American citizens, below the age of 25 years—and offers it on a silver platter!

BUT lately the eyes of amateur radio were focussed on the Atlantic Coast, where—under the auspices of the ARRL—eminently successful trans-Atlantic tests were made, whose results indubitably proved that the signals from East-Coast amateur stations crossed the Atlantic Ocean.

So far—so good!

But we, of the enthusiastic West, are by no means content to rest at these achievements. It has been shown that a great many Pacific Coast stations—and some from far inland—are being heard (QSA) by that indefatigable worker, Clifford J. Dow, in Honolulu. The question arises in our mind: if Honolulu is hearing many of us, so well, how much *farther* are our signals carrying?

The only answer is to make effort at ascertaining!

And this plan has occurred to us:

With the co-operation and advice of the Radio Inspector of the 6th District, let the Editor appoint an A-1 commercial operator to cross the Pacific on some vessel going to Yokohama—or Shanghai. By prearranged schedules—to be published in RADIO—let this operator—who shall represent the great body of western amateurs—*listen* each night of the voyage out—on the wavelengths used by amateurs, special stations, and those that broadcast music, etc. Let the representing operator keep a careful log of every station heard, together with such data as may seem of effective and interesting use. If the vessel on which he sails stops at Honolulu, let him send, in the most abbreviated form, the call letters of such stations as he has already logged, from that place. He will continue to listen, each night, *after* the ship leaves Honolulu, Orient-bound. We conceive that some

Continued on page 75

Industrial Uses of Radio

By R. C. Denny

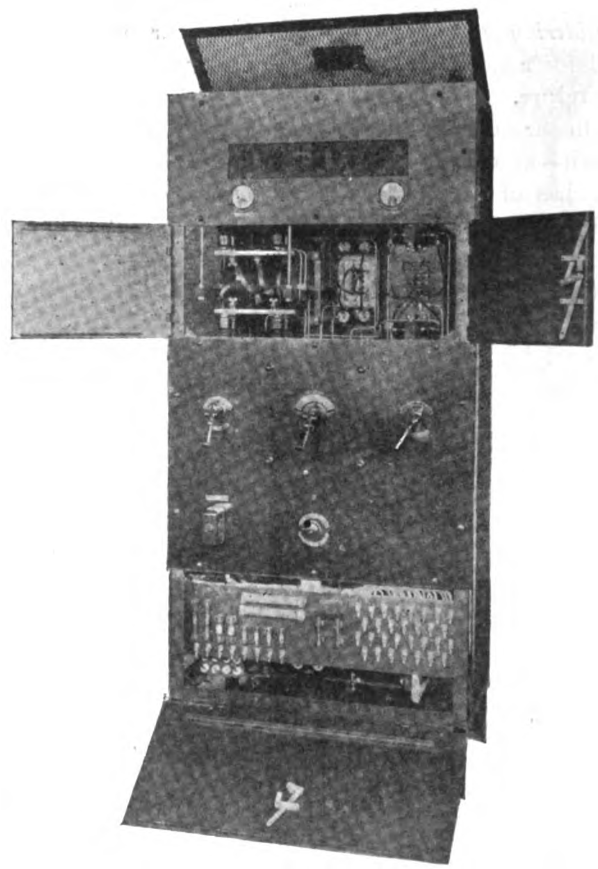
HOW far radio can grow out of the stage of a popular parlor toy and take its place as a serious factor in business service is a question which has attracted much interest of late. It is obvious that there are wonderful possibilities latent in this field in the West where such industries as lumbering, mining, stock raising, and fishing often carry on the greater part of their activities in remote regions not reached by the ordinary modes of communication. The power companies, with their mountain plants and distant construction projects, have already experimented with wireless with some success, and their experience will be of interest and value to those contemplating similar installations. The writer, as chairman of the sub-committee on Radio Communication, has embodied his views in a report submitted at the recent convention of the Pacific Coast Electrical Association, as follows:

Among the power companies of this district, it has developed that there is considerable need for an emergency means of communication for system operation or load dispatching in times of storms and line failures, which so affect the telephone lines as to make them inoperative. Radio in such instances should prove a valuable aid to the system dispatcher in restoring conditions to normal. There is no apparent great need for radio for communication with construction camps, but it might be well used in such cases, instead of monopolizing existing lines or building new lines just for this purpose.

Opinion seems somewhat divided as to whether the use of radio for system dispatching should be for emergencies or used as routine. In all probability it would resolve itself down to emergency use, for in the absence of any practical signalling device, the dispatcher would have to be "listening in" at all times, which would very considerably interfere with his routine office work. In an emergency, however, when the telephone line fails, it would be quite the natural thing to turn to the radio set for communication. Construction work would probably justify routine operation, depending somewhat on how extensive the project.

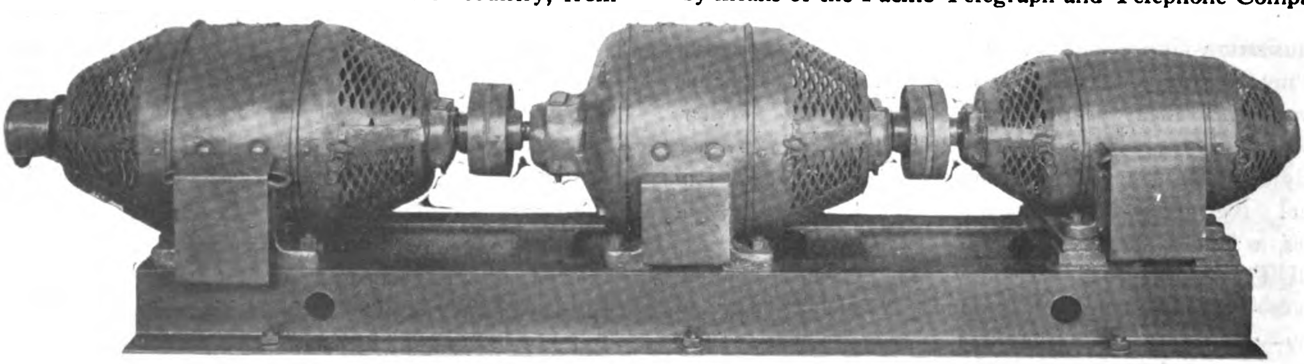
The companies seem unanimously in favor of the undamped or continuous wave system of radio. Recent demonstrations have certainly proven it superior to the damped or spark system in many ways and there is little doubt but that it will entirely supplant the older system. The radio telephone would seem most adapted to system dispatching where speed and accuracy under personal supervision is necessary; while for construction work the radio telegraph should quite well suffice, as the work is not of such exacting nature.

Probably the maximum distance from headquarters that must be reached by any of the companies in order to cover their system, would be 300 miles. On practically all the systems, transmission distances cover all sorts of country, from level valleys to mountains. The climatic conditions are much the same for similar portions of all systems in this district, so that all would have to contend with considerable atmospheric electricity in the summer months, which are, however, fortunately not the season for line failures. The problem of reliable power supply for remote installations is comparatively simple, as in most cases the hydro plants themselves would be the location of the radio; and in the case of construction camps, reliable power lines must be built in order that work of any magnitude may be carried on at all.

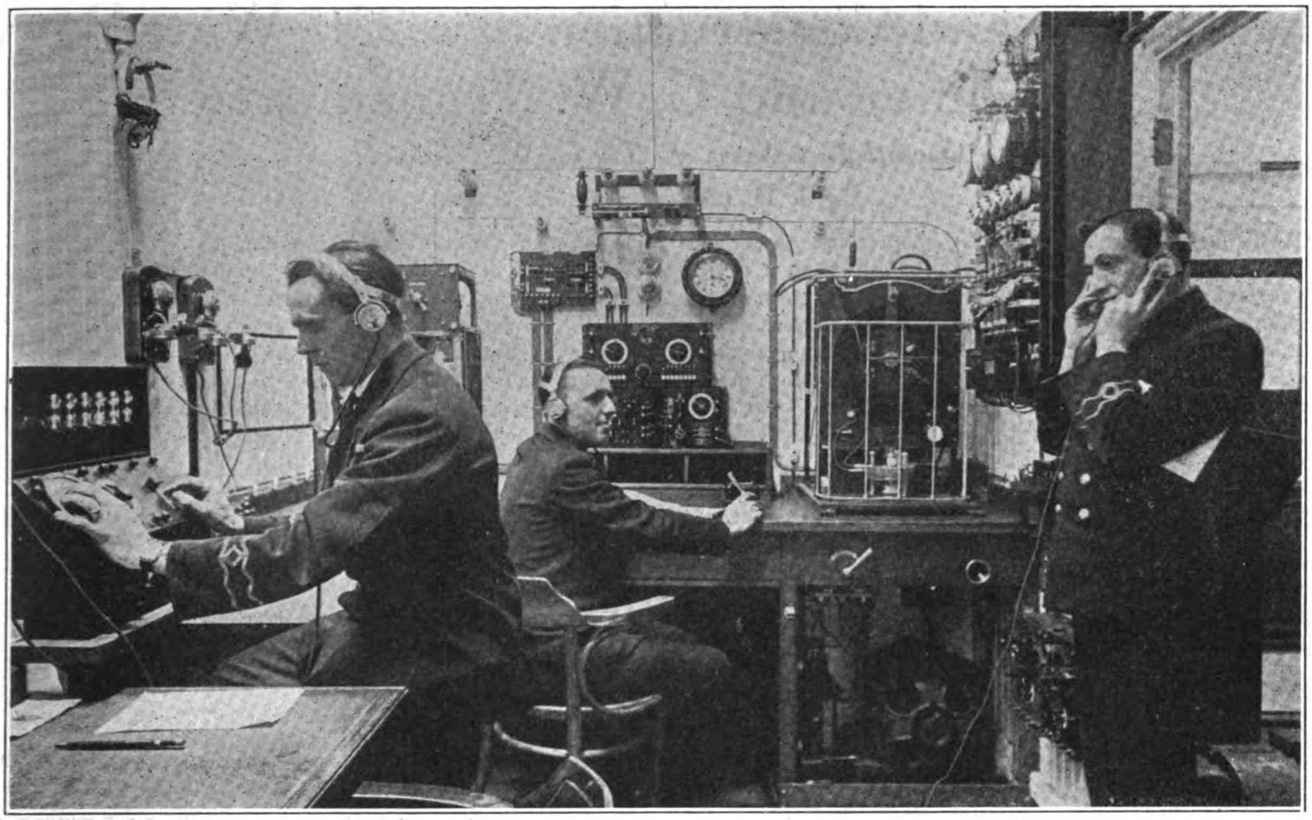


1 K. W. Radio Transmitter Panel for Ocean Telephony. Employing Four 250 Watt Radiotrons as Oscillators and One 50 Watt Tube as Speech Amplifier; Controls Provide for either C. W., I. C. W., or Telephone Transmission on Any Wavelength between 300 and 800 Meters.

The distances between dispatchers' offices of the interconnected companies in this section vary from 5 to 234 miles. Direct communication between these offices is now to be had by means of the Pacific Telegraph and Telephone Company's



Three Unit Motor Generator Set with 6¼ H. P. 115 Volt D. C. Motor Driving 2000 Volt Generator Supplying Plate Circuit and Double Current Generator Supply 4 Amps. at 125 Volts D. C. Exciting Current and 10 Amps. at 88 Volts A. C. for Feeding 12 Volt Filament Heating Transformer.



Ewing Galloway, Photo

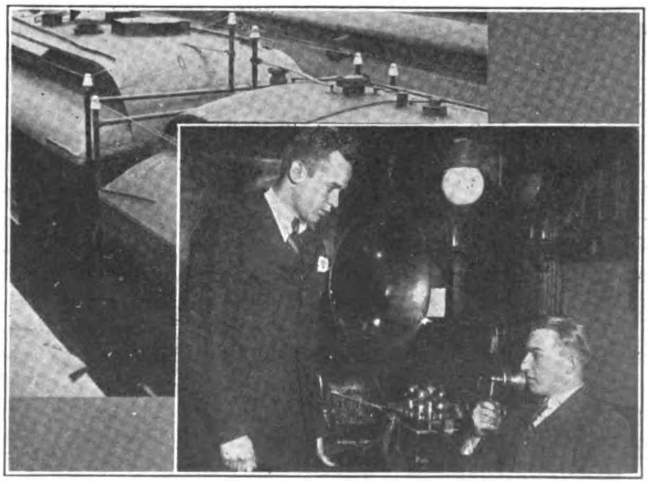
Radio Room in "Majestic," the World's Biggest Ship, Showing Tube Transmitter at Left Center and Spark Transmitter at Right Center. Radio Compass is Shown at Extreme Left.

long distance service and, indirectly, by relaying phone messages through substation operators over the private lines. The long distance phone is usually quite reliable—but not always, and it is never very rapid. The method of relaying messages is slow and often results in inaccuracies. In several cases the radio requirements of a company in covering its own system have resulted in overlapping the operating headquarters of interconnected systems, which would indicate that the problem of radio communication between dispatchers' offices should not be such a formidable one.

Several of the operating companies have made use of the radio telegraph for construction purposes, with great satisfaction. The Southern California Edison Company makes use of the undamped system and in a typical month's operation, has telegraphed 121,000 words between headquarters and camps. Its operations are over distances of 14 to 25 miles in extremely mountainous country. The San Joaquin Light and Power Corporation utilized the damped system a year ago in connection with the Kern power house job. This operation was over 115 miles of valley country. The Edison Company's sets are rated at ½-kw. and cost $1,500.00 each; the sets used by the San Joaquin Light and Power Corporation cost $750.00 each, and although rated at 2 kw., accomplish successful transmission when using not over 6/10 kw.

The stations were all operated under Limited Commercial station licenses, which were obtained without difficulty or cost and were operated by men holding first grade commercial operator's licenses. There was an occasion on each of these systems where the radio telegraph was called in to assist the dispatcher in handling an operating situation. No extensive experiments have been made by any of the companies with "wired wireless," although it is contemplated. The San Joaquin Company are carrying on experiments with a radio telephone set of 50 watts rating and report that they are having considerable success.

The Radio Corporation of America, who practically control the manufacture and sale of tubes and parts for radio phone sets, have two standard sets on the market rated at 1000 watts and 200 watts, selling for $7,500.00 and $6,000.00 respectively, complete in each case with receiving instruments. They have no objection to the power companies buying their tubes and parts for use in experimental work, so long as the work is truly experimental. They go further to say that they probably will be prepared at an early date to take care of limited commercial needs. It is coming to be recognized that if reliable phone sets could be developed at a cost of $500.00 to $750.00 power companies would be justified in installing them at remote and important plants for the betterment of the service in emergencies. In conclusion it might at least be said that the outlook is very encouraging, as with the apparatus on the market, and the right to make limited commercial use of it, there is little to stand in the way of applying it to the use of power system operations.



International Photo

Aerial and Radiophone Installation on Buffet Car of Lackawanna Railroad Made by D. W. Richardson and G. D. Murray of Princeton. Complete Conversations to and from the Traveling Train Were Carried on With Stations at Scranton and Binghampton.

The Design and Construction of a 250-Watt Power Amplifier and C. W. Transmitter

Seventh Installment of "The C. W. Manual"

By J. B. Dow, Ensign U. S. N.

FROM a study of the preceding chapter the reader has become familiar with the power amplifier as a device for increasing the output of a previously constructed radiophone or other type of vacuum tube transmitter. The amplifier now under consideration is one employing a single 250-watt tube, and capable of being "driven" from a single 5-watt tube as a master oscillator and another 5-watt tube as a modulator if control of the emitted wave by voice is desired.

This amplifier is also designed to operate as a complete C. W. transmitter. It contains the necessary grid condenser and grid leak for this purpose as well as the input and output inductances. Figs. 54, 55 and 56 show three views of the completed apparatus (except for the wiring). All non-metallic parts of the completed unit, except the cabinet, which is of oak and 12½ by 11 by 16 in. inside and rabbitted to receive the front panel, are constructed of bakelite. The major dimensions of the various panels and sub-panels may be found by referring to Fig. 57. If the constructor will follow these dimensions carefully in cutting the required material, the expense incurred in manufacturing such a piece of apparatus will not be as great as might be expected and the finished product will be a device well worth the care necessary to construct same.

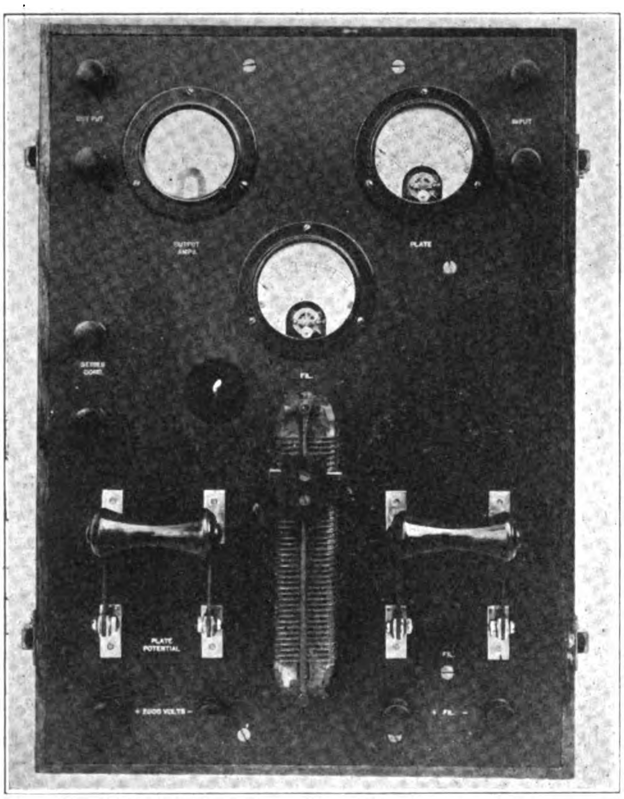


Fig. 54. Front View of 250-Watt Power Amplifier

Since, from Figs. 54, 55 and 56, the details of the assembly are quite clear, it is considered unnecessary to include further detail in connection with Fig. 57. This figure also explains the method of supporting the vacuum tube, wherein standard Radio Corporation end mountings are suspended inside two bakelite rings by means of helical springs. This method of suspension prevents possible damage to the tube from any shock received in handling the equipment, and is highly recommended.

Fig. 58 illustrates the circuit used in this combined power amplifier and C. W. transmitter. Reference to this figure will convince the reader of its flexibility and consequent utility. Because of this feature it is a most valuable asset to any radio laboratory.

By merely impressing a portion of the output of a small oscillator or radio phone set (see Fig. 21) upon the grid circuit of the amplifier, and, of course, at the same time supplying the latter equipment with the necessary plate and filament energy, the entire output of the amplifier may be controlled with the same precision as the much lower-powered "driver."

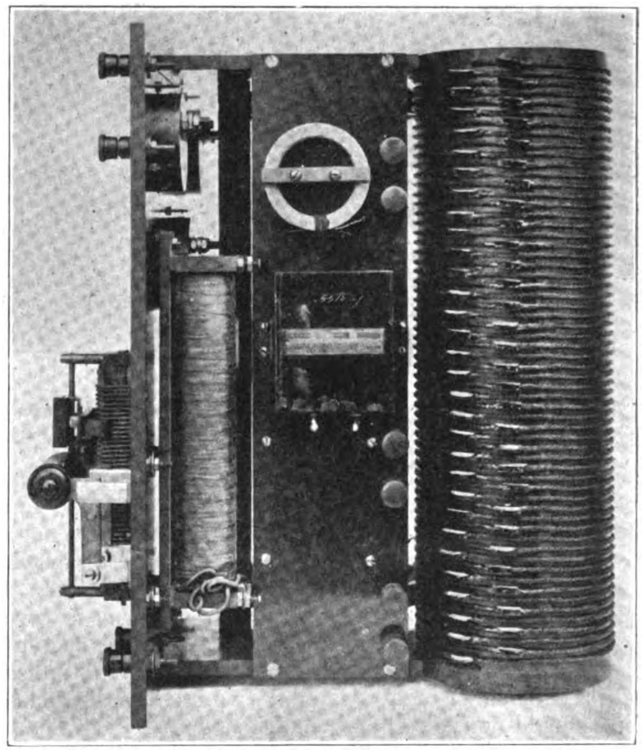


Fig. 55. Right Profile of 250-Watt Power Amplifier

If it is desired to use the device as an oscillator for the transmission of telegraph signals only, the master oscillator of Fig. 21 is unnecessary. To do this it is only necessary to connect as shown by the broken lines, these connections being simple post to post operations.

Either alternating or direct current may be used on the filament and plate. The process of shifting is a simple one and will be considered in detail later.

As stated in connection with Fig. 58, binding posts 1, 2, 3, 4 and 5 are located on the vertical sub-panel and are in evidence in Fig. 55. These posts provide a simple, efficient means for operating the device as an amplifier or oscillator. The balance of the binding posts provide exterior connections to the completed apparatus and are located upon the front panel. Some of these are not shown in the original model from which the photograph in Fig. 54 was made, but in all subsequent models the additional posts were provided.

The grid condenser, C_1, and the grid leak, R_1, comprises a 0.002 microfarad mica dielectric condenser and a resistance of 5000 to 10,000 ohms. The necessary details for the construction of such a resistance will be found in Fig. 27.

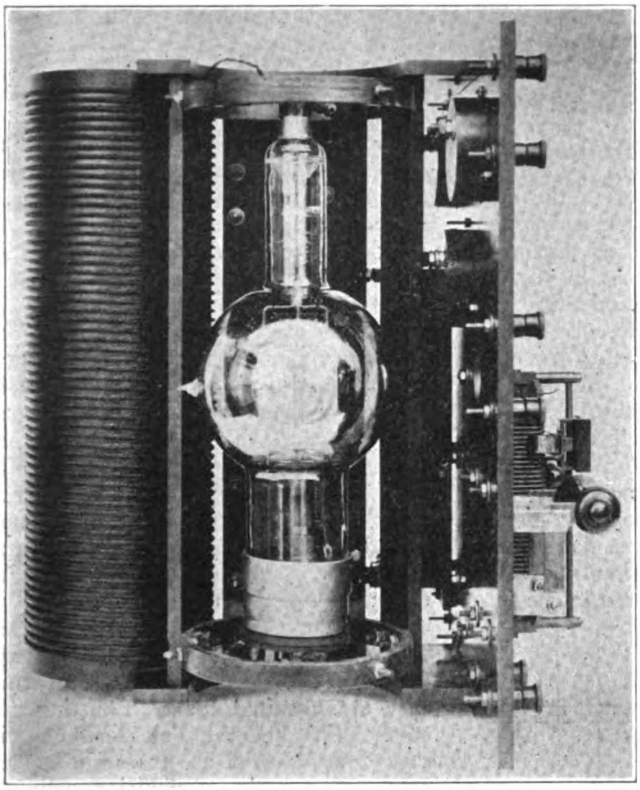


Fig. 56. Left Profile of 250-Watt Power Amplifier

The condenser, C_2, of Fig. 58, is of the oil dielectric type shown as the left one in Fig. 59 and must be capable of withstanding 4000 volts. Its capacity should be approximately 0.002 microfarad. The smaller condenser of Fig. 59, while admirably suited to use in low power C. W. circuits, cannot supplant the one mentioned above, but is

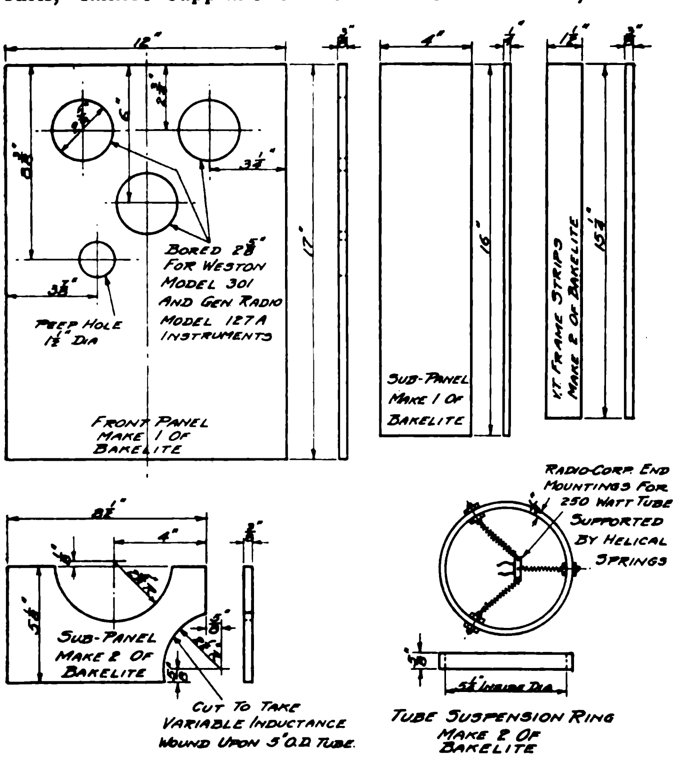


Fig. 57. Panel Dimensions for 250-Watt Power Amplifier

merely shown in this figure for comparison. If an oil dielectric variable transmitting condenser is not available, a mica dielectric fixed capacity may be used in place of C_2 in Fig. 58.

The inductance, L_1, consists of a 250 turn honeycomb coil and prevents radio frequency energy from entering the supply circuit by way of the generator leads to the posts, 14 and 15. In series with this radio frequency choke is the audio frequency choke, L_2, which prevents a damping of any audio frequency signal which is being transmitted. This latter choke also serves the important purpose of maintaining

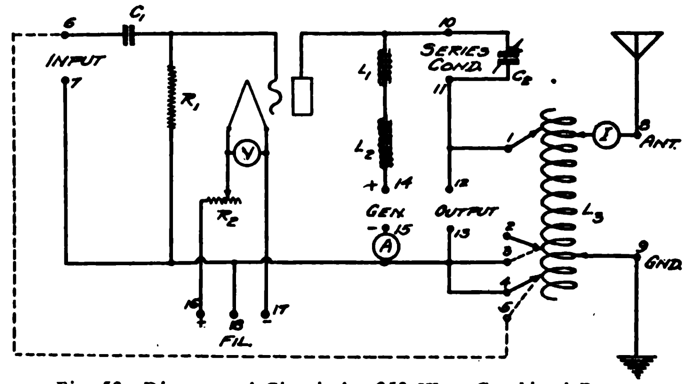


Fig. 58. Diagram of Circuit for 250-Watt Combined Power Amplifier and Oscillator

a steady current flow to the plate from the high voltage generator or other source of supply. If the device is to be used only for the amplification or generation of continuous waves at high frequencies the choke L_2 is unnecessary. The details of construction for L_2 will be found under Fig. 29 of a previous chapter. To smooth out the ripples caused by commutation and to provide a bypass for such radio frequency currents as get by the choke L_1, the posts, 14 and 15, should be bridged with a capacity of 0.5 microfarad. This capacity is not provided for in the instrument itself, because when alternating current of the voltage required is used to supply the tube via the plate, this capacity must be left out of circuit or a much smaller one must be provided. The reason for this is quite obvious.

The inductance, L_3, which is shown in Figs. 55 and 56, consists of sixty turns of 10 by 30 Litz twisted seven cord, around a 5 in. outside diameter bakelite tube. Different construction for this inductance is permissible, but in designing another type employing solid conductor in place of the above mentioned Litz, the reader is urged to consider the theory of eddy currents, which are very pronounced in power circuits operating within the scope of radio frequencies. It would not be consistent with good engineering policies to use copper tubing less than 5/16 in. in diameter nor copper strip less than ¾ in. wide. The flexible leads to this inductance terminate at the binding posts provided

Continued on page 87

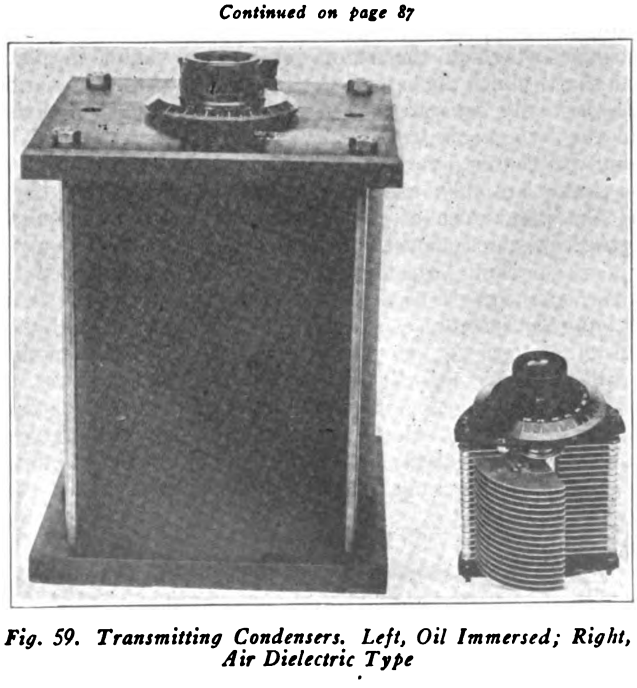


Fig. 59. Transmitting Condensers. Left, Oil Immersed; Right, Air Dielectric Type

Variometers

By D. B. McGown

A VARIOMETER is a type of inductance that is variable, as the name suggests, but differs from the tapped coil, or the coil using a slider, in that no actual variation of the length or amount of wire is made. The inductance of the variometer as a whole is variable, due to its being made up of two coils, which are so placed that they will either add to or oppose each other's magnetic fields, and thus give a variation of the inductance of the total. It might, therefore, be defined as "a continuously variable inductance, varied thru its own mutual inductance."

Variometers are made in several types. The commonest form, and that with which the majority of the radio fraternity are familiar is composed of two spherical windings, one inside the other, which are connected in series.

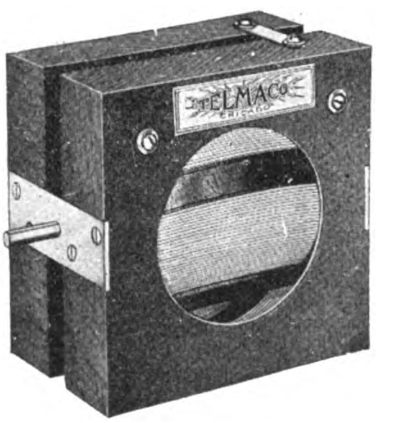


Fig. 1. Typical Variometer

This type is illustrated in Fig. 1. Here it will be seen that the inner coil or "rotor" is wound on a ball, while the outer coil, or "stator" is wound on the inside of the outer frame, or housing, which acts both as a support for the stator winding, and a support for the bearings in which the rotor revolves. The shaft, which appears to go thru the ball, is really separated in the center, and the two pieces serve as conductors from the center winding. The rotor and stator are then connected together and the inductance of the whole unit depends, as stated above, on whether the coils are "bucking" or aiding each other. This variometer is used exclusively in receiving equipment.

Another type of variometer is the so-called "figure eight" type, which is represented in Fig. 2. This variometer consists of two disks slotted across their diameters at the centers. These disks are wound in the same manner as the tracing of a figure 8, as it is ordinarily made in script figures, as shown in Fig. 2C, which shows the method of winding of one turn, which is shown in order not to confuse the drawing. The additional turns follow in the same order, on both coils. One coil is fixed, and the other is rotated. A rotation of 180 degrees in this, as in the other type of variometer, gives a complete variation from minimum to maximum. The action is the same as in the ball type of variometer, the mechanical construction is the chief difference. However, this instrument takes up less space than the other type, and furthermore, can be made up by anyone with much less trouble than the ball type, which takes considerable skill to make, as well as a lathe to turn out the forms.

The figure eight variometer may be easily made up by taking a flat piece of wood or bakelite, and simply winding as many turns as are desired in the form

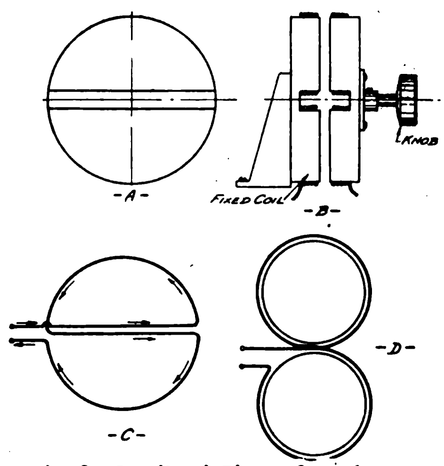


Fig. 2. Details of Figure 8 Variometer

of a true figure 8, on two wooden pegs a couple of inches in diameter, as shown in Fig. 2D. The windings are then removed, fastened with shellac, insulating varnish or thread, and mounted on square pieces of board. They might be also wound on two square blocks of wood, which are fastened to the back before winding, the wire being wound in place and left there. Numerous variations of this type will present themselves to the reader. They may be used for anything and everything that the ball type can be used for, altho they do not possess any particular advantages except that they are easier of construction. The number of turns needed for these instruments will vary with the use to which they are to be put, and the exact number will have to be determined by experiment. For the ordinary receiver about 30 or 40 turns on each coil will suffice.

Another type which is almost exactly similar to the ball type, is the variometer made up of two concentric cylindrical tubes, one rotated inside the other. In fact, this type was the forerunner of the ball type. It is very much easier to construct than the ball type, but does not have as low a minimum, or as high a maximum inductance, as will be explained later. This type is usually made up by amateurs and others who do not have the facilities to make up the other types.

It is not necessary that the variometer be made so that the variation is accomplished by a rotary motion. It may be accomplished by sliding one coil over the other, or the same result may be obtained by two coils which can be brought nearer together, or separated farther apart. The latter system may be represented by two honeycomb coils, one of which is fixed, and the other is movable. The movable one is swung closer, or farther away from the stationary one, and a variation of the inductance is accomplished.

While at the present time the general use for variometers is in receiving apparatus, it must not be thought that they are unsuited for transmitting circuits. The Federal Telegraph Co., in their low powered arc transmitters, use an antenna series variometer called a "note varying variometer." Its function is to change the length of the emitted wave of the transmitter by a small amount, the amount varying on the position of the two coils, and their total inductance. When a receiving operator hears a station calling him he must be just on its exact tune, with an arc set. If it is off tune he will generally hear nothing. If the receiver is set to just 2400 meters, and the ships are also on that wave, well and good, but if the ship happens to be a little above or below, the receiving operator will not hear it unless he is constantly manipulating his apparatus. Now, if the wavelength of the transmitting set is altered so as to "cross" the wave of the receiving station, communication can be established with much greater ease, as is self evident. The variometer used for this purpose is carefully insulated and made up in the form of the ball type, but is wound with wire (litz) which is capable of carrying the total antenna current of the set, instead of the small wire used for a receiving variometer.

Another use for variometers in transmitting is found on the Telefunken transmitters. These sets, like all quenched sets, are extremely critical in the adjustments between the antenna and closed circuits. The Telefunken equipments are supplied with two spiral inductances, one of which is hinged, and the antenna circuit is then tuned by first roughly tuning for resonance, by means of the number of turns and then the actual final adjustment is made by swinging or varying the position of the movable coil of the variometer. The same result could be obtained by the use of a slider, of course, but the use of such a device introduces a moving contact which is liable at times to prove unsatisfactory—or at least this appears to be the contention of the Telefunken people. It is interesting to note, however, that the modern American quenched set accomplishes the antenna tuning by means of a slider, and no serious effects result, and much greater compactness and convenience is noted.

The so-called "vario-coupler," Fig. 3, is nothing but a special type of variometer, altho it is not connected in the usual variometer manner. It consists of two separate coils, and is really a "coupler," altho it is of the variometer family. It is made up in several types, and may be made on cardboard tubes or on figure 8 coils if considered necessary, altho the present commercially marketed types will answer all purposes as a rule.

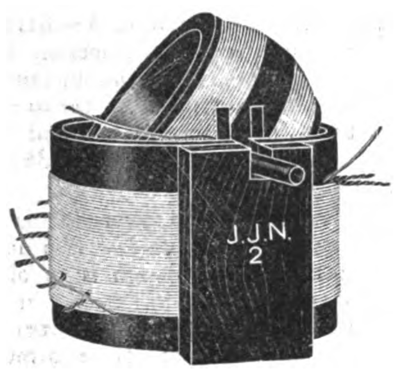
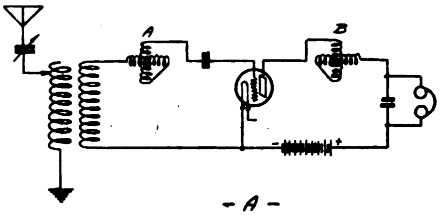


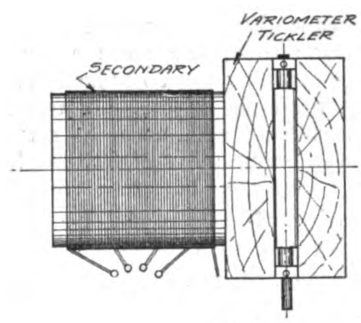
Fig. 3. Typical Variocoupler

Fig. 4A shows the circuit of the popular two variometer receiver, such as has been used and is still used in countless amateur stations. Here we have the grid variometer, A, which serves to vary the secondary C circuit, after the antenna has been properly tuned, and B is the plate variometer. When A is tuned to a given wavelength, B may be adjusted so that the plate circuit is in tune with the grid circuit, and the tube starts to oscillate. Just before the position of oscillation is reached, we have a condition in the tube whereby the incoming signals are greatly amplified. This action is called "regeneration."

A handy use for a variometer is shown in Fig. 4B, where the variometer is used as a "tickler" coil, in the ordinary circuit. The secondary coil is wound on a tube, and is fastened to the side of the variometer. The winding on the secondary depends, of course, on the wavelength range it is desired to receive over, while the tickler, consisting of both the rotor and stator of the variometer, may be varied so the bulb will either act as a detector, a regenerative amplifier, or as an oscillator. It will be found that this system possesses a marked advantage over the tuned plate system. When used as shown, the limit of the wavelength of the secondary depends on the number of turns on the tube. This may, of course, be increased by bank winding, etc. On the other hand, the tuned plate "two variometer" system will not give a greater wavelength range than is possible to get, due to the maximum and minimum in the variometer, resulting in a comparatively narrow wave band. The usual type of this receiver will only go from about 175 to 400 meters, while if properly constructed, one with a variometer tickler will go up to as high a wavelength as is needed.



- A -



- B -

Fig. 4A. Standard Tuned Plate Circuit
Fig. 4B. Tubular Secondary Fitted to End of Ordinary Variometer

For general results there will be found to be little difference in the efficiency of the various types of variometers on the market. The moulded type, in which the rotor and stator windings are made up on bakelite, are probably better than those made of wood, altho a variometer made of good hardwood, well seasoned, should not give any trouble.

Besides the uses mentioned above a single variometer may be used as a simple receiver, of the single coil type, either for a crystal or a vacuum tube detector. This possesses, as all single coil receivers, reasonable sensitivity, but with but little selectivity, altho if the listener does not have any local interference with which to contend, he will be able to obtain very good results.

The best variometers are those that have a minimum clearance between the rotor and stator, and which have exactly equal coils for both the rotor and stator. By this is meant that the two coils both have the same inductance. If they are then adding, their total inductance will be very high, while if they are bucking, it will theoretically approximate zero. In general, a variometer fills the place of the clumsy, crude tapped tuning coil, or inductance, shunted by a condenser, as the variometer is itself continuously variable, and as fine adjustment can be had with it as with any condenser, and, furthermore, no loss will be introduced, as always exists in a condenser. It also eliminates the use of the multi-tapped coils which were sometimes used when it was not possible to use a shunt condenser, and, in fact, which would be absolutely useless for the reception of continuous waves of any kind.

ELIMINATING STATIC BY RESONANCE WAVE COIL

Plans for the perfection of the resonance wave coil method recently demonstrated at Chicago as a static eliminator in radio receiving, and the design of a standard instrument for general use, are being worked out, according to Dr. Louis Cohen, consulting engineer of the War Department. At present this instrument is only in the form of special laboratory apparatus, Dr. Cohen pointed out and as such demonstrated by him and Major J. Mauborgue, Chief Signal Officer of the Sixth Army Corps Area in Chicago.

At the suggestion of Major General Geo. O. Squier, Dr. Cohen and Major Mauborgue undertook a study of combining their developments in the use of resonance wave coils with line-wire broadcasting, with the result that they found a means of eliminating a large amount of the static ordinarily encountered. For some time Major Mauborgue and Dr. Cohen have been experimenting with their resonance coils method used in the reception and transmission of radio signals, and upon combining the theories of General Squier with their own, were able to get most satisfactory results in eliminating static interference. A number of patents have already been filed on circuit arrangements for use with wave coils.

Commenting on the recent experiments in Chicago, Dr. Cohen said that two important things were accomplished: First, they broadcasted by means of "wired wireless" on the mains of the Edison Company in the city of Chicago, plugging in a transmitter on the line through condensers and sending with a 50-watt lamp. The messages transmitted were received at one point on the circuit six miles from the transmitting station and at another point twelve miles distant. This was the first time that a practical demonstration of General Squier's line broadcasting system had been given in public.

Second: Messages were also received from a distance on the Edison system, it was said, showing that besides the signals put on the circuit messages sent from a distance could be received, the city lighting circuit serving in the place of an aerial. During the demonstration, signals from Government transmitting stations in Washington were picked up and heard clearly, the Chicago city

Continued on page 82

How to Design an Iron Core Audio Frequency Choke Coil

By A. K. Aster, Ph. D., University of California

THE design of a choke coil may be determined from five factors, namely: the inductance of the coil, the length of the magnetic field, the area of the core, the permeability of the iron, and the number of turns of wire. As two or more of these factors are likely to be unknown at the outset, it is necessary to assume certain values for them, so that we may determine approximate values for the other factors. To design a coil for a definite inductance, we must proceed more or less by trial, making reasonable assumptions and trying them out in the formula. If the desired result is not obtained, we make some changes and try again, until after several trials the desired value is obtained.

Let us therefore proceed to work out the design for a 100 henry choke coil to be wound on a rectangular closed core, having a cross sectional area of one sq. cm. and a magnetic path of 15 cm. Thus we have three of the five required factors and have only to determine the permeability of the iron in the core and number of turns in the coil.

The permeability depends upon three things: the kind of iron, the magnetic flux, and the frequency.

Only the best kind of silicon steel should be used for the core. Curves or tables giving values of permeability for differences in magnetic flux are furnished by the manufacturers. For instance, Fig. 1 shows the magnetization curve for Apollo special electrical steel, made by the American Tinplate Co.

Let us therefore assume a magnetic flux of 12 lines per sq. cm. From Fig. 1, it will be seen that the corresponding permeability is 1000. But this value is for low frequency and must be multiplied by a factor to give the correct value for a higher frequency of, say, 1000 cycles, which we will adopt as a standard, because it is the average frequency of the human voice and so is suitable for both telephone and telegraph work. For No. 29 gauge sheet steel, this correction factor is 5/8. Therefore, the effective permeability is $1000 \times 5/8 = 625$ for a frequency of 1000 cycles.

Consequently our problem now reduces itself to finding out the number of turns necessary for a 100 henry choke coil, having a one sq. cm. core area and 15 cm. magnetic path, assuming that the iron has a permeability of 625 for 1000 cycles. This may be found from the equation $t = 8944 \sqrt{Ll/a\mu}$ where t=number of turns, L=inductance= 100 henries, l=length of magnetic path=15 cm., a=cross sectional area of core=1 cm., and μ=permeability= 625. Substituting these values in the equation, we have $t = 8944 \sqrt{100 \times 15/1 \times 625} = 8944 \sqrt{2.4} = 13{,}823$ turns.

So now we know that 13,823 turns will give an inductance of 100 henries, if wound on a rectangular core 1 cm. in area with a magnetic path of 15 cm., as shown in Fig. 2, *if* we have a magnetic flux of 12 lines per sq. cm.

The next question that arises is how many amperes in such a coil will cause a magnetic flux of 12 lines. This may be found from the equation $A = .8HL/t$, where A=current in amperes, H= magnetic flux=12, L=inductance= 100 henries, t=numbeı of turns=13,-823. Substituting these values and solving, we get $A = .8 \times 12 \times 100 \div 13823 =$ .07 appromixately.

The next thing to determine is the size of wire to be used. The usual rule in transformer design is to allow 1000 circular mils per ampere. Since the rating of this coil is .07 ampere, 70 circular mils should be allowed. Therefore No. 36 B. & S. gauge wire will be ample, this value being determined from the ordinary wire table.

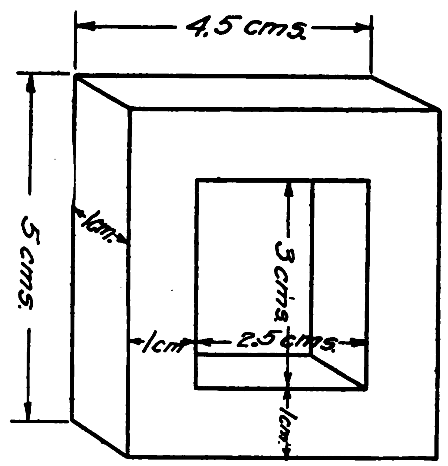


Fig. 2.—Choke Coil for Audio Frequency Amplifier.

Fig. 2 shows the general details of the core discussed. All joints should be lapped. A butt joint must never be used, as the magnetic leakage of this type is very high. The details of the actual method of winding the coil have been omitted, as it was assumed that the reader is familiar with them.

There are probably some readers who have not the equipment or time to make their own coils, and who would like to know what standard apparatus is available on the market, as there are no choke coils actually being made especially for use in amplifiers. After testing a number of standard coils, the writer believes that the smallest size Wayne bell ringing transformer will be satisfactory for amplifier work. This coil has an inductance of about 30 henries. The 110 volt winding should be used as a choke coil, and the 12 volt winding should be left open. This transformer can be purchased from any dealer in electrical supplies.

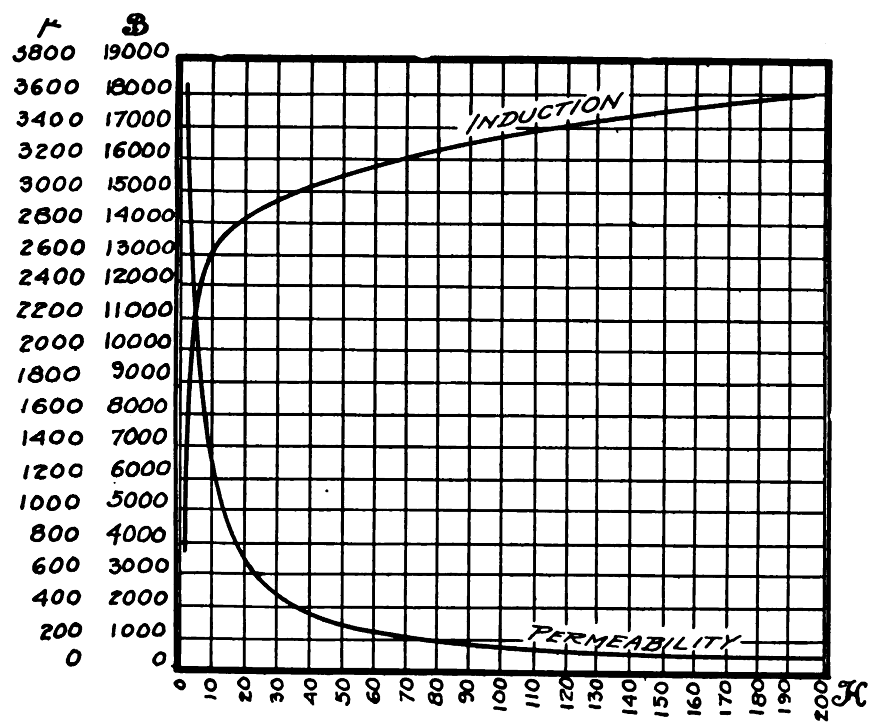


Fig. 1.—Magnetization Curves for Apollo Special Electrical Steel. Read left column μ as permeability in lines per sq. cm.

A New Loud Speaker

By G. M. Best

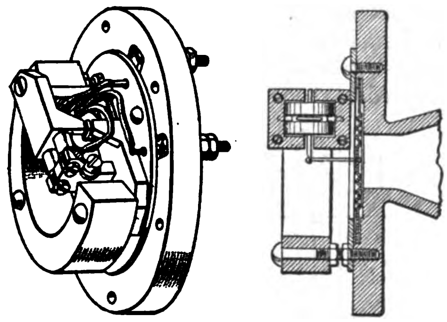
TO meet the ever increasing demand for high grade radio equipment, the Western Electric Company has recently introduced a new loud speaking unit, for use in the home, or in fact any place where a reproduction of speech or music is desired in moderate amount.

The complete outfit consists of a two stage amplifier enclosed in a cabinet, and a loud speaker with horn attached, ready to connect to the output of any standard vacuum tube detector and receiving set. The amplifier is the principal part of the set and embodies some principles that are new to the radio art, although previously used in other fields.

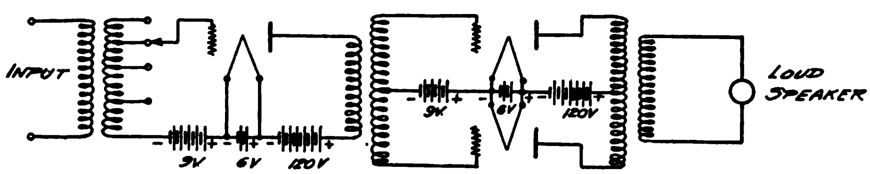
The outstanding feature of the amplifier is the second stage, which consists of two tubes of like characteristics, both being connected in the circuit in the same manner as the first stage, but each tube having only one-half the voltage variations impressed upon its grid. This is accomplished by constructing the input transformer with a center tap for the connection to the filament of the two tubes. As the input voltage divides equally between the two grid circuits, input voltage equal to twice the amount allowable with a single tube may be employed, with a correspondingly greater output into the loud speaker. As the loud speaker is of much lower alternating current resistance than the output of the last stage of the amplifier, a step down transformer is necessary. This transformer also keeps the plate current in the last stage from flowing through the windings of the loud speaker, and thus avoids the distortion which is so often present where the direct current is allowed to pass through the loud speaker.

A unique feature of the set is a volume, or output control, which enables the operator to regulate the volume of sound coming from the loud speaker without having to resort to any of the customary methods of control such as reducing or increasing the filament current, changing the tuning of the receiver, etc. This is accomplished by bringing taps from the secondary of the first amplifying transformer to a variable switch mounted on the panel. By means of this switch the connection to the grid of the first amplifying tube is varied to increase or decrease the input voltage into the first stage.

The tubes used with the amplifier are the Western Electric type 216-A, which require 120 volts on the plate and 6 volts on the filament. Due to the rather wide range of filament current values through which the 216-A tube will operate, filament rheostats are not necessary provided that not more than 6 volts is supplied to the filaments. This eliminates annoying adjustments and simplifies the operation to a considerable degree.



Sketch of Loud Speaker Mechanism.



Circuit Diagram

The loud speaker itself, as shown in the accompanying sketch while built along the same principles as the already well known Baldwin receiver, is much more rugged in design, and will carry a much greater amount of power without distortion. It consists mainly of a permanent magnet mounted on a heavy frame, a coil to transform the energy received from the amplifier into useful magnetic vibrations, a soft iron armature placed in the center of the coil and connected to a composition diaphragm by means of a rigid lever. This loud speaker will reproduce all the voice frequencies, from 200 to 3500 cycles, without distortion and by its simplicity of operation and ease of adjustment should fill a long felt want in the radio field.

THE SET

Did you ever put on your head-set,
And start copying NSS,
When your mother calls, "Oh, Charlie!
Show these folks your wireless?"

With a frown you let them enter,
And provide each with a chair,
And they say, "Oh, my! How wonderful!
What's that thing over there?"

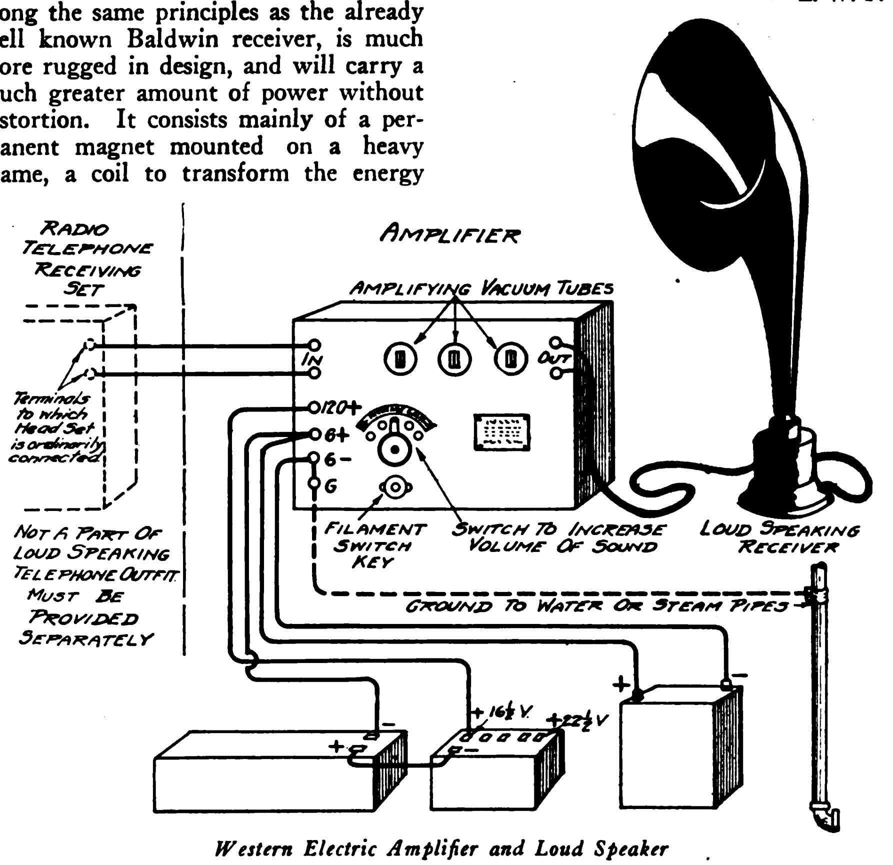
So you begin explaining
From the beginning to the end,
About audions, and vacuum tubes,
And the distance you can send.

You show them your transmitter,
And explain things through and through,
And they say, "Oh, my! How wonderful!
Wish I knew as much as you."

And after careful explanations,
Which leave you in a sweat,
They rise and say, "Well, thanks, Charles,
For showing us your set."

And just as they are leaving,
And are pausing at the door,
Someone pointing at your aerial says,
"Hey! What's those wires for?"

—L. W. P.



Western Electric Amplifier and Loud Speaker

Construction of a Simple Receiving Set and Two-Stage Amplifier

By B. F. McNamee

THE object of this article is to describe a simple receiving set, consisting of tuning apparatus, detector, and two-step amplifier. The chief novelty lies in the fact that without an expensive Bakelite panel and cabinet we obtain an extremely efficient set. The arrangement is such that good insulation is used where required so that the leakage losses are cut to a very small amount.

Suggested List of Material and Parts

3 Remler Sockets.
2 Wesrad Amplifying Transformers.
9 Binding Posts.
1 Universal Tuning Transformer.
3 Fada Rheostats.
1 Rotary Switch with two contacts.
1 Grid Condenser. (.0003 mfd.)
1 piece hardwood, 8"x14¾"x⅝".
1 piece hardwood, 2⅜"x10"x12".
Connecting wire.

The wooden parts should be cut and drilled as shown in the drawings. They should be made of some good hard wood, preferably Spanish cedar or mahogany. The base board may be 5/8 or ¾ in. thick, while the rheostat board should be ½ in. After drilling, they should be very carefully finished with fine sand paper, then dusted and stained. After the stain has had ten or twenty minutes to soak in, wipe the boards with a soft rag to remove the surplus stain. Apply one or two coats of orange shellac, being careful to get the shellac on the insides of the holes. This will serve as insulation between the binding posts and the wood.

When properly shellacked, the wood will not absorb moisture. If it is dry to begin with, there will be practically no losses due to leakage through the wood since further insulation is used where especially needed.

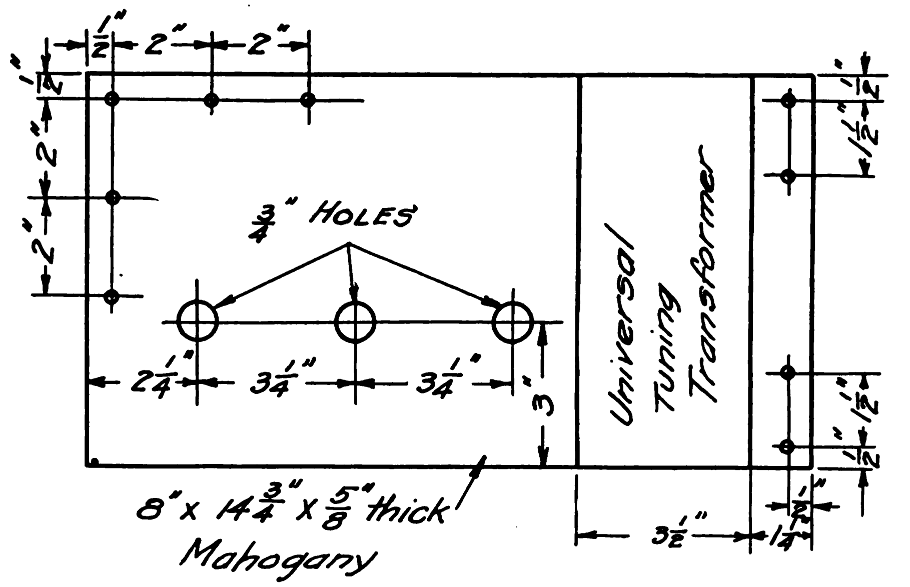
The place for mounting the rheostat board can be seen from the picture of the set. The three tube sockets are mounted directly over the ¾ in. holes in the base board.

Use some type of socket in which the contact springs will not make contact to the wooden base. This is necessary for proper insulation. The ¾ in. holes immediately beneath the sockets are for the purpose of rebending the springs if they should fail after a time to make good contact to the base prongs on the tubes.

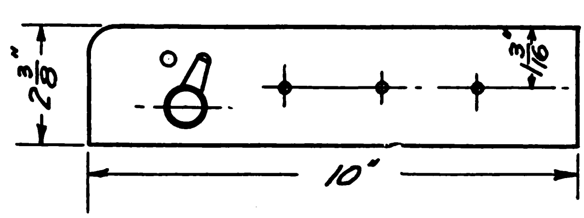
The two amplifying transformers are placed immediately behind the tubes and as far apart as possible to prevent howling from interaction. They are placed at right angles for the same purpose.

The switch on the left-hand end of the rheostat board may be any form of single pole double throw switch for changing from one to two steps of amplification. A two-point rotary switch will suffice.

A Universal Tuning Transformer is secured to the base at the right-hand end, as shown. This can be made by winding a primary and a secondary coil end to end on a 2½ in. cardboard tube, separating the ends by about ¼ in. space. The primary consists of about 60 turns of No. 22 enamel wire and the secondary of 140 turns of the same wire. This is in effect a fixed coupler, suffi-



DRILLING FOR BASE



DRILLING FOR RHEOSTAT BOARD.

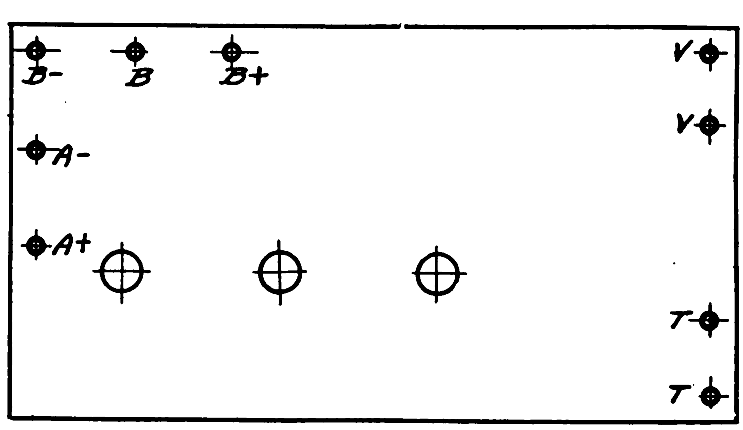
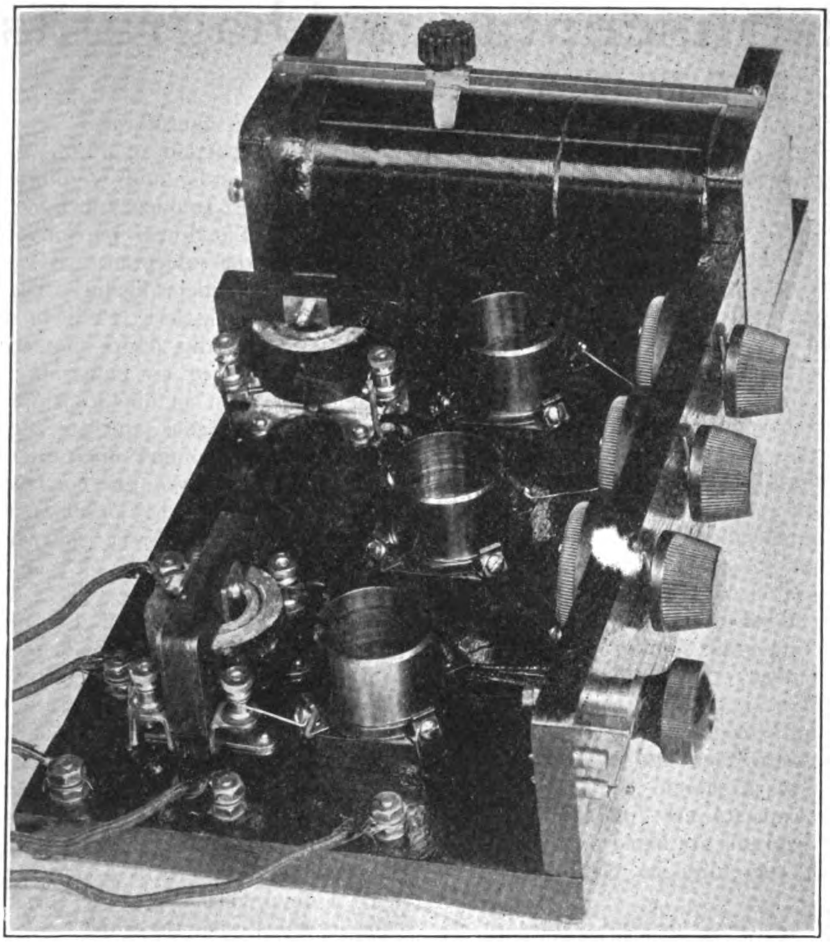


DIAGRAM TO SHOW LETTERING ON BINDING POSTS.



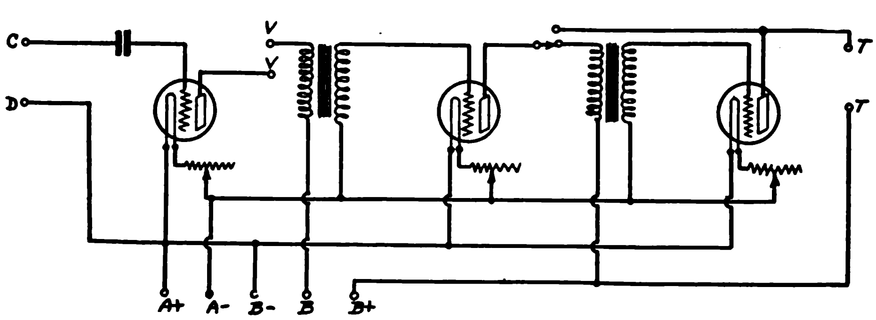
Completed Receiver and Amplifier Set

ciently loose to eliminate interference and doing away with the necessity for a variable condenser. Tuning of both the primary and the secondary is accomplished by means of a slider.

A small, fixed grid condenser (.0003 mfd.) is connected between binding post *C* of the tuning transformer and the grid terminal of the right-hand tube socket. The tube sockets commence with a detector at the right-hand end and end with a second step at the left-hand end. Binding posts *A* and *B* on the tuning transformer are for connection to the aerial and ground respectively, and binding post *D* or *E* to the positive end of the filament battery. Binding posts *TT* are for the receivers, and binding posts *VV* may be used if the receivers are desired in the plate circuit of the detector tube. In order to make the set regenerative, use the receivers in binding posts *TT* and connect a variometer to binding posts *VV*. If the variometer is not used, the binding posts *VV* should be connected together.

The storage battery should be connected to binding posts *A*+ and *A*—. Binding post *B*— goes to the negative end of the B battery. *B* should have a wire terminating in a spring clip so that any desired potential of B battery may be selected for the detector tube. Binding post *B*+ is connected to the plate circuits of the amplifier tubes, and for best results should be connected to the positive end of a 90-volt B battery.

A very convenient arrangement is to have flexible lamp cords from these 5 binding posts, terminating in spring clips for connection to the batteries.



Circuit Diagram

$100 RADIO FREQUENCY AMPLIFIER CONTEST

Every progressive amateur is interested in radio frequency amplification. Many of our readers have been experimenting with this method of bringing in more distant stations that can not otherwise be heard or in making local broadcasting louder. Many other readers are anxious to try out these methods.

In order to bring out these ideas the publishers of RADIO are offering four prizes for the best description of the design, construction and operation of a radio frequency amplifier. There will be a first prize of $50, a second of $25, a third of $15 and a fourth of $10, totaling $100.

Contestants are requested to submit manuscript written on one side of the sheet and with all diagrams and sketches in ink on separate sheets. Photographs of completed equipment should accompany the manuscript. It is requested that no description that has been previously published be submitted as it cannot be considered and also that no description be submitted of designs that have not been tried out in practice.

The publisher reserves the right to print all worthy ideas, not prize winners, at the usual space rates. No manuscript entered in this contest can be returned. The contest is open to everyone, radio clubs included, except manufacturers of radio equipment. Prizes will be paid upon publication.

This contest closes at noon, August 15, at San Francisco, by which time all entries must be received. Address all communications to the Editor, care of this publication.

NAVAL RADIO COMPASS STATIONS

It has been unofficially reported to the Navy Department that during the past winter fourteen large merchant vessels were saved from destruction by the Navy's radio compass stations. Due to the severe storms in the Atlantic, ships were often unable to determine accurately their positions on approaching the coast. By simply calling by radio the nearest fixed compass station and asking for bearings, they were given their positions accurately and it is estimated that fourteen ships thus aided would otherwise have been wrecked.

Reactance and Susceptance Diagrams

By G. W. Cattell

REACTANCE and susceptance diagrams afford an easy and quick method of analyzing complex circuits consisting of inductance and capacity, and are especially useful in radio work.

With the use of such diagrams it is possible to ascertain how many resonance points the circuit has, the frequencies at which they occur, whether they are for zero or infinite reactance and the nature of the reactance (positive or negative) for other than resonant frequencies. By "resonant point" is meant a value of frequency which will make the reactance either zero or infinite.

All these quantities may be calculated mathematically, but the equations involved are often difficult of solution.

Complex circuits are merely combinations of simple circuits. In the present consideration of the subject, the simple circuits will be treated first and then the more complex.

Reactance is that property of an electrical circuit which tends to stop or reduce the magnitude of an alternating or radio frequency current. Susceptance is that property of an electrical circuit which tends to accept or allow an alternating or radio frequency current to flow. Obviously, one is the reciprocal of the other. The symbol usually applied to reactance is "X" and that applied to susceptance is "b". Reactance due to inductance (L) is called positive, and that due to capacity (C) is called negative.

Mathematically, the reactance of an inductance is expressed by the equation $X_L=2\pi fL$, the susceptance of an inductance by $b=1/X_{LL}=1/2\pi fL$, the reactance of a capacity by $X_C=-1/2\pi fC$ and the susceptance of a capacity $b_C=1/X_C=-2\pi fC$.

Reactances of circuits in series can be added directly and the result will be the algebraic sum of the component reactances. The corresponding susceptance will be the reciprocal of the resultant reactance.

The reactances of circuits in parallel can not be added directly. Susceptances of circuits in parallel, however, can be added directly and the result will be the algebraic sum of the component susceptances. The corresponding reactance will be the reciprocal of the resultant susceptance.

The reactance and susceptance diagrams of a simple inductance and a simple capacity are fundamental. All other diagrams are based on them. They should, therefore, be clearly fixed in mind.

For clearness, definite values of inductance and capacity have been assumed and the diagrams drawn accordingly. Let $L_1=150$ micro henrys, $L_2=100$ micro henrys, $C_1=0.001$ microfarads and $C_2=0.0006$ microfarads.

The upper portion of Fig. 1 shows the reactance of L_1 and L_2 plotted as ordinates against frequency in kilo-cycles as abscissa. The lower portion of the figure shows the susceptance of L_1 and L_2 plotted as ordinates against frequency in kilo-cycles as abscissa. It will be noted from a study of this figure that the reactance diagram of an inductance is a straight line with an upward slope, the larger the inductance the steeper the slope. The susceptance diagram of an inductance is a curved line concave upward, the larger the inductance the lower the curve and the sharper the curvature.

The upper portion of Fig. 2 shows the reactance of C_1 and C_2 plotted against frequency. The lower portion of the figure shows the susceptance of C_1 and C_2 plotted against frequency. A study of this figure shows that the reactance diagram of a capacity is a curved line, concave downward, the larger the capacity the higher the curve and the sharper the curvature. The susceptance diagram of a capacity is a straight line with a downward slope, the larger the capacity the steeper the slope.

For convenience, a reactance or susceptance diagram will be designated as X or b with a subscript corresponding to the figure number in which it first

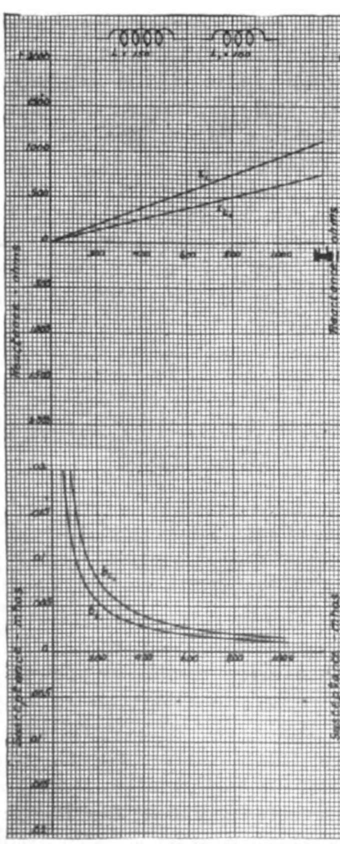


Fig. 1

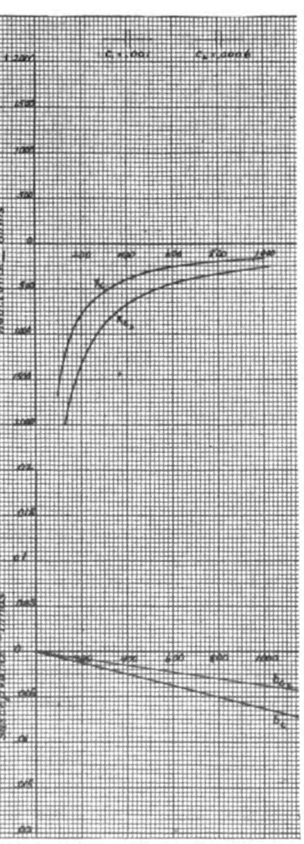


Fig. 2

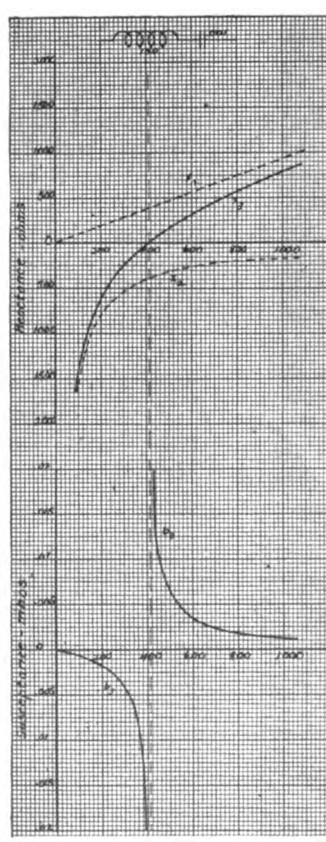


Fig. 3a

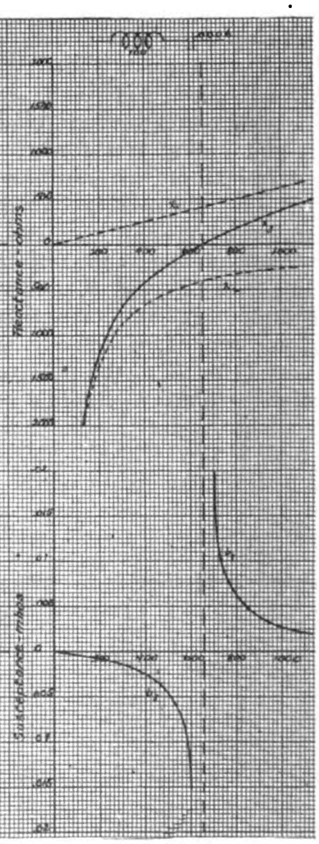


Fig. 3b

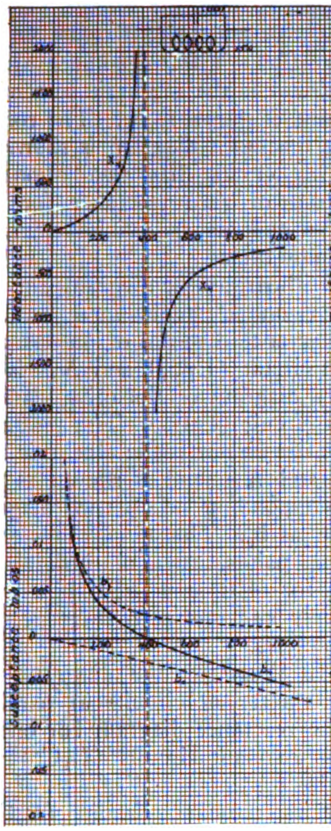


Fig. 4a

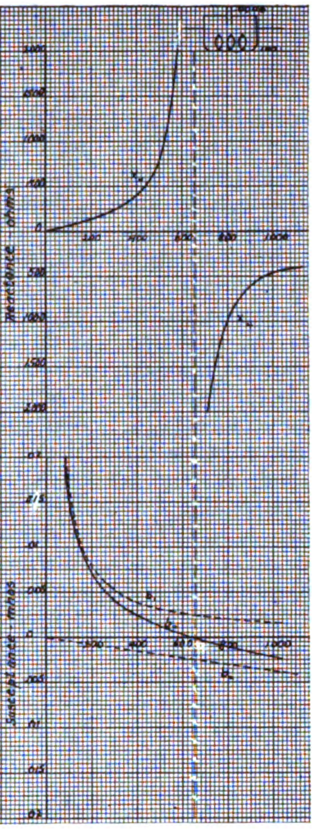


Fig. 4b

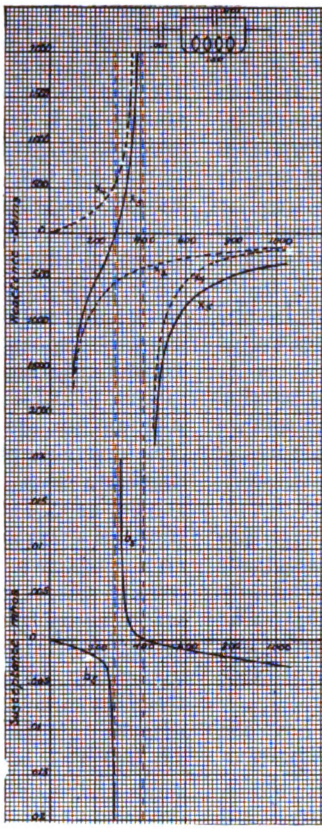


Fig. 5

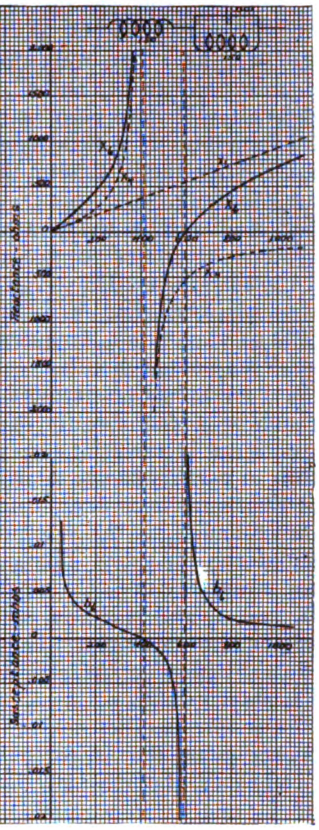


Fig. 6

appeared. For example, the reactance diagram of a capacity would be referred to as X_2 etc. When diagrams are used as parts of other circuits, they are shown in dotted lines.

Fig. 3 shows the reactance and susceptance diagrams of an inductance and capacity in series (frequently called a parallel resonant circuit). Fig. 3_a is for L_1 and C_1 while Fig. 3_b is for L_2 and C_2.

X_1 is the reactance diagram of the inductance and X_2 is the reactance diagram of the capacity. The reactance of the entire circuit is the algebraic sum of X_1 and X_2 and is shown as X_3. The corresponding susceptance diagram is obtained by plotting the reciprocal of X_3 and is shown as b_3.

The simple series circuit has one resonance point, that is, for one particu-

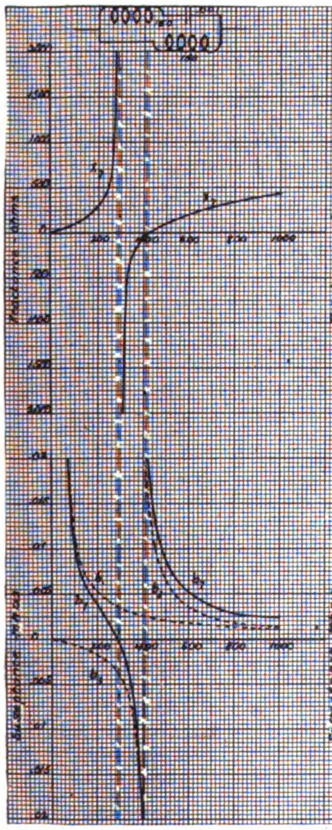


Fig. 7

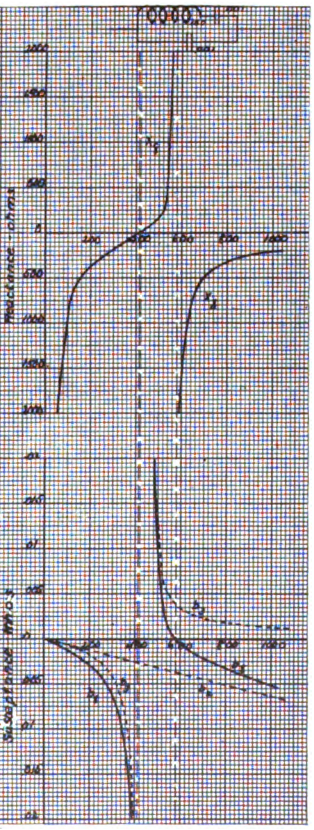


Fig. 8

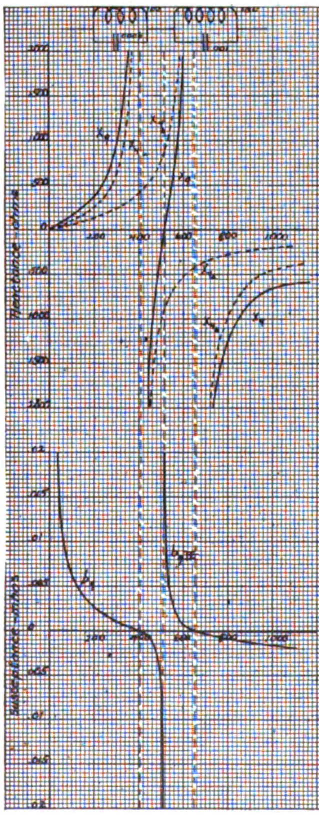


Fig. 9

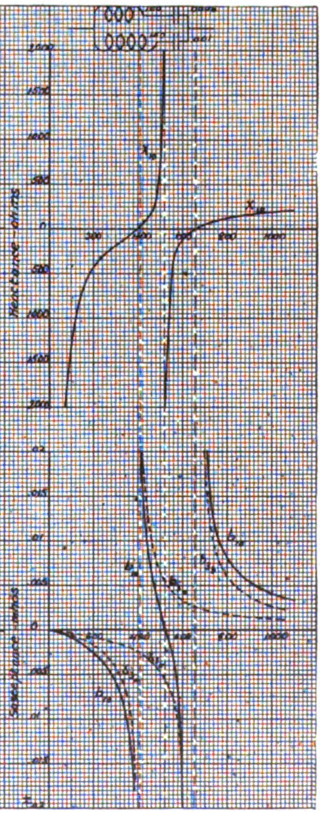


Fig. 10

lar value of frequency the reactance is zero. With L_1 and C_1 in series, the circuit will have zero reactance for 410 kilo-cycles. With L_2 and C_2 in series the circuit will have zero reactance for 650 kilo-cycles. It will be observed that when the reactance is zero the susceptance is infinity.

Fig. 4 illustrates the reactance and susceptance diagrams for an inductance and capacity in parallel. Fig. 4_a is for L_1 and C_1 while Fig. 4_b is for L_2 and C_2. Such a circuit is frequently called a parallel resonant circuit.

Since reactances of circuits in parallel can not be added directly, susceptance diagrams can be used, for susceptances of circuits in parallel can be added directly. b_1 is the susceptance diagram of the inductance and b_2 is the susceptance diagram of the capacity. The susceptance of the entire circuit is the algebraic sum of b_1 and b_2 and is shown as b_4. The corresponding reactance diagram was obtained by plotting the reciprocal of b_4 and is shown as X_4.

The simple parallel circuit has one resonance point, that is, for one particular trequency the reactance is infinite. With L_1 and C_1 in parallel, the circuit will have infinite reactance for 410 kilo-cycles. With L_2 and C_2 in parallel, the circuit will have infinite reactance for 650 kilo-cycles.

Fig. 5 illustrates the reactance and susceptance diagrams for a circuit consisting of a capacity in series with a parallel resonant circuit. X_4 is the reactance diagram of the parallel resonant circuit (L_1C_1) and X_2 is the reactance diagram of the series capacity (C_1). The reactance of the entire circuit is the algebraic sum of X_2 and X_4 and is shown as X_5. The corresponding susceptance diagram is shown as b_5. This circuit has two resonance points, one of infinite reactance for 410 kilo-cycles and one of zero reactance for 290 kilo-cycles.

Fig. 6 illustrates the reactance and susceptance diagrams for a circuit consisting of an inductance in series with a parallel resonant circuit. X_4 is the reactance diagram of the parallel resonant circuit (L_1C_1) and X_1 is the reactance diagram for the series inductance (L_1). The reactance of the entire circuit is the algebraic sum of X_1 and X_4 and is shown as X_6. The corresponding susceptance diagram is shown as b_6. This circuit has two resonance points, one of infinite reactance for 410 kilo-cycles and one of zero reactance for 590 kilo-cycles.

Fig. 7 illustrates the diagrams for an inductance in parallel with a series resonant circuit. b_3 is the susceptance diagram of the series resonant circuit (L_1C_1) and b_1 is the susceptance diagram of the inductance (L_1). The susceptance of the entire circuit is the algebraic sum of b_1 and b_3 and is shown as b_7. The corresponding reactance diagram is shown as X_7. This circuit has two resonance points, one of zero reactance for 410 kilo-cycles and one of infinite reactance for 290 kilo-cycles.

Fig. 8 illustrates the diagrams for a capacity in parallel with a series resonant circuit. b_3 is the susceptance diagram for the series resonant circuit (L_1C_1) and b_2 is the susceptance diagram for the capacity (C_1). The susceptance of the entire circuit is the algebraic sum of b_2 and b_3 and is shown as b_8. The corresponding reactance diagram is shown as X_8. This circuit has two resonance points, one of zero reactance for 410 kilo-cycles and one of infinite reactance for 580 kilo-cycles.

Fig. 9 illustrates the diagrams for two parallel resonant circuits in series. X_{4a} is the reactance diagram of one parallel resonant circuit (L_1C_1) and X_{4b} is the reactance diagram of the other parallel resonant circuit (L_2C_2). The reactance of the entire circuit is the algebraic sum of X_{4a} and X_{4b} and is shown as X_9. The corresponding susceptance diagram is shown as b_9. This circuit has three resonance points, two of infinite reactance for 410 and 650 kilo-cycles respectively and one zero reactance for 520 kilo-cycles.

Fig. 10 illustrates the diagrams for two series resonant circuits in parallel. b_{3b} is the reactance diagram for one of the series resonant circuits (L_1C_1) and b_{3b} is the susceptance diagram of the other series resonant circuit (L_2C_2). The susceptance of the entire circuit is the algebraic sum of b_3, and b_{3a} and

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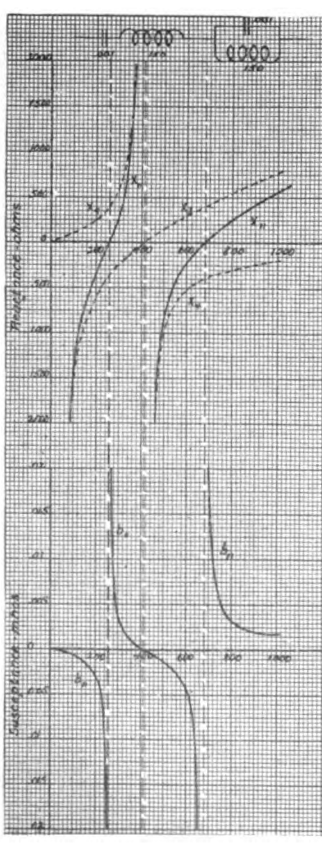

Fig. 11

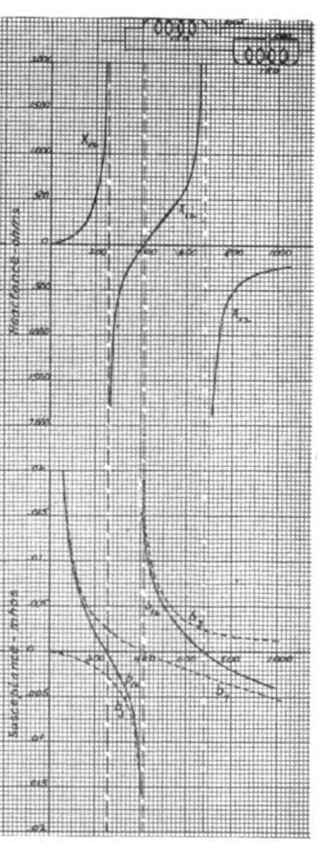

Fig. 12

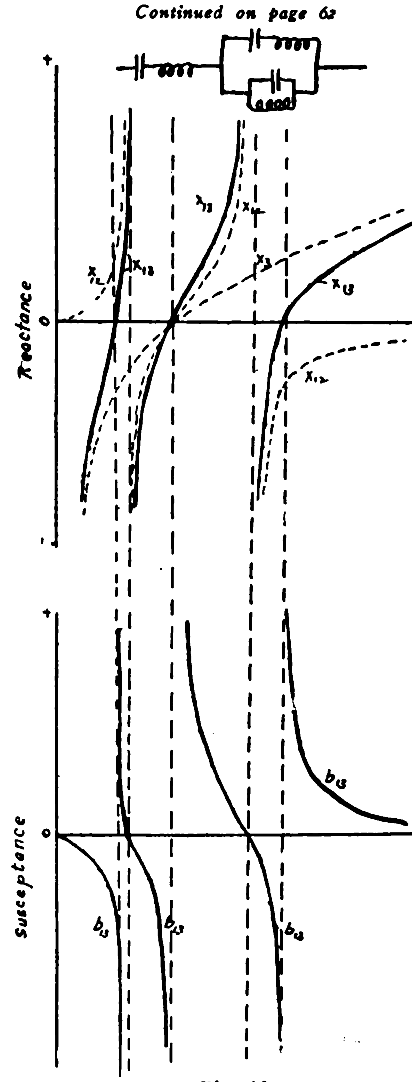

Fig. 13

Proposed National Electric Code Revisions

With Comment by Bureau of Standards

THE proposed revisions of Rule 86 of the National Electrical Code, as applied to receiving stations only, were published in June RADIO. Herewith are the proposed changes of rules for transmitting stations, together with a discussion and explanation of the proposals for both receiving and transmitting stations by the radio laboratory of the U. S. Bureau of Standards.

Suggestions for improvements in these proposed rules should be sent to William S. Boyd, Chairman, 175 W. Jackson Boulevard, Chicago, not later than September 1, 1922.

For Transmitting Stations

g. Antennae outside of buildings shall not cross over or under electric light or power wires of any circuit of more than six hundred (600) volts or railway trolley, or feeder wires nor shall it be so located that a failure of either the antenna or of the above mentioned electric light or power wires can result in a contact between the antenna and such electric light or power wires.

Antannae shall be constructed and installed in a strong and durable manner and shall be so located as to prevent accidental contact with light and power wires by sagging or swinging.

Splices and joints in the antenna span shall, unless made with approved clamps or splicing devices, be soldered.

h. Lead-in wires shall be of copper, approved copper-clad steel or other metal which will not corrode excessively and in no case shall they be smaller than No. 14.

Antenna and counterpoise conductors and wires leading therefrom to ground switch, where attached to buildings, must be firmly mounted 5 in. clear of the surface of the building, on non-absorptive insulating supports such as treated wood pins or brackets equipped with insulators having not less than 5 in. creepage and air-gap distance to inflammable or conducting material. Where desired approved suspension type insulators may be used.

i. In passing the antenna or counterpoise lead-in into the building a tube or bushing of non-absorptive insulating material shall be used and shall be installed so as to have a creepage and air-gap distance of at least 5 in. to any extraneous body. If porcelain or other fragile material is used it shall be installed so as to be protected from mechanical injury. A drilled window pane may be used in place of bushing provided 5 in. creepage and air-gap distance is maintained.

j. Protective Grounding Switch. A double-throw knife switch having a break distance of 4 in. and a blade not less than 1/8 in. by ½ in. shall be used to join the antenna and counterpoise lead-ins to the ground conductor. The switch may be located inside or outside the building. The base of the switch shall be of non-absorptive insulating material. Slate base switches are not recommended. This switch must be so mounted that its current-carrying parts will be at least 5 in. clear of the building wall or other conductors and located preferably in the most direct line between the lead-in conductors and the point where ground connection is made. The conductor from grounding switch to ground connection must be securely supported.

k. Protective Ground Wire. Antenna and counterpoise conductors must be effectively and permanently grounded at all times when station is not in actual operation (unattended) by a conductor at least as large as the lead-in and in no case shall it be smaller than No. 14 copper or approved copper-clad steel. This ground wire need not be insulated or mounted on insulating supports. The ground wire shall be run in as straight a line as possible to a good permanent ground. Preference shall be given to water piping. Gas piping shall not be used for the ground connection. Other permissible grounds are the grounded steel frames of buildings and other grounded metal work in buildings and artificial grounding devices such as driven pipes, plates, cones, etc. The ground wire shall be protected against mechanical injury. An approved ground clamp shall be used wherever the ground wire is connected to pipes or piping.

l. Operating Ground Wire. The radio operating ground conductor shall be of copper strip not less than 3/8 in. wide by 1/64 in. thick, or of copper or approved copper-clad steel having a periphery, or girth (around the outside) of at least ¾ in. (for example a No. 2 wire) and shall be firmly secured in place throughout its length. The radio operating ground conductor shall be protected and supported similar to the lead-in conductors.

m. Operating Ground. The operating ground conductor shall be connected to a good permanent ground. Preference shall be given to water piping. Gas piping shall not be used for ground connections. Other permissible grounds are grounded steel frames of buildings or other grounded metal work in the building and artificial grounding devices such as driven pipes, plates, cones, etc.

n. Power from Street Mains. When the current supply is obtained directly from street mains, the circuit shall be installed in approved metal conduit, armored cable or metal raceways.

If lead covered wire is used it shall be protected throughout its length in approved metal conduit or metal raceways.

o. Protection from Surges, etc. In order to protect the supply system from high-potential surges and kick-backs there must be installed in the supply line as near as possible to each radio-transformer, rotary spark gap, motor in generator sets and other auxiliary apparatus one of the following:

1. Two condensers (each of not less than ½ microfarad capacity and capable of withstanding 600 volt test) in series across the line and mid-point between condensers grounded; across (in parallel with) each of these condensers shall be connected a shunting fixed spark gap capable of not more than 1/32 in. separation.
2. Two vacuum tube type protectors in series across the line with the mid-point grounded.
3. Non-inductively wound resistors connected across the line with mid-point grounded.
4. Electrolytic lightning arresters such as the aluminum cell type.

In no case shall the ground wire of surge and kick-back protective devices be run in parallel with the operating ground wire when within a distance of 30 ft.

The ground wire of the surge and kick-back protective devices shall not be connected to the operating ground or ground wire.

p. Suitable Devices. Transformers, voltage reducers, keys, and other devices employed shall be of types suitable for radio operation.

Discussion and Explanation

These rules do not apply to radio equipment installed on shipboard, but have been prepared with reference to land stations.

Receiving Equipment

a. Antenna. Indoor receiving antennae are not included within the requirements of this proposed rule, which provides for the protection of radio equipment against lightning. Indoor receiving antennae and auxiliary apparatus are, however, included in the general requirements covering the wiring of signal systems, for it is obviously desirable to insure, for example, the freedom of all receiving apparatus from contact with electric power circuits either inside or outside of buildings.

It is desirable that electrical construc-

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Scratchi Gets a Broadcast Earful

By David P. Gibbons

To Editor RADIO (which endeavor to tune all the jangly notes into harmonic chorus.)

Sir Dear:—

In recent bout which my Cousin Scratchi engage with Hon. Radio Inspec., you remember mightbe, Mr. Editor, he got knocked for row of Mexican bean-pots. He are complete mentally wreck, capsized, bottom-up, waterloggy menace to navigators, so for rest cure he decide to rig up very simple receiver described by trained expert of the Daily Yowl and listen to musical strains which ether are full up with.

For three days and four nights he strew highly confused messup from kitchen to roof and back again. Grand jumble consist greatly of henry coils, black chew-gum which hold same asunder in box, paper fasteners, clothespins, catswhishers and other ends and odds which expert have sniggested for set that all children can build. "Must mean oldish children of Methusalem," mutter Scratchi, while making pigstail splicings with knotty wire around Faker Oats box.

When I see that my cousin are on edge of another nervy smashdown, I visit honest retail friend and purchase latest model Barko Receiving Set, Type 000. New style tube which come along with this fitout, he inform me, have no filament, no grid and no plate but are not yet on market, owing to vast volume of something or another, and in meantime he design that I use the RAZ4 Type Audion, which operate on half per cent of one volt and not very critical about that. After he burn up several of these Scratchi go out and buy regular tube and at last we hear KPH quite plain. He jiggle around some more and then we hear loud burr-r-r and swishh-h-h noises and we know sweet phoney music are about to pour fourth into many listening earpieces, so we prepare for jolly eventide of highclassy programs.

First voice which ramble down aerial are quite feeble as we strain eardrums to grab any, but we soon give them resting spell, as it denounce rapidly, "This are station Glub Glib Blaa brawcassin'. First slecshun t'ni' are violin solo by Fritz Pieface——" But Scratchi turn out filament to save juicy battery as we hear Humoresque many, many times and violin soloist never execute anything else. Next six slecshuns are foxytrotting pieces played by Royal Jazziola Troupe, direct from extensive run in Congo, and Scratchi save more current as he say he can obtain same defect by making very loosely connection on "B" battery and pounding table with fists. When we light up again denouncer are saying for eleventeenth time, "This station are owned, controlled, managed and operated by the Blump-Blomp Radio Co. We are in debt for the musiky numbers to the Tynpani Organ House, needles are kindly loaned by the Victory Funnygraft People, the table is furnished by the Mary Ann Period Furniture Society and the chair are donated by the Maison de Fromage. You will confer fine favor on us by writing letters and telegrams to those gents thanking them for great crusty and how muchly you have enjoyed this splendor program. That will be all from Glub Glib Blaa this evenin'. Goo' ni'."

Quite soonly after him we hear some more swooshing and whiffing and thickish voice say, "Hello! Hello! (18 times) Zee Kee Zoo callin' (12 times). How you gettin' me, ole man? (10 times). Come back ole man (8 times)." Scratchi say, "He come in like farmboy making Spanish speech down empty well. Hope that ole man gone where they never come back from."

After 15 or so minutes of this QRM he start his program. First number he produce as special treat are lecture by Hon. Traveling Professor from Leavenworth University, Rufus J. Whoozzat, entitle, "How I made my pile." Next special treat which he donate are exhibition of flapper language and flipper costumes by denoted Oaklander, Miss Muriel O'Kavnaw, in person, who are visiting America for first occasion. "This are a screech!" Scratchi slang me as new tube turn blue around gills.

Number after this, he propose, are piano reciting by Ignatz Polaxski and Scratchi are much ticklish, as he highly enjoy piano recitings, but not for long, as he discover this are not a really piano at all, but machine like that formally used to accept continuous input of nickels, while helping old soaks pass pleasing hours in back room. Scratchi say, "Better shut off quickly before he begin reciting 'The Sheik' by populous request," and we save 3 or 4 additional amps.

When we pick him out again he are taking slight exercise for imagination as he say, "Hello! Mr. Spring Bock of South Africa! Hello! Mr. Shammy of Patagonia! Hello! Mr. Kang Aroo of Australia! Glad to know you are all getting us so well over there! Hello! Mr. John Doe of Honolulu! Thank you for nice lemons you sent, and Hello! Mr.——" but Scratchi have hanged up fones on hook and slapped airy switch as bedtime signal.

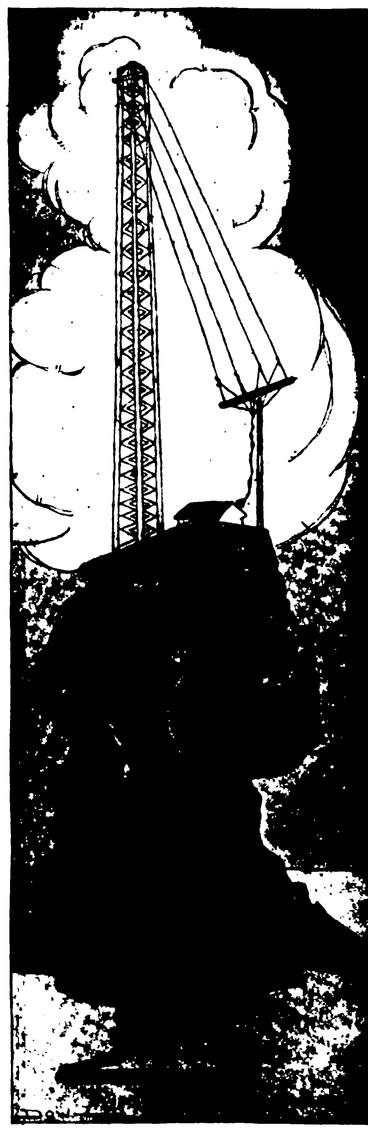
While he are hiding new triode in obscure recess under pillow I demand to know if we shall continue to improve our intelligences next eventide in similar manner.

"Tomorrow night," he tone back, "I require mentally relief from such and shall read few volumes of Einstein or so. These are lighter drains on nervy system, and only effect one victim simultanely."

He are recovering very gradually, Mr. Editor, and hoping you are likewise, I enclose myself, Verily yours,

HILOLI NOGO.

Radio equipment is being sold by all sorts of stores, everywhere. "Jelliometers" are sold by delicatessen stores, bakelite by bakeries, ground clamps by florists, sockets by plumbers, aerials by milliners, tuners by music dealers, detectors by Burns, receivers by banks, plates by crockery stores, but the prize story is told by W. E. Lufkin, former president of the San Francisco Radio Club. While he was in a Powell St. jewelry shop trying to pawn a wedding ring, a youth tried to buy a crystal, saying that he was told he could buy one in any jewelry store.



Why Not a Tongue for the Sphinx?

Harmo-Radiopathy

By Earl Ennis

IT was toward the end of 1950—in October to be exact—that the world was suddenly jarred out of a condition of peace and normalcy by the development of a critical situation at the International Musical Epicentrum on the Island of Yap. On a Saturday night of that month, at 8 o'clock in the evening, universal meridian time, the lights in the wireless receivers in millions of homes all over the world twinkled in unison. Almost immediately thereafter, the voice of the announcer-general at the international broadcasting station at Berne was heard.

"Ladies and gentlemen," he said. "We regret to announce that there will be no music from Yap . . tonight."

The words fell upon startled ears. No music from Yap? Impossible! There must be some mistake. There was a moment of hushed silence as men and women fronted each other with whitened faces. The next instant, the universal query disk at the Berne station burst into sudden brilliance as millions of fingers all over the world reached for the third button of the Automatic Radio Language Questionnaire and pressed it—hard. The button bore on its surface the word "Bjorbllcm," which in the condensed stenographic speech of the period meant: "Are you certain of your facts and being so can and will you inform me concerning the reasons leading up to and responsible for such a state of affairs?"

The announcer-general shook his head sadly and turned to his transmitter. "I have no information at present," he said wearily. "I hope you will all be patient until . . . "

He left the sentence unfinished and snapped off his transmitter. He and the chief engineer of the big news station faced each other before the intricate switch board that controlled the powerful bulletin waves.

"There is only one way," said the chief engineer.

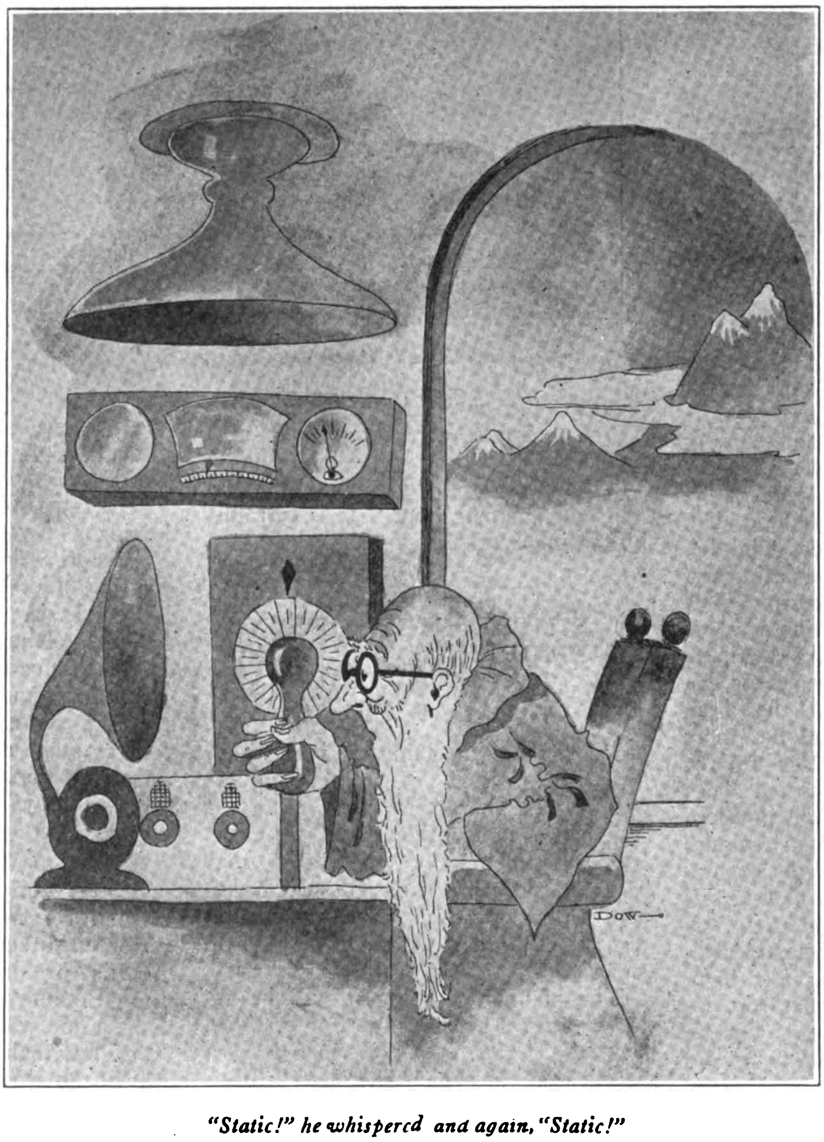
The announcer-general nodded.

"And if that fails . . . ?"

The chief engineer shook his head.

"If that fails—we can do nothing!" he said.

He walked to a tiny, nickeled lever at the far end of the switch board, over which burned a perpetual crimson pilot-light. It was the lever which controlled the sinuous, coiling, undulating exploration wave, from which nothing could be concealed. Above it was the great chart of magnetic decrements—the chart on which was noted the resident magnetic value of every important spot on the earth's surface. His eye sought out Yap—the tiny spot near the Japanese coast—taking in the close-written numbers of the decrement. He touched the buttons of the control—setting the destination points in the code designation of Yap—G-51 south 9x. As the last button slipped into place, he reached for the lever and thrust it home. Instantly the meters over his head began to dance and the powerful exploration wave, swirling around the conical radiators over his head, raced forth into the night, seeking the solution to the mysterious silence from the Island of Yap.



"Static!" he whisperd and again, "Static!"

"Yoo-hoo!" wailed the wave. "Oh, Yap—yoo-hoo!"

It whipped among the ice-floes of the northern sea and a hollow reverberation was the only response. It swirled down among the typhcons of the tropic waters, and only the breadth of a whisper returned. It whined through mountain passes, it sped over jungles, it poked behind continents, it gyrated around the Japanese coast, encircling the Island of Yap and making more noise than a Democratic convention conducting a secret ballot. Tired and exhausted, it returned again to Berne—back into the wave recharger—with not a scrap of success to mark its flight. Yap was as silent as the grave.

By 8:30 that evening every man, woman and child knew that some sinister calamity was overhanging the world. Business suspended. Cafes shut down. Opera stars cancelled contracts and went home, throwing whole acres of impresarios into hysterics. Into many minds crept the almost forgotten prophecy of Peccan—greatest musician of his time — he who had played the monster steam ukulele at the peace jubilee in '42—that some day this very thing would transpire.

"Comes it — someday—silence!" he had said.

The world had scoffed at him, steeped in the drunken revelries of its noise-maddened existence—scoffed until his ashes had been placed in a silver shell and fired out into the eternal spaces by the magnetic planetary defense gun, whose projectiles, by the law of centrifugalics, were destined to whirl among the asteroids for all time. Was Peccan, now, after all these years, to be vindicated?

Continued on page 44

RECEPTION OF SHORT WAVE DX SIGNALS IN HAWAII

By T. A. MARSHALL

LONG distance transmission of radio signals at short wavelengths is dependent mainly on the choice of the receiving apparatus, if due consideration is not given to locality in which the receiving station is located. This is the general opinion of the radio fans of Honolulu. Amateurs here consider a variocoupler, such as the Remler type, tuned regenerative set with a detector and two stage amplifier as the most efficient type of receiver for receiving Coast amateurs.

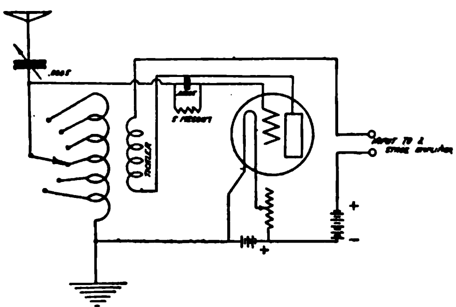


Fig. 1.—Variocoupler Tuned Regenerative Receiver

In Fig. 1 is shown a variocoupler tuned regenerative receiver. Heretofore the reason for failure of amateurs of this district in receiving coast amateurs is due to the location and type of receiving apparatus. This has been definitely proven by the writer, who has carried on considerable experimental work in receiving coast amateurs.

Some time ago an invitation was extended to the writer to make a trip to Makapuu Point, which is the most distant point from QRM. It has been often said that Oahu Island has more QRM than any other place in the world. Makapuu Point is located about 25 miles from the Navy high powered arc station, and about the same distance from the big set of the Radio Corporation of America at Kahuka. On April 22nd a truck was secured and a trip was made to Makapuu Point. Shortly after our arrival we had erected a 55 ft. bamboo mast and a four-wire flat top, inverted L antenna, 75 ft. long. The receiving equipment was placed in an old wash house where a water pipe served for a good ground. For long wave reception duo-lateral honeycomb coils were used. Every arc station under the American flag was logged. I might add right here that most of those who think that good work cannot be done on honeycomb coils have never learned to use them correctly.

After enjoying a good campfire meal and inspecting the lighthouse, a watch was started on short waves. At 9:10 p. m. 6ZX was picked up. His signals were so steady and so seemingly dependable that I wished for a transmitter with which to make a real record. Nothing further was heard until we changed bulbs. A UV-200 brought in 6KY, 6ZB, 6TQ, and 6EX. Many calls were lost on account of jamming and harmonics from Heeia arc station. 6ZZ came in very QSA. Finally at 9:57 p. m. 6ZI came rolling thru in good style as he worked with Dow, 6ZAC. The stations heard up to 12:30 a. m. follow: 6ZG, 6ASJ, Chas. L. Elvin, Oakland, Calif.; 6ZAC, 6SY, GP, 6KI, 5BG, 7AC, 6NB, 6NY.

The most remarkable feature was the strength of the signals from 6ZI and 6ZG. The latter station was easily

Antenna and Shack

read 25 feet away from the receiver. Three messages were intercepted from 6ZG. If the editor will tolerate us we will have more to tell about our next trip and amateur hunt. It is certainly interesting work.

A SIMPLE METHOD FOR MEMORIZING THE CONTINENTAL CODE

By DAVID P. GIBBONS

No extravagant claims are being made for this method of committing to memory the characters representing the alphabet in the Continental Morse Code. It is believed however, that its use may be of considerable value to such beginners as have unusual difficulty in this respect. In other words it may "help some."

The manner of using it will be apparent after a brief study. For example, take the letter L. The word used is "linoleum," in which the letter itself occurs twice. The first syllable (lin) has a short accent, the second (ol) a long accent, and the two final syllables (e, um) short accents, thereby reproducing the dot-dash-dot-dot, which form the Morse character representing the letter.

Again take the letter Q. Here three words are used to obtain the proper accents and at the same time include the letter itself. The first two words (quite, queer)—of one syllable each—are long, the third syllable (in-) is short, and the final syllable (-deed) is long, thus giving the dash-dash-dot-dash, which represents Q in the Continental Code.

Similarly the connection between the other letters and the corresponding words will be seen on inspection, and the correct combination of SOUNDS for any given letter be more readily impressed on the memory.

A *Away* - —
B *By B*illiken's — - - -
C *C*rowded *C*loister — - — -
D *D*angerous — - -
E *E*ggs -
F *Fifi F*oolish - - — -
G *G*ood *G*racious — — -
H *H*illy Billy - - - -
I *Izzie* - -
J *J*erome *J*ay *J*ones - — — —
K *K*o*k*omo — - —
L *L*ino*l*eum - — - -
M *M*ile-long — —
N *N*ailer — -
O *O*z*o*ne bl*o*ws — — —
P *P*ersuades *P*eter - — — -
Q *Q*uite *Q*ueer indeed — — - —
R *R*eported - — -
S *S*en*s*itive - - -
T *T*ube —
U *U*ndertaker - - —
V *V*isible glow - - - —
W *W*ith *W*hite *W*ire - — —
X Hoa*x* silly jokes — - - —
Y *Y*earl*y* told *y*arns — - — —
Z *Z*ero weather — — - -

If the student find any particular difficulty in memorizing the various words selected he might connect them together to form sentences like the following: Away by Billiken's crowded cloister the dangerous eggs made Fifi foolish. "Good gracious!" said the hilly-billy to Izzie, "look at Jerome Jay Jones laying linoleum with a mile-long nailer, while the ozone blows and persuades Peter he is quite queer indeed, as it is reported that a sensitive tube will undertake to make a visible glow with white wire, but such hoax, silly jokes and yearly told yarns are a sign of zero weather."

Radio control of ships was discussed by Max Laubeuf, formerly chief engineer of the French Navy, in his presidential address before the Society of Civil Engineers. Reference was made to the fact that "the battleship Iowa with nobody on board was driven with the utmost ease by the battleship Ohio, which kept at a distance of five miles behind. The experiment lasted three hours and no mishap whatever happened." M. Laubeuf further explained that the water and oil taps of the Iowa were opened and closed by the radio waves emitted from the Ohio in order to increase or diminish at will the speed of the driven crewless battleship. The helm was also maneuvered from a distance, and the Iowa avoided with great accuracy the air attacks made upon her.

A Radio Primer

By H. A. Eveleth

The Vacuum Tube

BEFORE we consider in detail the operation of the vacuum tube detector and vacuum tube amplifier as employed in modern receiving apparatus it may be well to bring out what an important electrical development is the three-electrode vacuum tube which is used to detect and amplify radio signals. It is claimed by some that this device is the most important electrical development of the twentieth century so far.

A long time ago Edison made a two electrode tube containing a filament and a plate. Later Fleming, one of Marconi's engineers, used this two electrode tube as a detector of "wireless" waves. Finally DeForest, about the time the war broke out, added a third electrode, the grid, and since then wonderful things have been accomplished.

Credit for long distance telephone communication over land wire between San Francisco and New York belongs to the vacuum tube. It will relay and amplify or magnify the voice perfectly, without distortion when properly adjusted, which enables telephone communication to be carried on over great distances.

Using a series of tubes the human voice can be magnified a million times. If one tube amplifies ten times two will amplifiy one hundred times, hence six will amplify a million times.

When services were held over the grave of the Unknown Hero near Washington, D. C., every word uttered was understood by a large audience in the San Francisco Auditorium. The vacuum tube relay and amplifier made this possible.

The combination of detector and amplifier tubes makes it possible to detect, in radio communication, much smaller values of electrical energy than can be detected with the crystal detectors. Not only does this greatly increase the range and efficiency of radio communication, but makes possible the use of small portable aerials such as are used for compass work and on aeroplanes and submarines.

When properly connected these tubes will generate a high frequency current of constant amplitude which may be used for both radio code and telephone work and a tube may be used to modulate current in telephony. Also the C. W. (continuous wave) permits much sharper tuning and practically eliminates interference between stations.

The detecting and amplifying actions of the vacuum tube depend primarily on the electron flow between two elements of the tube called the filament and the plate. The metallic plate surrounds the filament, but is insulated from it and is connected to a terminal on the base of the tube. The filament is connected to base terminals and operates from a six volt storage battery. A rheostat is connected in series to control the current flow and hence the temperature of the filament. A flow of electrons, or negatively charged particles, takes place between the heated filament and the comparatively cold plate.

To explain this action let us consider briefly the composition of matter, that is, what goes to make up material or objects. Consider a piece of ordinary yellow brass. We might attempt to divide it into the smallest particles possible by using a very fine file. This would give us brass dust. Now each particle of this dust would consist of millions of still smaller particles of brass called molecules, but we could never hope to divide the brass into its molecules nor see them with the most powerful microscope. Molecules are the smallest particles which combined make up a visible object.

Now this yellow brass is made by mixing two elements, 67 parts of copper and 33 parts of zinc. Copper and zinc are called elements because they are not a mixture of two or more other substances. These elements are in turn composed of extremely small particles called atoms and the size and other properties of these atoms determine the kind of element. Thus an atom of copper differs from an atom of zinc, but all copper atoms and all zinc atoms are alike.

The atom is supposed to consist of particles of negative electricity called electrons. It is assumed that these electrons revolve about a positive central point within the electron like the planets revolve about the sun and it is the number and group arrangement of these electrons which determine the nature of the atom, that is, whether it is a copper atom or a zinc atom. There are many kinds of atoms besides these two.

Also there are electrons moving about between the different atoms called free electrons.

The particles of matter are supposed to be in a state of motion or vibration. The molecules are vibrating within the piece of brass and the atoms of copper and zinc which compose the brass are vibrating within the molecules.

If heat is applied to the brass the molecules vibrate faster and through a greater amplitude or space. Naturally they take up more room and we say the brass expands. On the other hand if the brass is cooled the amount of vibration is decreased and the metal is said to contract.

We said in the last letter that there are free or extra electrons moving about between the atoms. Now if we increase the vibration of the atoms by applying heat there will be more space between the atoms and hence the free electrons will have more room in which to move about. If the metal is made very hot the atoms will vibrate so much that the free electrons will escape from between them and leave the surface of the metal.

This is just what happens in the vacuum tube. We heat the tungsten filament by passing an electric current through it and the result is that free electrons or negative charges of electricity pass from its surface and we can control the amount of electrons which pass by adjusting the temperature of the filament.

The object is to secure a flow of negative particles or electrons from the filament to the plate so a second battery called a "B" or plate battery is connected with its positive terminal to the plate and its negative terminal to the filament. The plate will then be charged positively and will attract the negative particles or electrons emitted from the filament and the result is an electron flow in the vacuum tube from the filament to the plate.

A third electrode, called the grid, is inserted between the filament and plate. When connected properly with external circuits the grid will regulate the electron flow so that the tube will detect or amplify electric currents.

Grid Action

Picture in your mind the three-electrode vacuum tube in operation: the lighted filament from which a stream of electrons is flowing to the positively charged plate and the grid or wire screen interposed between the filament and plate, through the meshes of which the electrons must pass.

This electron flow constitutes a current of electricity in the plate circuit, the dry "B" battery being connected by its negative and positive terminals respectively to those two electrodes of the tube.

If the grid receives a negative charge of electricity from an outside source it will repel to a certain extent the negative charges of electricity or electrons which are passing through its meshes to the plate because charges of similar polarity repel each other — positive charges repel positive charges but attract negative charges and vice versa. If the negative potential or negative charge of the grid is increased the point will be reached where the repulsive effect of the grid on the electrons will neutralize or equal the attractive force exerted by the positively charged plate. The electron flow will stop and the current flow in the plate circuit will cease.

On the other hand if the grid is given a positive charge it will attract electrons emitted from the filament and the combined attraction exerted by both plate and grid will result in an increase of current flow in the plate circuit. However, since the grid is charged positively some of the electrons will remain with the grid instead of passing through the grid to the more positively charged plate beyond. This will result in a current flow in the grid circuit from grid to filament which will act in part toward limiting the current flow that can take place in the plate circuit.

As the positive charge on the grid is increased the electron flow and hence plate circuit current increases at a rate more rapid than the positive grid potential and finally the point of saturation is reached when no further increase of plate current will result because the attractive effect of the positive grid on the electrons is neutralized by the excess of negative electrons flowing through the tube.

Detector and Amplifier Action

To explain the detector action let us consider a hook-up using a loose-coupler, a grid condenser and grid leak, telephone receivers, vacuum tube, storage battery and plate or "B" battery. The primary winding of the coupler is connected to aerial and to ground. The secondary winding is connected to one terminal of the grid condenser and to the negative terminal or side of the storage battery which heats the filament of the tube. The other side of the grid condenser is connected to the grid element in the tube. The grid condenser is therefore in series with the grid and one terminal of the secondary winding of the coupler. Connected to the terminals of the grid condenser (in shunt with it) is a high resistance called the gridleak. The positive terminal of the plate or "B" battery is connected to the plate element within the tube with the telephone receivers in series.

When no oscillations are taking place in the aerial circuit and the filament of the tube is heated, an electron flow takes place and permits a definite current to flow through the telephone receivers. When the aerial "picks up" a station and an alternating current at radio frequency is set up in the aerial circuit a current at like frequency is set up by induction in the secondary winding of the coupler (when the secondary circuit is tuned to the primary circuit) and the alternating current passing through the condenser alternately charges the grid within the tube positively and negatively. When charged positively it attracts the negative electrons passing from filament to plate and becomes negatively charged itself; then the grid leak permits this negative charge to leak off from the grid which then assumes its normal potential or original state. Since a change in grid potential causes a change in amount of current flow in the plate circuit a sound will be produced in the telephone receivers, the frequency of which will correspond to the frequency of the groups of oscillations or "wave trains" sent out by the transmitting station. The grid acts as a relay to control the plate current flow much as you could control the flow of a powerful stream of water by manipulating a mechanical valve.

A very slight amount of energy acting on the grid element produces a comparatively large variation of current in the plate circuit; the grid acts as a relay, as it were, to control a larger amount of energy. It is an electron relay. Referring again to the water analogy, the expenditure of a comparatively small amount of energy in operating the mechanical valve would control a very much larger amount of energy represented by the powerful stream of water. It is therefore apparent that the vacuum tube will amplify as well as detect.

Several vacuum tubes may be connected in circuit with transformers interposed and the combination of two amplifier bulbs and two transformers will give an energy amplification of about ten thousand times. The primary winding of the transformer is connected to the plate of one tube and positive terminal of the plate battery and the secondary winding is connected to the grid of the next tube and negative terminal of the plate battery. The pulsating direct current set up in the plate circuit of the first tube passes through the primary winding of the transformer and sets up an amplified alternating current in the secondary winding which acts on the grid of the second tube.

Amplification may be at audio frequencies or at radio frequencies. In the former case the energy received is amplified after it has been rectified by the detector bulb and rendered audible. In the latter case the energy is amplified before it is rectified by the detector. Several stages or steps of radio frequency amplification will enable the detector to function on signals it otherwise would not pick up and the audio frequency current may then be put through several stages of audio frequency amplification and the combination of the two kinds of amplification gives more satisfactory results than can be obtained with an equal number of stages all at audio frequency.

When the plate voltage of a tube is increased a greater current will flow in the plate circuit. Detector bulbs are usually designed for 22½ to 35 volts plate potential. If the voltage is increased much a blue glow will be observed around the plate and a hissing noise will be heard in the receivers. If the degree of vacuum in the tube is not correct and the blue glow occurs at normal plate voltage the tube is said to be *soft* and less plate voltage should be used. Tubes which operate at a definite plate voltage and degree of filament temperature are said to be critical. Most amplifier bulbs are non-critical and while they will function at low plate voltages the addition of sufficient "B" battery to bring the plate voltage to 100 and over will greatly increase the amount of amplification. Amplifier tubes are therefore made *hard*, the degree of vacuum being sufficient to prevent the plate glow at comparatively high plate potentials.

Amplifier circuits must be designed carefully to prevent induction effects between adjacent wires which will cause howling and distortion. Furthermore, three stages of audio frequency amplification are about the practical limit because any sounds not desired are brought out so strong that they are very objectionable, especially when music or speech is being received.

A human antenna was accidentally discovered by Captain D. H. Muse of Cincinnati, Ohio, while listening to a concert broadcasted by the Crossley Mfg. Co. The ground wire of the set had been disconnected to demonstrate that the set still would receive. Then Captain Muse, his hands slightly moist with perspiration, unhooked a 3 ft. insulated copper wire leading to his outside aerial and by accident held the bare, exposed end of the metal strand in his fingers. To his surprise, music, faint but audible, continued to reach his ears through the head phones. Captain Muse clamped a pair of head phones on his phonograph, so the horn would act as an amplifier. Then he held the bare wire in his hand and the room was filled as if with distant music. He transferred the copper strand to his mouth and the harmony instantly was intensified by this more perfect connection. He asked another officer to take hold of the wire with him, and learned that the music came in stronger by virtue of the dual aerial. A third, fourth and fifth man attached himself to the wire at its non-insulated surface and the music became so strong that the doors of the phonograph had to be closed. When all the men let go the wire so that it dangled in midair the sound stopped entirely.

The Vacuum Tube as an Amplifier

By B. F. McNamee

THE type of vacuum tube used as an amplifier is the "hard" or high vacuum tube. The vacuum is so nearly perfect that there is no noticeable effect of gas molecules; in fact, for practical purposes it may be considered a perfect vacuum. The "soft" tube, that is one containing a certain small pressure of gas and intended for use as a detector, can be used to a certain extent for amplification purposes. However this almost always results in distortion which would prohibit its use as an amplifier in radio telephone work, and its use is also restricted because it will not work with high plate voltage, thus limiting the strength of signals that can be obtained.

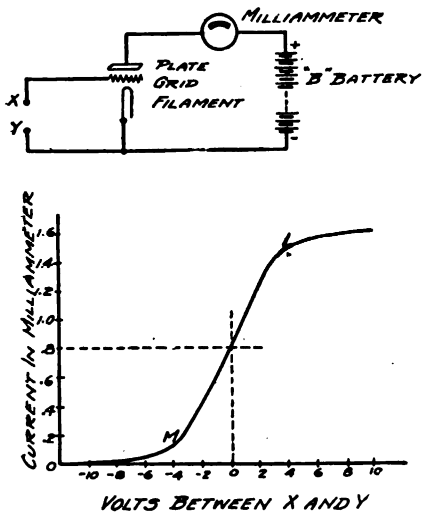


Fig. 1 and Fig. 2

The hard tube therefore is the only one that will be considered in this article.

In the soft tube we have both electrons and gas molecubes acting as carriers of electricity, but in the hard tube the electrons are the only carriers and the action is thus simplified. When the filament becomes incandescent it throws off negative electrons. The B battery is connected with its positive end toward the plate and this positive charge on the plate attracts the negative electrons. There is, therefore, a flow of electrons across the tube from filament to plate and returning to the filament through the meter and B battery shown in Fig. I. As long as no charge is placed on the grid this current will remain at a steady value of about one or two milliamperes with ordinary B battery voltages.

The grid is a sort of screen interposed between the filament and the plate. The electrons in going from the filament to the plate pass through the openings in this screen. When electric charges are placed on the grid it acts like the faucet in a water pipe since it controls the flow of current through the tube. When a negative charge is placed on the grid, it repels the electrons coming from the bulb and a smaller number of them will reach the plate. If this negative charge is sufficiently great all the electrons from the filament will be repelled and driven back to the filament, and the meter which shows the plate current will read zero. If, on the other hand, a positive charge is placed on the grid, it will accelerate the electrons, and larger numbers will reach the plate. This will increase the current through the meter.

The grid is charged positively or negatively by connecting the battery between the points X and Y in Fig. 1. If points X and Y are connected by a wire, and Y is connected to the negative end of the filament, the grid is said to have zero charge. By changing the voltage of the battery connected between X and Y and marking down the corresponding values of current shown by the meter we obtain the curve of Fig. 2. We note that when X and Y are connected by a wire, that is, when there is zero charge in the grid, there is a current of .8 of a milliampere in the plate circuit. This value of current of course holds good for only one particular adjustment of filament and B battery on one particular tube; we might make this current almost anything we pleased.

Note that as the voltage is increased in the negative direction the current in the plate circuit falls very suddenly until we have reached a negative charge on the grid of 4 volts, corresponding to point M on the curve. As the voltage is increased in the negative direction beyond this point the plate current falls very gradually to zero at about 10 volts.

On the other hand, if the plate voltage is increased in the positive direction the plate current rises suddenly at first until about 4 volts positive has been reached, corresponding to a plate current of 1.5 milliamperes. If we increase the positive charge of the grid beyond this point there will be hardly any corresponding increase in plate current. This is because all the electrons given out by the filament are now reaching the plate and consequently no further increase in plate current can take place except the filament is made hotter. This is known as the saturation part of the curve.

Suppose that a small alternating voltage is connected between points X and Y in Fig. 1. If the voltage on the grid is made to fluctuate from 2 volts positive to 2 volts negative it will be seen that the needle of the milliammeter will show that the plate current is rising and falling between the values 1.2 to .6 milliamperes.

The usual method of supplying an alternating voltage to the grid of a vacuum tube is by means of a transformer, as shown in Fig. 3. The primary of the transformer may be connected to a telephone line and the alternating current in it will in that case consist of voice currents. The transformer is usually of the step-up type in order to supply as great a change of voltage on the grid as is practically possible. Since the grid requires little or no current we can have large voltages from a source supplying very little power. This is the case in long telephone lines where nearly all the power is expended in overcoming resistance losses in the line.

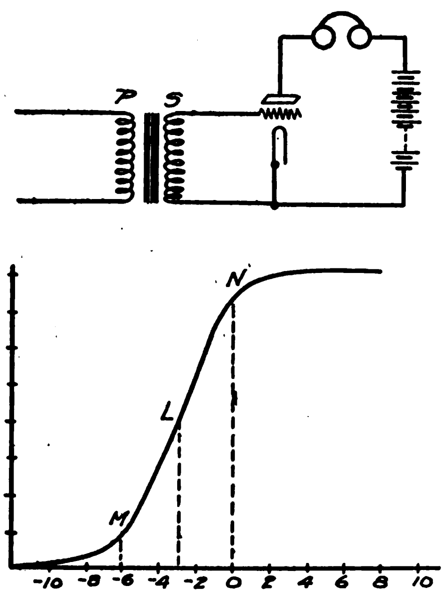


Fig. 3 and Fig. 4

With such a voice-controlled voltage applied to the grid, the current in the plate circuit of the tube will fluctuate accordingly, and if a pair of telephone receivers are used in place of the milliammeter in Fig. 1, the speech of the telephone line will be clearly heard. The result will be much stronger than if the telephone receivers are connected directly in the telephone line, because the energy now used to produce the sound waves comes from the B battery and is simply controlled by the minute amount of energy in the telephone line. The grid circuit of the vacuum tube is for this reason called the control circuit or input circuit, and the plate circuit is known as the output circuit. A very small amount of energy in the control circuit will release in the output circuit a comparatively large amount from the B battery.

In telephone work another transformer would be connected in place of the telephones and this would supply the energy to the continuation of the telephone line. Of course this would provide for one way communication only, but a rather complicated hook-up has been devised, generally using two tubes which provides for amplification in both directions and is used in all long distance telephoning today.

Fig. 4 shows the curve obtained from some types of amplifier tube with certain adjustments of filament and B battery. If this tube were used with the connections shown in Fig. 3, the amplified sounds would be distorted, because a positive charge of let us say two volts would increase the plate current but very little, while a negative charge of the same amount would cause a comparatively large decrease. In order to amplify without distortion it would be necessary that the increase in this case should equal the decrease. This could be brought about by connecting a battery of about three volts between the filament and the secondary of the transformer with its negative end toward the latter. This would bring the plate current to point L on the curve of Fig. 4. If the grid voltage now fluctuates two or three volts in either direction, the corresponding increase and decrease in plate current will be equal and there will be no distortion. Such a battery connected in the grid circuit is called a "C" battery or "bias" battery. Since it supplies little or no current it may consist of the smallest size of flashlight cells.

If more amplification is required than that given by one tube, the telephones of Fig. 3 may be taken out and the primary of another transformer connected in their place. The secondary of this transformer is connected to the grid and filament of another tube, which will amplify the results of the first tube. This action may be continued through four or five tubes in succession, and is known as cascade amplification. Very careful design is necessary in such multi-stage amplifiers in order to prevent distortion.

The matter of "howling" in amplifier circuits can be entirely avoided. This subject will be taken up in the next article of this series, which will deal with the vacuum tube as an oscillator.

SWEDEN AND FINLAND TO GET RADIOPHONE BOND

A radio telephone system to take the place of the contemplated telephone cable between Sweden and Finland now is being investigated by officials of the two governments involved. Estimates place the cost of the cable from 20,000,000 to 40,000,000 marks and the radio station at 10,000,000 marks.

HIGH-FREQUENCY RESISTANCE OF INDUCTANCE COILS

An "inductance coil" is simply a coil of wire wound in any one of a number of different familiar forms. The behavior of such coils in circuits carrying direct current or alternating currents of low frequencies, such as 60 cycles, has been studied for many years and is well known. When the attempt is made to predict the behavior of an inductance coil at radio frequencies by extending the relations which are sufficient to predict its behavior at low frequencies, it is found that other effects are present at the radio frequencies which do not require consideration at the low frequencies. At low frequencies the same number of amperes flows in every part of the wire constituting the inductance coil, and the distribution of the current over a given cross section is practically uniform. At high frequencies the current density is not uniform over a given cross section of a wire, nor is it the same for different cross sections of the wire. The current flow is modified by induction effects of magnetic as well as electrostatic nature. For direct current the resistance of inductance coils can be determined by Ohm's law, but at radio frequencies Ohm's law by no means gives complete information regarding the resistance of a coil. The study of non-uniformity of current density in a particular cross section is the subject of "skin effect," on which various investigators have already done considerable work. The difference in the current flowing across different cross sections of the wire forming a coil is caused by the capacities distributed along the winding of the coil.

An inductance coil behaves in an electric circuit primarily as an inductance. The potentials of the different parts of the coil are, however, different from each other and from the potentials of the ground. For this reason the coil behaves also to a certain extent as an electric condenser, or rather a system of condensers. The impedance of these capacity paths is low at radio frequencies, and the capacities constitute shunt paths for the radio frequency current and cause charges to collect at various points of the coil, thus creating back electromotive forces. There are several effects of the non-uniform distribution of current along the wire, of which the most important is the increase in the resistance of the coil with the frequency. At radio frequencies the resistance of an inductance coil depends upon the point of the coil at which an e.m.f. is inserted and the current measured.

On account of the importance of inductance coils in radio communication, careful studies, both theoretical and experimental, have been made at the Bureau of Standards on capacity effects and other effects in inductance coils at radio frequencies. Some of the results of these investigations are contained in a new publication, Bureau of Standards Scientific Paper No. 430, "The High-Frequency Resistance of Inductance Coils," by Gregory Breit. In this paper a formula for the resistance of an inductance coil is derived which takes into consideration both the skin effect and the capacity effect for the case of a short single-layer solenoid, and the results of experiments are given which check this formula. Other more general formulas for current distribution and resistance are also derived. A copy of this paper may be purchased for 5 cents from the Superintendent of Documents. Government Printing Office, Washington, D. C.

NAVY VACUUM TUBE BIDS REJECTED

Seventeen bids received by the Navy Department for its 30,000 surplus vacuum transmitting tubes were rejected, and new bids called for June 1. The best bid received was at $3.17¾ each. These tubes, although originally purchased for transmitting tubes, can be reslotted and used as receiving tubes. When these tubes are retailed, they must be sold in their original cartons to licensed amateurs only, for experimental or entertainment use. The fact that they are several years old and that they were originally purchased by the Navy as transmitting tubes, must be shown on the label. In case the retailers fail to comply with the regulations of the Navy Department, the tubes will be seized and the payments forfeited.

NORWAY MAY RADIO UNITED STATES

With a new and powerful radio telegraph apparatus being installed on Rundemanden, a 2500 foot mountain at Bergen, Norway, it is believed that direct communication with America will be possible. The radio telegraph will have a 3000 kilometer radius. An 800 kilometer radius wireless phone for communication with England and Continental Europe will also be established. The improvements represent an investment of about $25,000, and are expected to be completed by June 1, according to Consul George Nicolas of Bergen.

A pale blue glow in a detector vacuum tube is due to the ionization or electrical breakdown of the gas in the tube and is generally caused by too high a voltage on the plate from the B battery. The tube usually will not detect until the voltage is reduced.

The detecting efficiency of a three electrode vacuum tube increases with the square of the signal voltage.

OFFICE BUILDING WIRED FOR RADIOPHONES

For the first time in the history of Pacific Coast office building construction, a 15-story skyscraper in San Francisco, the new Matson Navigation Co. building, will be wired throughout for radiophone installation, so that tenants wishing to put in a receiving set will only have to "plug in" the same as for a desk lamp, to a socket in the wall, to be connected up with antennae on the roof and receive broadcasting programs from stations in San Francisco and vicinity.

The building is now in process of construction and will be ready for occupancy next March or April.

Matson Navigation Co. New Building to be wired for Radio.

Not only will the new building be completely wired as a convenience to tenant radiophone enthusiasts, but the company intends to install a powerful sending and receiving set, with which it is expected it will be possible to give orders to the captains of the company's nine freight and passenger ships, all of which maintain a weekly service from San Francisco to all Hawaiian Island ports.

Within the next year the Matson Line hopes to be able to talk by radiophone with its agencies in Honolulu, Hilo and other Hawaiian ports. Only recently a radio amateur at Kahului, Island of Maui, 90 miles from Honolulu, was able to hear with distinctness broadcasting sent out from the Rockridge station in Oakland, 2000 miles away.

THE WORLD'S LARGEST MAGNAVOX

As a means for employing the great drawing power of radio many publicity stunts are being carried out at the present time. One of the very latest is that of building a huge Magnavox and setting it up in an amusement park, thus providing free radio concerts and entertainment for all those who may wish to listen.

The World's Largest Magnavox

The Magnavox here illustrated was designed and built by the engineering department of the Magnavox Company for Idora Park, at Oakland, California. The horn contains 1000 running ft. of clear airplane spruce one inch thick. It has an opening 12 ft. in diameter and is 35 ft. over all. An interesting comparison is that while the bell or opening has an area of 144 sq. ft., the smaller end has an area the exact size of a buffalo nickel.

Connecting to the enormous horn there is a standard Magnavox radio telemegafone energized by one of the latest developments in the audio frequency amplifier science—a super power amplifier, capable of giving to the horn and telemegafone about 1/16 horse power in modulated voice current or sound producing energy, under the influence of the average radio signal. The enormous sound produced can thus be imagined, for only an infinitesimal amount of current is necessary to produce an audible sound in head receivers. The radio concerts are daily heard all over the large amusement park and people have reported hearing the music for over three miles. This use of radio as a drawing card for an amusement park is one which is new in its design, and one which can profitably be used by many other resorts with equal success. The idea for the huge Magnavox must be credited to Mr. York, manager of Idora Park, who is always on the lookout for new and unique methods of amusement.

SIMULTANEOUS MULTI-WAVE BROADCASTING

Within a few months it will probably be possible for a representative of the Government to talk to anyone in the world, or to all people at one time, on the new Naval radiophone transmitting set at NAA, the Arlington station on the Potomac. This statement was made by a high-ranking officer of the Navy Department, who said that the Navy could now send code messages practically around the world, by the use of relays.

Speaking into any ordinary telephone in Washington connected with the Arlington broadcasting station, an official could talk to a Pacific Coast station, which would automatically relay the message within a sixtieth of a second to Pearl Harbor, thence to Guam and Cavite, where the message would arrive only one-quarter of a second after it left Washington. The further routing he did not explain, but it is known that other big stations are in prospect overseas.

The simultaneous broadcasting of a single spoken message from two stations on different wavelengths has been successfully conducted by the Navy, for the purpose of making sure that plans for broadcasting the headquarters dedication program of the National Woman's Party were satisfactory. Through the co-operation of the American Telephone and Telegraph Company, direct wires were strung from the Woman's Party headquarters to the Naval air station at Anacostia and the Naval radio station at Arlington. Test messages spoken at the headquarters were transmitted by wire to these stations and put on the radio broadcasting circuits. At Anacostia, NOF, a 412-meter wave was used, with about 13 amperes radiation, and at Arlington, NAA, on a 2650 meter wave, with 40 amperes.

The system worked perfectly, serving two classes of receiving stations at once, the 412-meter wave furnishing many amateur stations within from 400 to 700 miles, while the long wave served stations equipped with larger receiving sets, between 800 and 1500 miles distant.

The actual broadcasting of the speeches Sunday afternoon, however, was prohibited by Naval officials Saturday, on the ground that the meeting was of a political nature such as previously ruled against by Secretary Denby.

The experiments in simultaneous broadcasting from two stations on different wavelengths have been so successful that it is believed that several stations, not too greatly separated, will soon be able to broadcast a single phone message on a number of different wavelengths at one time, reaching receiving stations nearby and at great distances, even crossing oceans.

With the perfection of this system and the [illegible] sary apparatus, the President, for example, could address practically the whole world, or at least all the people provided with suitable receiving apparatus who understand English. This would furnish an excellent method of issuing official verbal statements of serious import or bearing on the policies

Continued on page 60

ARMY RADIO NET SAVING, $18,000 YEARLY

While the Naval Communication Service handles all official trans-oceanic radio messages, and most of the shore to ship communication, the Army is far from idle in its radio activities. A great radio "net" now stretches practically all over the United States, with 43 large sending stations located in the nine corps areas of the Army.

This net is controlled by the Signal Corps, under the direction of Major General George O. Squier, an eminent soldier and scientist, credited with many of the inventions and devices which have made radio and "wired wireless" practical. At present the Signal Corps is clearing practically half of the Government communications, and only the signature of Secretary Weeks is needed to make the Signal Corps radio headquarters the message center of the Army.

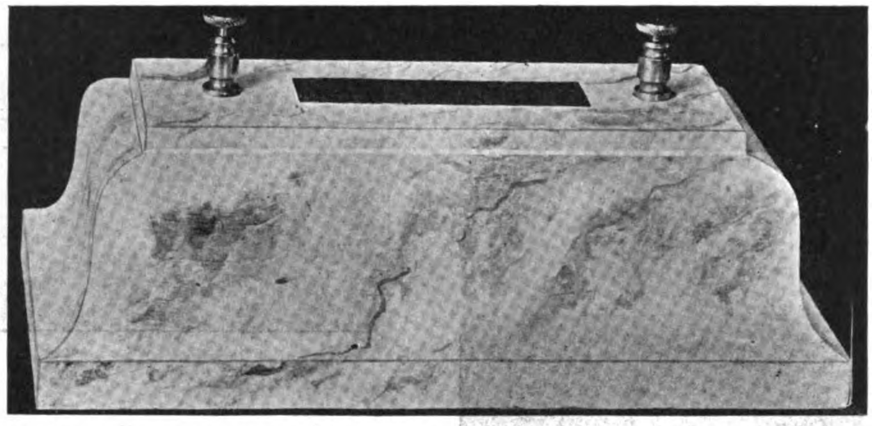
In two months the radio communication system has saved the Government $3354, by carrying over 20,000 words in messages, which would have cost that amount if sent in the old manner by commercial rates on land lines. For April, 3249 messages, comprising 136,316 words, were handled by Signal Corps radio stations, estimated as a saving of $2167. The saving would approximate $18,000 a year.

With the installation of a powerful radio station at Fort Douglas, Salt Lake City, on May 9th, which is now communicating with the Presidio station at San Francisco, and the completion of a similar station at Fort D. A. Russell, Cheyenne, Wyoming, the main transcontinental radio circuit will be completed. With stations already operating at New York and Washington, communication on the cross country circuit is routed as follows: Fort Benjamin Harrison, Indiana; Chicago; Forts Omaha, Douglas and Russell, to San Francisco. Stations have also been installed at Jefferson Barracks, Mo., and at Fort Leavenworth, Kansas.

Some of the Army stations are sending 1000 miles with an antenna input of 1000 watts, but as a number of the new stations are to be higher powered with an input of 5000 watts, a distance of 5000 miles may be reached.

In the event of a collapse of the commercial wires and radio stations or in an emergency, great possibilities are seen in the growing Army net, as practically every section of the country could be reached through it and the nine corps area local nets. Every branch, even the field detachments of the Army, is in constant communication with headquarters at Washington. No commercial work is handled, only official Army and Naval dispatches being carried, but all commercial traffic could be handled in time of need, and a large amount regularly in dull hours.

Smaller stations are going in daily; recently a station was opened at the Airship Field, Aberdeen, Md., and another at the Morgan Ordnance Depot, South Amboy, N. J. The Signal Corps plans shortly to have a fifty-station service in operation.



Marble Antenna Invented by W. J. Cormey of Minneapolis To Utilize House Wiring System as Aerial.

BROADCASTING AND RECEIVING ON LIGHT CIRCUITS

By CARL H. BUTMAN

Major General George O. Squier, Chief Signal Officer of the Army, has recently extended his experiments with "wired wireless," using the wires of an electric light system as a receiving antenna. The ordinary commercial electric light lines always have a return wire running in close proximity throughout the circuit, giving a distributive capacity and such a line may be considered as a reservoir comprising all values of antennae. The receiving instrument when plugged into a socket possesses the power of "picking out" or choosing from this reservoir the particular antenna necessary for resonance at any particular wavelength. This may be called the "fish pond" theory, General Squier says, in which one can either take from the pond a whale or a minnow, depending on the particular wavelength being received. The longer wavelengths might be considered whales and the shorter ones minnows, the receiving operator adjusting his instrument to maximum loudness, as usual.

The use of the lighting circuit—eliminating unnecessary wires—instead of aerials for receiving broadcasted messages, serves to reduce the static very materially. In the summer this static becomes very much more active than in the winter, and makes receiving with aerials difficult throughout the East and South, though it does not bother much in the West.

There is no necessity for any wires except the lighting circuit and the usual flexible lamp cord to the ordinary socket. This method will be a benefit to our skylines, as it will eliminate the necessity of all receiving antennae which now literally cover the roofs of apartment houses and private dwellings, meeting with the disapproval of architects and community beautifiers. The elimination of aerials also precludes certain dangers from possible contact with high power electric lines.

It is believed by experts that one of the most practical improvements will come in the very near future, by which the broadcasting service, whether from a distance or upon the wires themselves, will utilize in the receivers the electrical energy necessary to operate these receivers, taken directly from the same plug in the lighting circuit.

Once the whole apparatus is condensed and operated directly from the lamp socket, and maintained indefinitely therefrom, we have reached the point where the installation of home sets on a practical basis can go ahead on a big scale.

RECEIVING ON STEAM RADIATORS AND PIPE LINES

The latest scheme for receiving radio messages involves the use of a good steam radiator, or a hot-water radiator, for that matter, according to a report reaching the radio section of the Army. This system, said to have been evolved and tested out satisfactorily by a former electrical engineer of the Signal Corps, has evidently a market value, as the inventor is reported to have sold out his circuits and patents to a big corporation.

Many curious forms of receiving apparatus have already been used in lieu of the usual aerials, some of them with remarkable success by well-known experts. Among the unusual types of aerials employed are: the "tree antenna," demonstrated some time ago by Maj. Gen. Squier; the bed-spring antenna used by several experimenters, a trough of water and a cake of ice employed in Signal Corps experiments a year ago, and smaller and more handy devices such as umbrellas and fish poles. But the latest device for this purpose should interest many fans, as it is so readily available and should prove most useful, if practical.

News of the Broadcasting Stations

NEW BROADCASTING STATIONS

WBAE — Bradley Polytechnic Institute, Peoria, Ill.
WBAH—Dayton Company, Minneapolis, Minn.
KZN—Deseret News, Salt Lake City, Utah.
WBAG—Diamond State Fibre Co., Bridgeport, Pa.
KTW—First Presbyterian Church, Seattle, Wash.
WBA—Marshall-Gerkin Co., Toledo, Ohio.
WBAF—Fred M. Middleton, Moorestown, N. J.
KZC—Public Market and Department Stores Co., Seattle, Wash.
WBAD—Sterling Electric Co. & Journal Printing Co., Minneapolis, Minn.
WBAN—Wireless Phone Corporation, Patterson, N. J.
WIZ—Cino Radio Mfg. Co., Cincinnati, Ohio.
KUY—Coast Radio Company, El Monte, Calif.
WBAK—Pennsylvania State Police, Harrisburg, Pa.
WBAM—I. B. Rennysen, New Orleans, La.
WAAC—Tulane University of Louisiana, New Orleans, La.
KNN—Bullock's, Los Angeles, Calif.
KSC—Hale & Company, San Jose, Calif.
WBAO—James Millikin University, Decatur, Ill.
KNT—North Coast Products Company, Aberdeen, Wash.
KYF—Thearle Music Company, San Diego, Calif.
WBAY—American Telephone & Telegraph Co., New York, N. Y.
WBAV—The Erner & Hopkins Co., Columbus, Ohio.
WGM—Georgia Railway & Power Co., Atlanta, Ga. (Atlanta Constitution.)
WBAQ—Myron L. Harmon, Y. M. C. A., South Bend, Indiana.
WGI—Iowa State College, Ames, Iowa.
WBAW—Marietta College, Marietta, Ohio.
WBAU—Republican Publishing Co., Hamilton, Ohio.
KNI—T. W. Smith, Eureka, Calif.
WBAX—John H. Stenger, Jr., Wilkesbarre, Pa.
WCX—Detroit Free Press, Detroit, Mich.
WCAE—Kaufmann & Baer Co., Pittburgh, Pa.
WCAB—Newburgh News Print & Pub. Co., Newburgh, N. Y.
WBAZ—Times-Despatch Pub. Co., Richmond, Va.
KLX—Tribune Pub. Co., Oakland, Calif.
KOJ—University of Nevada, Reno, Nevada.
KZV—Wenatchee Battery & Motor Co., Wenatchee, Wash.
WBAP—The Star-Telegram, Wortham-Carter Pub. Co., Fort Worth, Texas.
KYI—Bakersfield Californian, Bakersfield, Calif.
WCAG—Daily States Pub. Co., New Orleans, La.
KNX—Electric Lighting Supply Co., Los Angeles, Cal.
WCAC—John Fink Jewelry Co., Fort Smith, Ark.
WCAD—St. Lawrence University, Canton, N. Y. (Only weather.)
KQI—University of California, Berkeley, California.
WCAR—Alamo Radio Electric Co., San Antonio, Texas.
KDYO—Carlson & Simpson, San Diego, Calif.
WCAP—Central Radio Service, Decatur, Ill.
WCAK—Alfred P. Daniel, Houston, Texas.
KDYN—Great-Western Radio Corporation, Redwood City, Calif.
WCAJ—Nebraska Wesleyan University, Lincoln, Nebr.
KDYQ—Oregon Institute of Technology, Portland, Ore. (weather only.)
WOC — Palmer School of Chiropractic, Davenport, Iowa.
KDYR—Pasadena Star—News Publishing Co., Pasadena, Calif.
WCAU—Philadelphia Radiophone Co., Philadelphia, Pa.
WCAL—St. Olaf College, Northfield, Minn.
WCAO—Sanders & Stayman Co., Baltimore, Md.
KDYM—Savoy Theatre, San Diego, Calif.
WCAN — Southeastern Radio Telephone Co., Jacksonville, Fla.
WCAT—South Dakota School of Mines, Rapid City, S. D. (weather only.)
WCAQ—Tri-State Radio Mfg. and Supply Co., Defiance, Ohio.
WCAM — Villanova College, Villanova, Penna.
WCAS—William Hood Durwoody Industrial Institute, Minneapolis, Minn.
WCAZ—Robt. E. Compton & Co., Quincy Whig Journal, Quincy, Ill.
KDZV—Cope & Cornwell Co., Salt Lake City, Utah.
WCAV—J. C. Dice Electric Co., Little Rock, Ark.
WDAD—William Louis Harrison, Central Kansas Radio Supply, Lindsborn, Kansas.
KDYU—Herald Publishing Co., Klamath Falls, Ore.
WDAI—Hughes Electrical Corp., Syracuse, N. Y.
WDAC—Illinois Watch Co., Springfield, Ill. (weather only.)
WDAF—Kansas City Star, Kansas City, Mo.
WCAY—Kesselmen O'Driscoll Co., Milwaukee, Wisc.
WDAG—J. Laurence Martin, Amarillo, Texas.
WDAK—Mine & Smelter Supply Co., El Paso, Texas.
WAAD—Ohio Mechanics Institute, Cincinnati, Ohio.
WCAW—Quincy Herald and Quincy Electric & Supply Co., Quincy, Ill.
KDYW—Smith-Hughes & Co., Phoenix, Ariz.
WDAB—M. C. Sumner & Son, Portsmouth, Ohio.
WKB—Sweeney School Co., Kansas City, Mo.
WDAE—Tampa Daily Times, Tampa Fla.
KDYS—The Tribune, Inc., Great Falls, Mont.
WCAX—University of Vermont, Burlington, Vt.
WDAA—Ward-Belmont School, Nashville, Tenn.
KDYY—Rocky Mt. Radio Corp., Denver, Colo.
WDAJ—Atlanta & West Point R. R. Co., College Park, Ga.

NEW YORK MUNICIPAL STATION

An appropriation of $50,000 has been made by New York City for a broadcasting station to be erected on the Municipal Bldg., in City Hall Park. The purpose is to send out musical programs, news information and educational lectures on health, fire and crime prevention, municipal government, etc. It is planned to have this new station on the air about August 1st.

MUNICIPAL STATION FOR SAN JOSE, CALIF.

The first municipal radio broadcasting stations on the Pacific coast has been authorized for the city of San Jose by the city council. It is indicated that the new station will cost $6000 to be raised by private subscription. The committee appointed by the combined Chamber of Commerce and Commercial Club to handle this work consists of H. F. Parsons, District Engineer of the Standard Oil Company, Chairman; Prof. Chas. D. Herrold; A. L. Anderson, former Asst. Chief Engineer of the Federal Telegraph Co.; Roscoe D. Wyatt, Manager of the San Jose Chamber of Commerce; Stanley Hiller, manufacturer, and W. T. Rambo, broker. This means the providing of high class broadcasting, free from any bias of politics or religion, or the direct advertising of individuals or firms.

WHB, one of the largest inland stations in the United States, has just been erected by the Sweeney Automobile School in Kansas City. The aerials are 325 ft. high and the station is equipped at a total cost of $20,000. The transmitter is a 500 watt W-E set. Mr. Sweeney has also installed a sound-proof studio where concerts will be rendered and arrangements are being made to install a pipe organ.

KQI, a new station established by the University of California at Berkeley, will be used for broadcasting educational matter and special events at the university.

Warner Bros. station at Oakland, Calif., has been transferred to the Daily News Bldg., at San Francisco, where it will broadcast music and news supplied through the cooperation of "The Daily News."

CKAC, the station of "La Presse," the French newspaper at Montreal, Quebec, has been installed by the Canadian Marconi Company. Broadcasting schedules are now being arranged for transmission in both French and English.

The *Advertiser*, Honolulu, H. T., started broadcasting service May 11th from a station erected by M. A. Mulroney, Naval Radio Aid.

WEW, St. Louis University, St. Louis, Mo., is broadcasting U.S. market and weather reports at 10 a. m., and 2 p. m., daily, on 485 meters. The first anniversary of this regular service was celebrated April 26th.

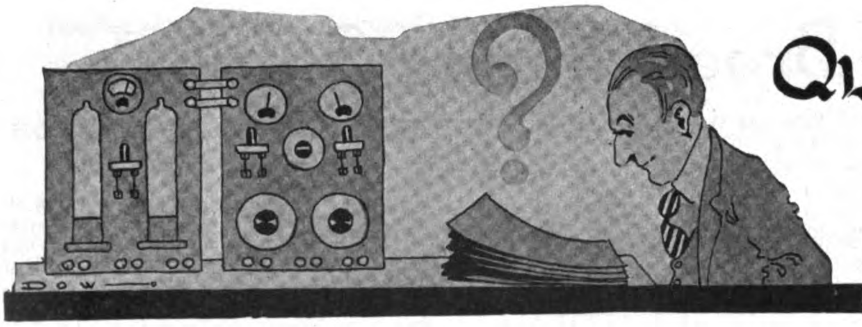
KLN, the new station of the Noggle Electric Works at the Hotel Del Monte, Calif., is broadcasting concerts daily between 12 and 1, and 6 and 7 p. m.

NOTES FROM THE OPERATORS

Call 4MN has been assigned to J. V. Settle at Winder, Ga.—using two 5-watters, acme 200, rect. A. C., rad. 1.6 amp.

The call 7FK has been reassigned to George W. Chinn, 263 East 50th St., Portland, Oregon.

6AOR, Sid Glasson, is radio operator at the Y. M. C. A. camp at Lakeport, Calif. for the summer months.



Queries & Replies on C.W. practice by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Please publish a diagram showing how a crystal detector may be inserted, with necessary switch, in place of the audion detector shown in Fig. 1 on page 29 of March RADIO.—D. N. S., Belleville, N.J.

The switch for this operation is shown in Fig. 1.

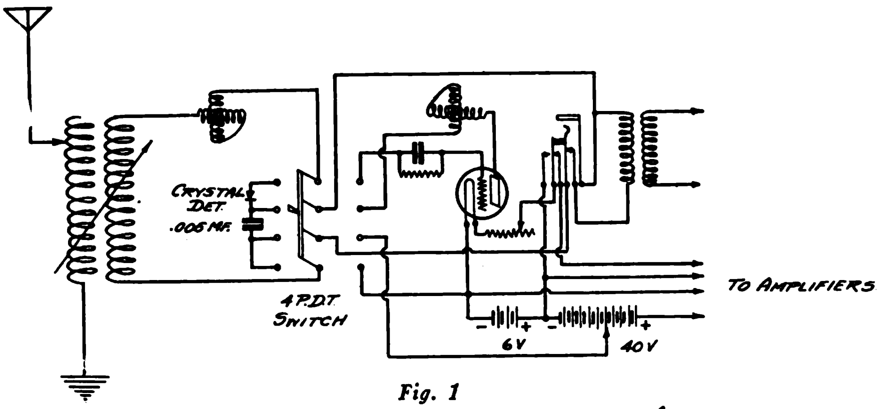


Fig. 1

Would the volume of signals coming from a detectaphone receiver, where the microphone is coupled to a Baldwin phone be as great as with the Baldwin phone alone?—W. B., Holtville, Calif.

The volume might be greater, but the quality would certainly suffer in passing from the Baldwin receiver to the sensitive microphone, and thence to the detectaphone receiver. Such an arrangement would probably overload your detectaphone circuit, if the signals were of very great volume, and the concerts or speech would be greatly distorted.

Can I use a wooden panel for an audion control mounting?—C. R. E., Hornell, N. Y.

Yes, provided that the wood is dry and well seasoned. For a receiving set, where no high voltages are used, a high degree of insulation is not necessary.

Please publish a diagram of a 10 watt C. W. set using an electrolytic rectifier, with Acme C. W. transformer.—E. C. P., Owatonna, Minn.

The circuit is shown in Fig. 2.

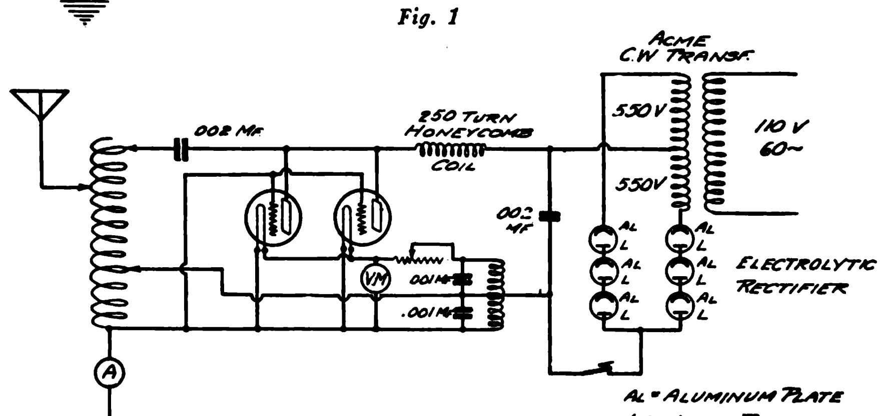


Fig. 2

Please publish a circuit for a two stage amplifier with filament control jacks, to be added to the single coil set as described by D. B. McGown in March RADIO. Can I use a 5 watt tube in the second stage, with 350 volts on the plate, for a power amplifier?—J. F. A., Grand Forks, N. Dak.

If you will turn to page 29 in March RADIO, you will find the amplifier with filament control jacks. A 5 watt tube can be used as you describe provided that the Magnavox you expect to use has a step down transformer suitable to withstand such a high potential.

Can a short wave regenerative set be used in connection with a three step Radio Frequency amplifier.—F. C., New Albany, Ind.

A circuit employing a regenerative set as well as radio frequency amplifiers is shown in Fig. 3.

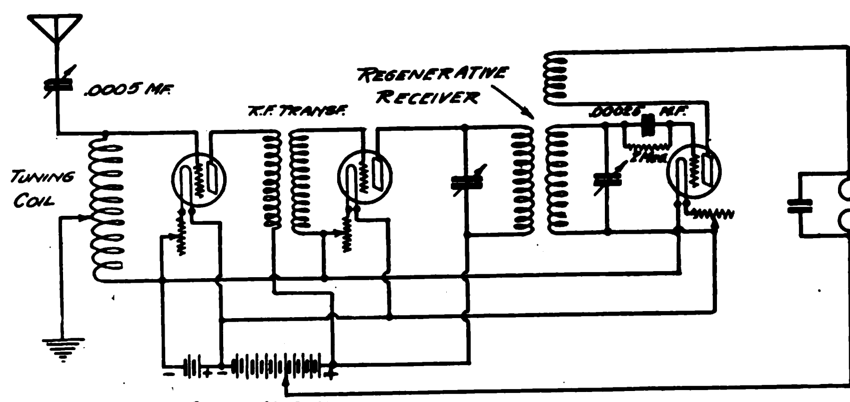


Fig. 3

Is there any possible way to lengthen the wavelength of the set described on page 24 of March RADIO?—W. C., Miami, Fla.

Yes, by adding more turns to the loading inductance, or bank wound coil, as it is called.

I use my automobile storage battery to light the filaments of my vacuum tubes, by running wires from the garage to the set, a distance of 35 feet. Cannot receive the music or short wave signals until I bring the battery close to the set. How can I overcome this difficulty? How can the wavelength of a set be shortened without shortening the antenna?—W. J. P., Vallejo, Calif.

Your trouble probably lies in the capacity and inductance of the battery leads. Try bridging a 1 or 2 microfarad condenser across the filaments, at the set. This will serve to by-pass the radio frequency, and neutralize the effect of the capacity in the leads.

You can shorten the wavelength of your set by placing a series air condenser in the antenna circuit.

Please advise if enclosed hook-up will work efficiently as a radiophone. Why is it that I get better results without grid condenser and grid leak?—A. D. S., LaCrosse, Wis.

The circuit you enclosed will not work as a radiophone. See Fig. 33 of the C. W. Manual, on page 14 of April RADIO. In the Hartley circuit, which you are using, does not require a grid condenser, as the grid is connected directly to one side of the helix.

Could the C. W. set described on page 13 of May RADIO, be used as a radiophone?—A. C. K., Elgin, Ill.

Not without a great many changes, including the addition of either set of rectifying tubes, or a motor generator set. This set was designed for telegraph work only, and is not easily adapted to radiotelephone work.

Continued on page 80

Lawrence Mott, 6XAD, President *G. G. Griffeth, 6AA, Secretary* *H. O. de la Montanya, 6AUL, Treasurer*

SOME IMPROVEMENTS TO THE HARTLEY CIRCUIT

Considerable trouble is experienced in high powered C. W. circuits using A. C. as a source of filament and plate potential, from sparking at the key contacts, and recent development along the lines of mitigating this source of trouble will prove of interest to all C. W. experimenters. Credit for this work is due to A. H. Babcock, 6ZAF, who has succeeded in entirely eliminating key arcing by the method shown in the circuit diagram, Fig. B.

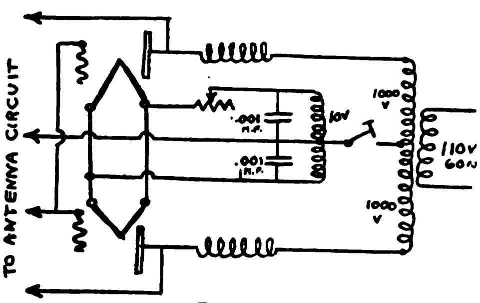


FIG. A

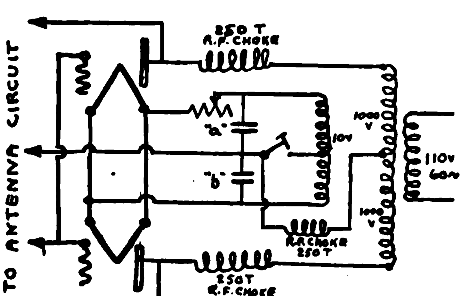
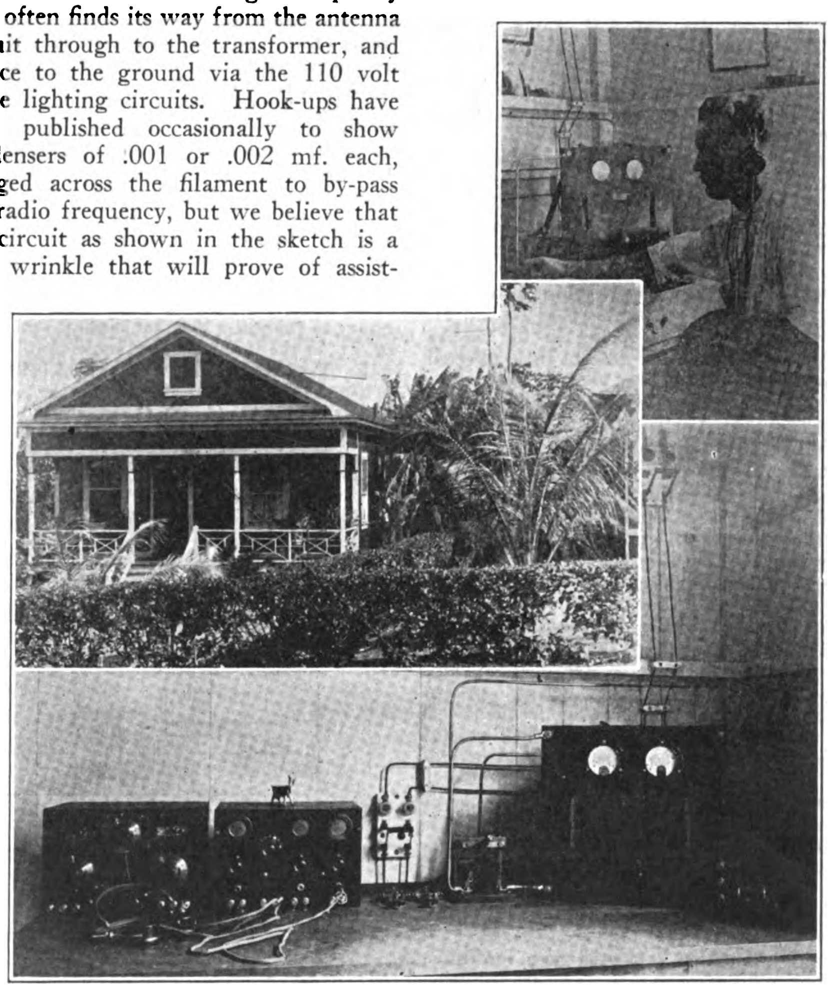


FIG. B

Improvements in the Hartley Circuit

Fig. A shows a self rectifying 100 watt transmitter, using the same transformer to supply the filament and plate circuits, keying being accomplished by connecting the center tap of the filament and plate windings. The connection from the filament to the tap on the oscillation transformer was tied to the center tap of the filament winding of the power transformer, and as a result, the high frequency energy passing from the tube to the antenna circuit found a path through the key. This produced a disagreeable spark which necessitated a large key, and in the case of sets employing 500 watts or more of power, a relay was necessary.

By the method shown in Fig. B., the high frequency is allowed to pass through the two bridging condensers "a" and "b" which are paper condensers of 1 microfarads each, and the only current passing through the key is the plate current being supplied from the transformer. A small radio frequency choke is placed in series with the lead from the high voltage winding to the key, to keep out undesirable high frequency that often finds its way from the antenna circuit through to the transformer, and thence to the ground via the 110 volt house lighting circuits. Hook-ups have been published occasionally to show condensers of .001 or .002 mf. each, bridged across the filament to by-pass the radio frequency, but we believe that the circuit as shown in the sketch is a new wrinkle that will prove of assistance in getting the most out of C. W. By its use, an ordinary small telegraph key can be employed to successfully break the plate circuits of four 250 watt tubes, with no more than a tiny spark at the key contacts.



Clifford J. Dow. His Aerial. His Transmitter and His Receiver

NEW C. W. RECORDS ESTABLISHED BY 6ZAC

6ZAC, located at Wailuku, Maui, Hawaiian Islands, continues to set the pace for C. W. telegraphy, by reaching out to almost unheard of distances during the month of May, in that this station has been heard several times at Oil City, Pa., Cleveland, Ohio, and numerous other intermediate points. The distance to Oil City, from Honolulu, is roughly 5000 miles and when it is considered that the signals, after traveling 2300 miles over water, were able to cross the Rockies and the lesser mountain ranges in between and could be heard in Pennsylvania, it can be realized what really remarkable results Mr. Dow is obtaining.

The illustrations on this page will give an idea of what Mr. Dow's installation comprises, and show his antenna

Continued on page 64

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

J. R. Carson, Pat. No. 1,410,890; March 28, 1922. Method of and means for modulating carrier oscillations.

Signals radiated from antenna 15 are supplied with energy from a constant source 13. Modulation is effected by varying the amount of energy absorbed from this source by the thermionic tube circuits. The tube 1 affects the energy of one polarity, while tube 2, that of the other polarity. The controlling circuits of these tubes are coupled to a transmitter circuit 20, 21, 22, in such a way that the potentials of grids 7 and 8 are varied equally so that they remain equal and of the same sign. In this way half waves of both polarity radiated from antenna 15 are equally affected.

J. Mills, Pat. No. 1,412,567; April 11, 1922. Means for and method of wave transmission.

Static disturbances received by the receiver D are substantially eliminated by passing the received signals and disturbances successively through the wave filters F_1, F_2, F_3 and F_4. These filters are tuned to audio frequencies and the impulse currents produced in them by the static disturbances are highly damped by the insertion of resistances 8, 9, 10 and 11. The signaling currents being in the nature of sustained oscillations, are but little affected by the filters.

A. H. Taylor and L. C. Young, Pat. No. 1,414,232; April 25, 1922. Method of receiving radio-signals with the compound heterodyne.

The antenna A receives signals to which is added the effect of the heterodyning circuit H. The detector D transmits waves of frequency equal to the difference between the signaling and heterodyning frequencies, to amplifiers A_1 and A_2. The amplified waves are again passed through another detector D_2 tuned to be responsive to the frequency equal to the difference between the heterodyning frequency and the frequency detected by D_1. In this way the heterodyning frequency is used twice, and it may be used a still greater number of times, since some energy at heterodyne frequency passes through the successive detectors and amplifiers. By proper choice of heterodyning frequency, great selectivity is obtained, and the signal may be brought to audio frequency to affect the telephones T.

M. M. Dolmadge, Pat. No. 1,414,629; May 2, 1922. Wireless duplex signaling system.

A single antenna 1 is used both for transmitting and for receiving. The transmission of modulated waves by the aid of elements 6 to 12 causes relay 17 to operate, due to the arrangement of the two branch circuits 2, 3, in the antenna circuit. The operation of this relay short circuits the receiving elements so that no signals can be received at 26. The reception of signals does not affect the relay 17, due to the symmetrical arrangement of the branch circuits 2, 3, through which the received signals must pass. Therefore, with this arrangement the system is in condition to receive except when modulated waves are transmitted, and there is thus no interference between the sending and receiving circuits.

Pupin and Armstrong, Pat. No. 1,415,845; May 9, 1922. Selectively opposing impedance to received electrical oscillations.

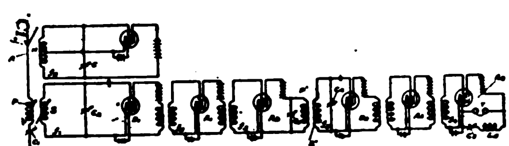
The receiving antenna circuits are so arranged that impulses of duration shorter than a predetermined time are greatly damped, while signals, which last many times longer than this short limiting value, are received with substantially no damping. A highly damped antenna 1 is used, the damping being effected by resistance 1^a and 2. The signals and impulses must travel over an artificial line consisting of inductances 12, 13, 14, etc., and capacities 15, 16, 17, etc. The constants of this line are so chosen that it takes a short period before the detector 6 is affected by the signal. This detector controls the circuits for the amplifier 8 which re-impresses, by means of coils 11, 3, sufficient energy upon the antenna so that the effect of resistances 1^a and 2 is overcome. This effect, however, is not of any benefit except for signals which persist long enough to affect the antenna 1 and the detector 6 simultaneously; that is, the impulse must be of longer duration than the time required to traverse the artificial line. To detect the signals, it is merely necessary to connect a detector circuit, such as 19, 20, 21, in the last amplifier stage.

E. T. Jones, Pat. No. 1,415,179; May 9, 1922. Radiocontrolling device.

A change-over switch is described, whereby antenna may be used either for receiving or transmitting. The connection between clip 4 and blade 5 completes the circuit for the source of the sending set, and permits spring clip 3 to engage connection clip 2 so as to complete the antenna circuit. As the switch is moved in a counter-clockwise direction, first the connection between 4 and 5 is broken, then the spring 3 is forced from contact with clip 2, and lastly blade 1 engages with clip 2. This connects the receiving set. The gap formed between 2 and 3 in this position serves as a protective gap against lightning. It is this feature which is an essential element of the invention.

NEARLY 20,000 TRANSMITTING STATIONS

The Department of Commerce has issued nearly 20,000 transmitting licenses, of which 16,000 are for amateurs, 3,000 for American ships, 500 for experimental and technical training schools and 500 for commercial stations, the greater part of which are broadcasting. It is conservatively estimated that there are 1,500,000 receiving sets in use.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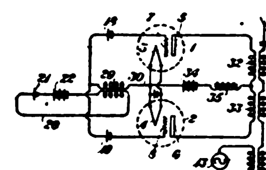
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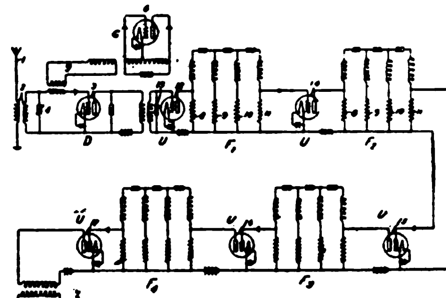
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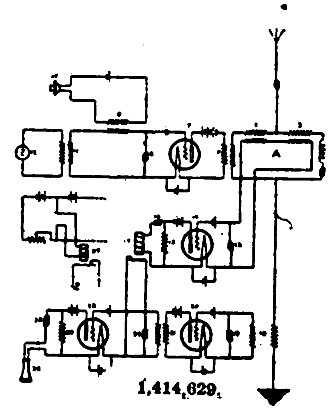
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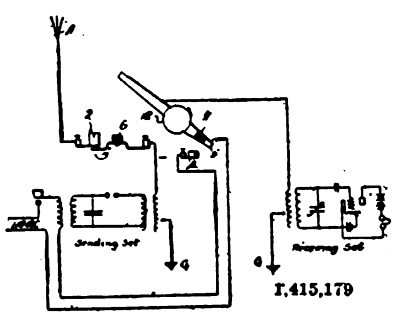
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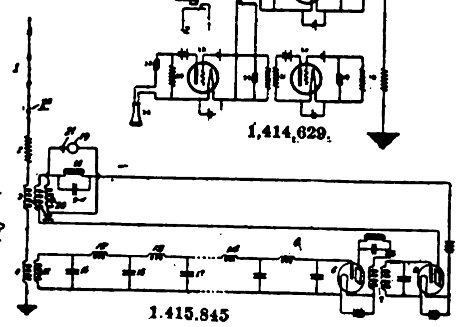
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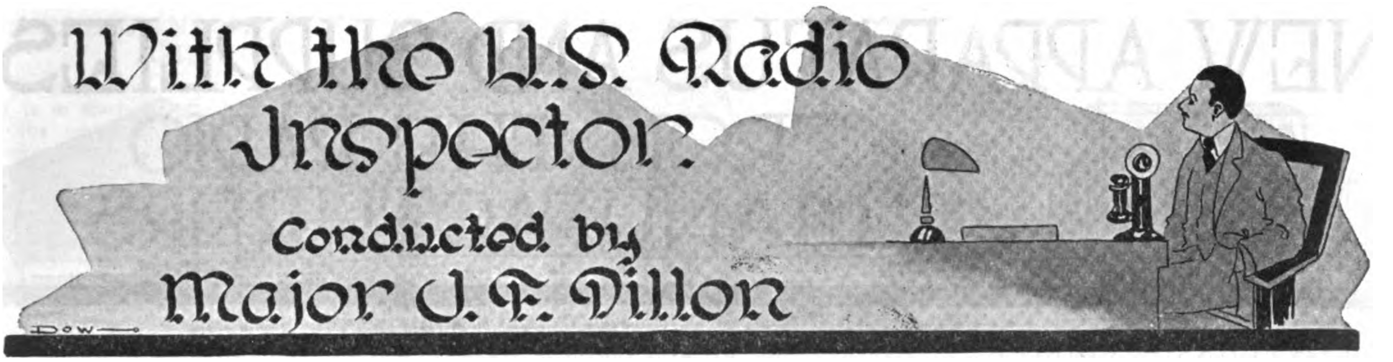


QUESTIONS AND ANSWERS

How may I calibrate a wavemeter without having a standard one available to check against?—H. K., Reno.

No entirely satisfactory method occurs off hand. This may be done with fair accuracy by erecting a long pair of evenly spaced wires, and then calculating their exact wavelength, or you might make up a standard coil and inductance, and calculate their exact values, and then make up a coil of half this value, etc. (see Bur. Stds. Circular 74 for details.) The best and simplest way is to have it calibrated in comparison with a standard. This can be done by the Bureau of Standards, at Washington, who will guarantee accuracy, or it may also be done at the offices of the various Radio Inspectors of the Department of Commerce, altho they will make no claim as to the absolute accuracy of the measurements. If you have access to an electrical laboratory they may be able to measure the frequency direct, which can, of course, be transposed to read wavelength.

Are the standard 5-watt tubes capable of much overload, or not?—H. K., Reno.

Yes, they seem to give good results in many amateur stations despite the fact that they are very seriously overloaded. This doubtless shortens their useful life a great deal, however.

What is the minimum code speed required for a commercial license?—J. G. F., Kansas.

The lowest commercial license is second class third grade. This requires a code speed of at least 12 words per minute, International Morse.

Why do radio telephone transmitting stations require operators to be familiar with the Morse Code, when such stations only wish to use voice transmission?—H. U. T., New Jersey.

Because the law requires, first, that the operators of all transmitting stations be licensed. This is necessary, because unlicensed operators would be very liable to cause serious interference with the work of other stations, and if they did not know the code as in a telephone station, they would not be able to tell whether or not they were causing such interference.

Why do the local broadcasting stations break off every now and then, and say they will stand by in compliance with the regulations?—P. R., San Francisco, Cal.

These stations are licensed as coastal stations, and all coastal stations are required to listen in on 600 meters, at least two minutes out of every 15, to determine if they are causing interference with ships who may be in distress.

I have noted that many ships send personal notes and messages from one operator to the other as a service message, prefixing it "SVC". Is this correct?—Ship Operator.

No, decidedly not. Service messages are messages connected with the handling, routing of messages, the charges or tariffs on them, etc., or other matter connected with the actual handling of telegraph business. For example, a ship may send a service message to ask the shore station rates plus landline charges thru a station it wishes to handle business, or it may send a service correcting the check in a message already sent, etc. It is decidedly not a service message, on the other hand, to ask if Operator Bill Jones is on watch, or if Mate Olaf Olafsen is still on the S.S. Blank. If the latter business is to be handled, it must be in the form of a regular paid message.

NEW RADIO RECORDING DEVICE

The necessity of an experienced radio operator to receive code messages may be eliminated by the recent development of a radio relay recorder at the Bureau of Standards by F. W. Dunmore. Applications of the new device include the recording of radio telegraph code messages on a tape at fairly high speed, so they can be read by an average operator visually instead of audibly. The elimination of a constant watch at stations may be effected by the installation of a call system, and in line-radio telegraphy a sounder may be operated from a signal transmitted by radio frequency currents, making it unnecessary for the Morse operator to use a telephone receiver.

Wire telegraph recording instruments have been employed for many years, but it is only within the past few years that they have been applied to radio telegraphy, on account of the fact that the exceedingly small amount of energy found in an incoming radio signal—ordinarily only a few microwatts—made it difficult to construct a radio recorder. Such devices as had been developed required such sensitiveness and so careful an adjustment, besides being very delicate and expensive, that they hardly proved practical.

Reports on this recording relay, which is more rugged than devices hitherto developed and using larger currents of the nature of 5 milliamperes or more, indicate that any form of mechanism may be operated by radio for remote control of moving bodies, such as automobiles, boats or airplanes. The simultaneous records of two messages received on the same antenna may also be secured by means of two recorders of this type connected in series.

Currents of 5 milliamperes or more are obtained, according to experts of the Bureau of Standards, by increasing the feeble signals received through the use of the electron tube amplifier. Electrical tuning to the audio frequency which is being received, is employed. The operation of the newly developed relay has been made possible by the development of the electron tube amplifier as a reliable instrument for engineering practice. With a current of 5 milliamperes or more, a strong and positive action is obtainable, and it is possible to use an ordinary telegraph relay of rugged construction which does not require careful and repeated adjustment in operation, it is explained.

The radio relay is constructed so that the electron tube circuits can be operated on 110 volt, 60 cycle alternating current from lighting circuits, or the relay can also be operated by batteries properly connected.

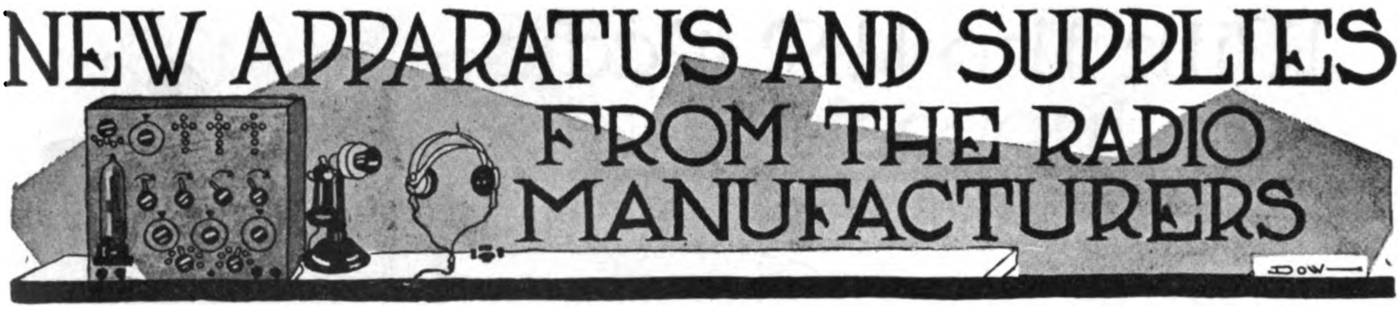
After amplification, the received radio signal is delivered thru a tuned audio-frequency transformer to the plate circuit of an electron tube in which is connected the windings of a high-resistance telegraph relay. A condenser with a capacity of about one microfarad is shunted across the relay windings. The movement of the armature of the relay may be made to operate any desired mechanism, such as the ordinary ink-tape register or other apparatus, or for the remote control of boats and vehicles.

The selectivity in this apparatus is greatly increased by the use of audio-frequency tuning of the secondary circuit on the input transformer, making duplex operation possible. Interference from strays is also reduced somewhat.

INTERFERENCE WITH CONCERT RECEPTION UNJUSTIFIED

Complaints of interference from amateur transmitters are frequently made to the radio inspector by radio concert fans. These complaints are often due to poor receiving equipment rather than to any fault of the sender. Amateurs operate on a 200-meter wavelength, while concerts are broadcasted on a 360-meter wave-length. Except for near-by stations there should be no difficulty in tuning out undesired signals with a properly designed receiving set. If the concert fan has purchased an "all wave" receiver, his only recourse is the dealer who sold him the stuff or else a few lessons on how to operate his set.

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



HOMECHARGE RADIO B BATTERIES

Miniature storage battery cells are being offered by various manufacturers for supplanting the small dry B battery used with vacuum tube receiving sets. These batteries consist of from 8 to 50 small cells, and the recharging of such batteries has presented quite a serious problem to the user and is largely responsible for their not being more readily adopted by the wireless enthusiasts.

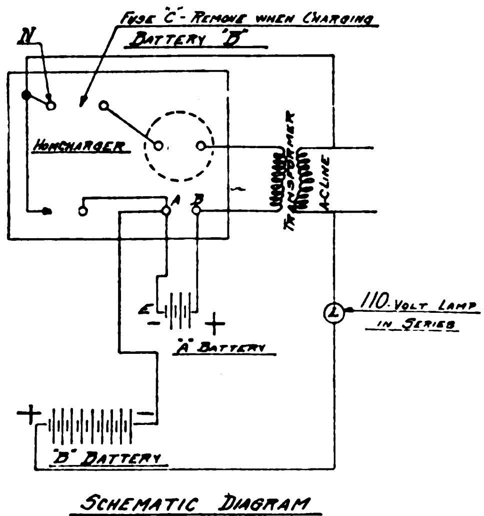


Fig. 1.—Schematic Diagram

These small cells require a very low charging rate, varying from 1/10 to 1 ampere, depending upon their size, but due to the number of cells employed, the charging voltage required is quite high.

Where direct current is available, it is a very easy matter to charge these batteries by connecting them in series with a 40 watt lamp. When charging in this manner it is quite essential that positive battery terminal be connected to positive line, as otherwise batteries will discharge instead of charge.

As 90% of the homes wired with electricity in the United States are supplied with alternating current, the charging of any type of storage battery has presented a much more complicated problem than were direct current available.

Various types of chargers are now on the market for charging the 3 cell "A" battery used for heating the lamp filaments, and practically every wireless enthusiast has one of these machines in order to eliminate the inconvenience and expense of having to lug his battery to a service station every time it requires recharging.

Through a very simple scheme of connection it is possible to recharge any radio B battery with the same homcharger that is used for charging the A battery. Fig. 1 illustrates the connections employed.

The Homcharger Fuse-C is removed, so as to open normal charging circuit. One side of the 110 volt alternating current line is connected to the Homcharger armature at N, the other going to positive terminal of the B battery through a 110 volt lamp—L in series, which acts as a current reducing resistance.

Charging circuit is completed from negative terminal of B battery to terminal A of the Homcharger.

The 3 cell 6 volt A battery is connected to the terminals A and B in the usual manner. As soon as alternating current supply is turned on, the armature should start to vibrate and act as a rectifying valve, completing the B battery charging circuit during the proper part of the A. C. cycle, thereby delivering to the B battery a series of intermittent unidirectional current impulses.

It is necessary that either the positive or negative pole of both A and B battery be connected to the terminal A. If this is not done B battery will discharge instead of charge, the same being indicated by the series lamp L glowing with intense brilliancy. When connections have been properly made, and B battery is charging, this lamp burns quite dull.

A very simple method of making the proper connections is shown in Fig. 2. The material required can be purchased at a cost of less than $2.00 from any electrical dealer, and consists of:

1—Two-way Socket Plug or Duplex Current Tap	$1.00
1—Attachment Plug	.25
1—Porcelain Wall Receptacle	.25
1—10 ft. Lamp Cord	.50

The two-way socket plug is screwed into lamp socket and the standard Homcharger attachment plug screwed into one side thereof. Another attachment plug is inserted in the other side of current tap, one lead being connected in series with the 110 volt lamp L of the proper size, the other lead running direct to screw N of the vibrator assembly. The other terminal of lamp L is connected to the positive terminal of B battery and the other side of B battery running to terminal A. Fuse C is then removed, A battery connected, and lamp socket turned on.

It is impossible to charge both A and B battery at the same time, as with fuse C in place the B battery will discharge through transformer secondary.

As the ammeter is not connected when fuse is out, this instrument does not indicate charging rate of B battery. However, when Lamp L burns dull the batteries are charging properly and no other indication is required.

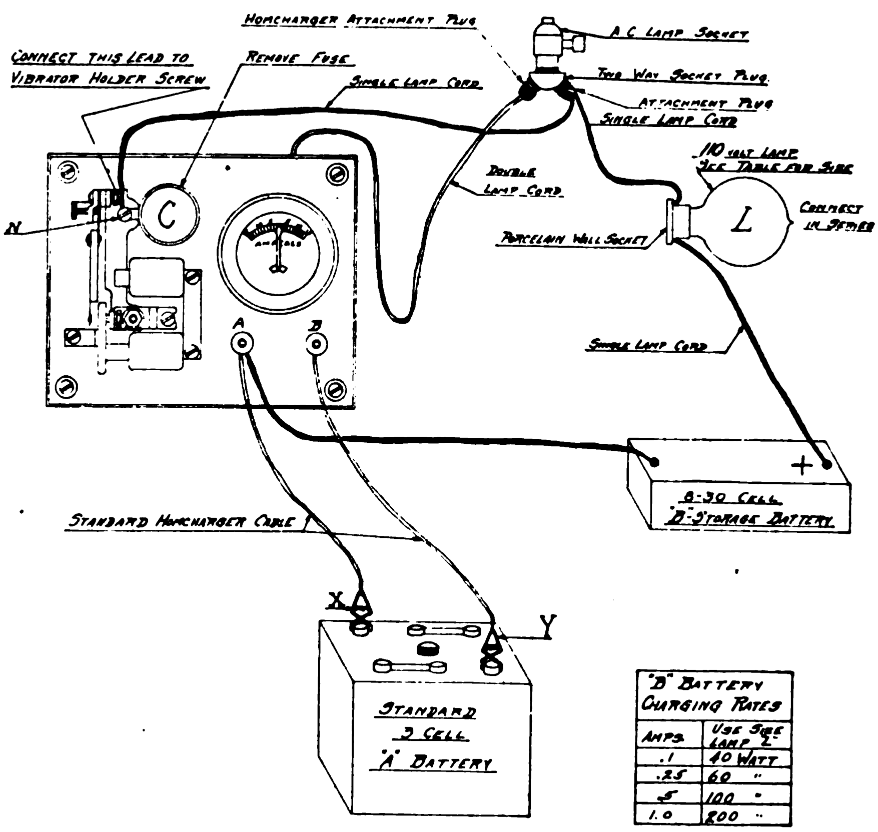


Fig. 2.—Method of Connecting

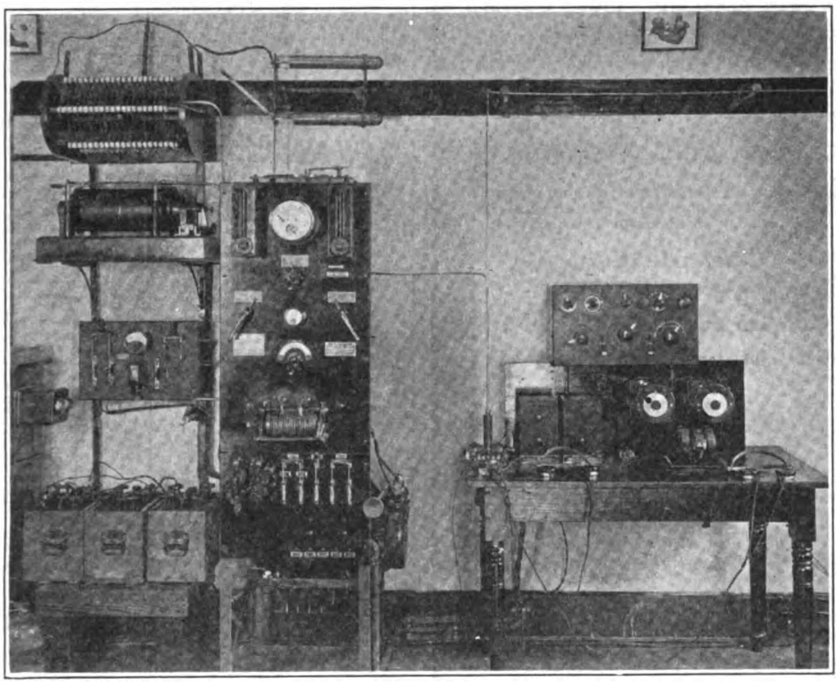
RADIO INSTITUTE OF AMERICA

The purpose of the Radio Institute of America is to teach the radio enthusiast, as well as the commercially inclined operator, the theory and practice of this most interesting art. Classrooms are located at 331 Call Building, San Francisco and instruction is conducted by the Radio Corporation of America, which has behind it the splendidly equipped research laboratories of the General Electric Company, the American Telegraph and Telephone Company, the Western Electric Company and the Westinghouse Electric and Manufacturing Company, where eminent physicists conduct investigations that result in new radio advances. Therefore students at the Radio Institute can avail themselves of the splendid opportunity to become familiar with the latest type of modern radio equipment.

The transmitting equipment includes several types of apparatus such as are used aboard ships and aeroplanes. Installation of the latest 3 way combination vacuum tube transmitter for CW, ICW and telephony will shortly be added to the present equipment.

Each month students are taken on a tour of inspection to the plant department of the Radio Corporation and also aboard various ships so as to become familiar with the apparatus as commercially installed.

A post-graduate course is provided for students, who, having been enrolled at least 3 months at the Institute, qualified and have obtained a U. S. Government first class license. The course consists of one month's free training at the High-Power Trans-Pacific station of the Radio Corporation located at Marshall, California. The student "listens in" with the regular operator, both on marine and high power circuits, and therefore becomes acquainted with the handling of commercial traffic on a large scale.



The Institute has been an established and successful institution for over fifteen years and during that time more than 6000 men have been trained in this new branch of science and industry. The course consists of instruction in spark, arc and vacuum tube transmitters and receivers, storage batteries and modern auxiliary equipment, U. S. and International Radio Laws and Regulations, commercial traffic and accounting.

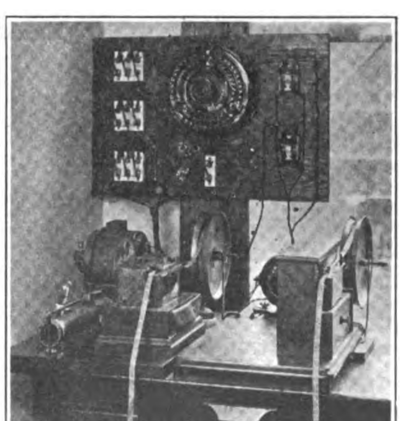
Theoretical lectures and practical instruction regarding the adjustment, maintenance and operation of the various types of transmitters and receivers in connection with amateur and commercial operation are regularly given.

For receiving practice the Institute is supplied with two Wheatstone automatic transmitters having a speed capacity of 5 to 75 words per minute. The receiving practice speed varies from 5 to 35 words per minute depending on the students ability. The tapes for these machines are punched by expert RCA operators on a Kleinschmidt perforator.

A complete receiving set is in operation at the Institute and advanced students keep an accurate watch and log during school hours, copying the Trans-Atlantic RCA high power station at "Radio Central," Long Island, New York, and also the Trans-Pacific RCA circuit at Bolinas, California and Kahuku, Hawaii on the most modern vacuum tube receiver. The students also copy the Radio Corporations Coastal Station at Marshall (KPH) working with the many vessels off shore.

The Institute is in charge of T. L. O. Fassett who has been a radio man both ashore and afloat for many years. Mr. Fassett until recently was in the U. S. Navy and made several trips across the Atlantic as Junior Lieutenant in the capacity of Radio Officer and Engineer Officer on the U. S. S. "Cuyama," engaged in the transportation of troops and supplies.

Department continued on page 66



Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

AT 6EA

C. W.—5za (buzzer), 6ak (voice), 6gl, 6gy, 6km, 6ku, 6ni, (600), 6rm, 6zq, (6zi), 6zs, 6zx, (6zz), 6aat, (6arb), 6asv, (6awt), (6bcd), 6xac (voice and music), 6xat, 6zac, (7dp), 7mf, 9amb, 9ayu, 9dva, 9wd, (9zaf), dm4, wv6 (voice and music).

Spark—5xd, 5yq, (6as), 6cc, 6ex, 6fn, (6gf), 6gr, 6hc, (6hp), (6ib), (6ic), 6im, 6km, 6ng, 6po, 6qr, (6tu), 6vk, (6vx), 6wg, 6xh, 6zd, 6zi, 6zk, (6zz), 6aau, 6abu, 6abw, 6acr, 6afp, 6agf, 6ain, (6ajr), 6ala, 6amk, 6aqu, (San Francisco now), 6ark, 6atq, 6atu, 6bak, 6bnn, 6zam, 7jd, (7kj), (7mf), 7ya, cl8.

Best 5 watt A. C.—C. W. reported heard was by 6zac at Wailuku, Hawaii (2100 miles).

AT 6LV ON ONE TUBE

6bj, 6cu, 6ec, 6ef, 6en, 6ea, 6ft, 6fh, (6cd), (6jj), 6jd, 6ka, (6ku), 6tw, (6aat), 6abx, 6ajh, 6akw, 6atp, 6avd, 6bes, 6bcd, 6za, 6zb, 6zs, 6zn, 6zr phone, 6zf, 6zz, 6qt, 7mf, 7rn, 7op, 7sc, 7zm, 7zu, 8lx, 9amb, 9ayu, 9zaf, cl8, wvy.

AT 7MF, EUGENE, OREGON

C. W.—2xb, 2om, 3fs, 4gl, 4bq, 5an, 5za, (6ak), (6cu), (6fh), (6ft), 6gd, (6gy), 6hc, 6ka, 6kbf, (6nx), (6oo), 6ti, 6vx, 6vm, 6xad, 6wz, 6xh, 6za, (6zf), (6zi), 6zz, 6aak (fone), (6aat), (6zx), (6bcd), 6bdl, 7ad, (7ce), (7dm), (7dp), 7go, 7hs, 7hw, 7kb, 7lr, 7qe, 7tj, 7rn, 7aag, 7aav, 7ack, 8bk, 8jl, 9aav, 9aao, 9ayu, 9dva, 9rv, 9aja, 9zn, xf1, (6awp), 6jd, (6aif), Can. (4cb), 9ax, 9bd, 5ct, 9aw.

Anybody hearing 7mf's C. W. or Spark, please qsl, and give check on sigs.

AT 9DSW

C. W.—2ba, 2fp, 2hg, 2zk, 3aay, 3any, 3ba, 3bij, 3bz, 3cc, 3fm, 3la, 3qz, 3rf, 4bq, 4by, 4cc, 4ds, 4gh, 4eb, 4iv, 4ya, 5aab, 5aw, 5bm, 5cb, 5do, 5ek, 5ga, 5hb, 5jb, 5jd, 5kp, 5la, 5mt, 5nk, 5np, 5nz, 5oi, 5qb, 5wo, 5za, 5zy, 6ka, 6zz, 7zf, 7zu, 8acf, 8aed, 8ago, 8ahr, 8aio, 8alb, 8am, 8anb, 8apt, 8aso, 8awm, 8awx, 8awy, 8azf, 8azh, 8bdo, 8bdu, 8bfx, 8bke, (8blw), 8bo, 8boi, 8box, 8buv, 8bas, 8caz, 8cz, 8cql, 8cfp, (8dv), 8dw, 8ea, 8gv, 8jm, 8ow, 8pt, 8sp, 8uc, 8vv, 8vq, 8wr, 8xe, 8xu, 9aap, 9aay, 9aly, 9aja, 9ajh, 9akd, 9amb, 9aog, 9aqe, 9ark, 9asf, 9asl, 9axf, 9axa, 9bdp, 9bed, 9bjb, 9bok, 9bxd, 9ct, (9dgq), 9dqq, 9dsm, 9dta, 9dtf, 9dtm, 9dub, 9dun, 9dva, 9ei, (9fm), 9gl, 9io, 9km, 9kp, 9ps, 9uc, 9vk, (9wa), 9wd, (9wu), 9xaq, 9yan (fone), 9ze.

Spark—5aq, 5fo, 5hk, 5xm, 7zv, 8afb, 8aq, 8ea, 8ug, 8ve, 9abv, 9aaw, 9ahz, 9anp, 9aso, 9avh, 9axm, 9ca, 9dsd, 9sv, (9tv), 9zc.

Canadian—(4cb), 2rz, 9bd, wsb, vaw, wvu.

AT 6AWF, LOS ANGELES

Spark—6ak, 6as, 6bn, 6cp, 6ex, 6gf, 6gr, 6gt, 6hc, 6ib, 6ic, 6im, 6ng, 6oh, 6pj, 6po, 6qk, 6qr, 6tc, 6to, 6tu, 6tv, 6vk, 6vx, 6wz, 6xh, 6zb, 6zd, 6zk, 6zu, 6zx, 6zz, 6aah, 6aak, 6aau, 6abu, 6abx, 6acr, 6ada, 6aeh, 6aei, 6afn, 6agf, 6agp, 6ahf, 6aif, 6ajh, 6ajr, 6akl, 6ala, 6alv, 6amk, 6anp, 6aoe, 6ape, 6aqu, 6ark, (6aud), 6awh, 6zam, 6bjv, 7bh, 7gj, 7mf, 7ya, 7zt.

C. W. and I. C. W.—5za, 6ak, 6gy, 6jj, 6pj, 6pk, 6pt, 6tw, 6xi, 6za, 6zf, 6zi, 6zx, 6zz, 6aif, 6alv, 6arb, 6asj, 6asv, 6bcd, 9wd, 9ayu, 9zaf.

AT 6FZ, BERKELEY, CALIF.

Spark—6ea, 6eb, 6gd, 6hy, 6kc, 6lc, 6mh, 6od, 6ol, 6qr, 6up, 6xu, 6zd, 6aak, 6aeh, 6aei, 6agp, 6ahq, 6aif, 6ajh, 6ajr, 6akl, 6alu, 6amn, 6aqx, 6ark, 6avd, 6awx, 6baj, 6bbv, 6bdz, 6bjv, 7bh, 7bk, 7cu, 7fi, 7gj, 7gq, 7hf, 7kj, 7mf, 7oh, 7ot, 7ox, 7oz, 7ui, 7xh, 7ya, 7yg, 7ys, 7zj, 7zk, 7zm, 7zt, can-9bd, cl8.

C. W.—4gl, 5za, 6ea, 6eb, 6en, 6gd, 6ka, 6ku, 6ky, 6pt, 6tw, 6agp, 6apw, 6awp, 6awv, 6xad, 6zb, 6zf, 6zn, 6zs, 6zx, 6zz, 6zac, 6bes, 6bmd, 7dp, 7gk, 7mf, 7nn, 7sc, 7xg, 7zu, 9wd, 9wu, 9amb, 9ayu, 9zaf, can-9bd, kdpw, kdpv.

AT 6ASN, BERKELEY, CALIF.

6ak, 6av, 6op, 6dd, 6en, 6gr, 6gt, 6lc, 6oh, 6ol, 6od, 6ot, 6qr, 6rc, 6aak, 6acr, 6ahq, 6ain, 6ajh, 6ala, 6ald, 6amw, 6ane, 6ano, 6anw, 6ark, 6ars, 6avr, 6bly, 6zah, 7bh, 7mf, 7nz, cl8.

Anyone hearing 6asn s 500 cycle please QSL.

KENNEDY EQUIPMENT

▼▼

Type 110
Regenerative Receiver
with Type 525
Two stage amplifier

▼▼

KENNEDY EQUIPMENT

▼▼

All Kennedy
Regenerative Receivers are
Licensed under
Armstrong U. S. Patent
No. 1,113,149

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KENNEDY

Universal Regenerative Receiver Type 110

is designed to meet the requirements of those who wish to cover the entire field of Radio. It permits of reception on all wave lengths in use today by Government, commercial, amateur, special and all broadcasting stations. Coupled with Kennedy Amplifier Type 525 it affords the user access to every field of Radio.

Type 110 Receiver can be made to detect, regenerate, or oscillate at will, with high efficiency, over its entire range of 175 to 25,000 meters.

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RIALTO BUILDING SAN FRANCISCO

AT 9BJI, F. L. HICKS, 3935 W. 30TH AVE., DENVER, COLO.

C. W.—4bq, 4fe, (5kp), 5za, 5ak, 5ho, 5mz, 5zx, 5nz, 5ir, 5ci, 5ek, 5zu, 5mt, 5mf, 5nk, 5ic, 5oi, 5fv, 6cu, (6zz), (6awp), 6aqp, (6xad), (6za), 6aav, (6atg), 6xaq, 6zs, 6pd, 6zf, (6en), 6aif, 7hs, 7jd, 7mp, 7zn, 8agz, 8box, 8bfx, 8vy, (9aor), (9dzq), (9bjv), 9jl, (9bbf), 9kp, (9bjb), (9fm), (9dzj), 9bly, 9ps, 9dtj, 9dme, 9ex, (9bvy), (9qe), 9akr, 9blo, 9aje, 9zac, 9dyn, 9dta, 9aja, 9aav, 9brl, 9akd, (9sl), 9aeq, (9pi), 9dv, 9wu, 9atu, 9dts, 9rv, (9ew), 9bmd, 9zg, 9bed, 9wa, 9ze, (9bow), (9awm), 9hl, (9dof), 9jg, 9ays, 9xi, 9xm, 9avn, 9amu, 9agn, 9sj, 9bum, 9aap, 9bey, (9nx), 9aou, 9amq, 9wq, 9bxh, 9aas, 9aay, 9dqm, (9bik), (9yam), 9bno, (9ajh), (9aua), (9ajp).

Spark—5lb, 5hk, 5ew, 6aah, 6ea, 7zv, 9dze, (9ayw), (9vak), 9agz, 9avz, (9aig), 9aeg, 9wi, 9pi, kyj and klc fones. Canadian 4cb. Would appreciate a card from any station hearing me.

CALLS HEARD AT 6APP

4xf, 5ec, 5ik, 5mg, 5fo, 5oz, 5cu, 5re, 5ak, 5fk, 5hk, 5ck, 5qe, 5cb, 5nk, 5xa, 5tl, 5ln, 5xb, 5xc, 5xe, 5xj, 5xu, 5xy, 5yc, 5za, 5zb, 5zf, 5zj, 5zl, 5zm, 5zo, 5zr, 5zz, 5zab, 5zak, 5zaf, 6ak, 6yv, 6tx, 6hw, 6ayh, 6bf, 6awh, 6awk, 6iv, 6aif, 6jy, 6fu, 6aer, 6ka, 6by, 6bal, 6az, 6ir, 6aph, 6tv, 6za, 6ab, 6zf, 6zk, 6zl, 6zm, 6zn, 6zo, 6zr, 6zs, 6zt, 6zu, 6zv, 6zx, (6zz), 6zab, 6zak, 6zaf, 6aay, 6aaw, 7kv, (7zu), 7zj, 7ya, 7um, 7zv, 7sj, 7la, 7ry, 7zt, 7zs, 7hf, 7zh, 7jt, (7jd), 6jt, 7ln, 7uk, 7za, 7ar, 7lv, 7nr, 6xd, 6xac, 6xad, 7ds, 6apj, 6zp, 6ot, 7sj, 9aey, 9yal, 9dp, 9ny, 9dy, 9aey, 9ar, 5if, 9yo, 9fx, 9auq, 9ax, 9ke, 9oe, 9pl, 9ff, 9arv, 8zaf, 9ym, 9tq, 9jx, 9afv, 9axa, 9dz, 9em, 9vv, 9yg, 9aw, 9atn, 6wv. A card to 1258 W. Pierce St., Phoenix, Ariz. will be appreciated by Herschel Rawls, from any hearing this call. All correspondence answered.

BY 6AWP, EVERETT W. THATCHER, 407 WEST FIRST ST., SANTA ANA, CALIF.

C. W.—2fp, 3fs, 3aln, 4bq, 4ft, Can. 4cb, (5za), (6aif), (6ak), (6akw), (6ale), (6asj), (6aun), 6df, 6ek, 6gh, 6ib, 6ku, 6nx, (6tw), 6xh, (6za), 6zac, 6zae, 6zaf, (6zf), 6zg, 6zi, (6zt), (6zz), (7dp), 7nf, (7oz), 7xf, (7zu), 8agz, 8brl, 8jl, 8xv, 9aav, 9aeg, 9alg, 9ajs, (9amb), 9arj, Can. 9bd, (9bji), 9bsg, (9dth), (9dtm), (9dva), 9dxn, 9dzj, 9nx, (9ps), (9wd), (9wu), (9xaq), 9xm, 9yae, (9zac), 9zaf(voice), cl8, dd5(music), xf1.

Spark—5if, 5hk, 5xd, 5yq, (5za), 6's too numerous, 7bs, 7cb, 7ck, 7gl, 7gt, 7hf, 7im, 7in, 7jd, 7kb, (7ly), 7mf, 7mp, 7nf, (7ot), 7tj, 7vo, 7wj, 7xv, (7ya), 7yg, 7yj, 7ys, 7za, 7zm, 7zo, (7zu), 9aeg, 9aog, 9ayu.

These stations were worked on two 5-watt tubes in a modified Hartley circuit. The radiation is 1.7 amps on 215 meters. Have reports from 6zac, Hawaii; 8agz, East Cleveland, Ohio; S. S. McKelvey off Key West, and S. S. Admiral Watson at Yakutat, Alaska. Best "QSO" with 9wu, Ellendale, North Dakota, 1400 miles. Would appreciate card QSL's and will promptly answer all.

BY 6ACM, 1551 EMERSON ST., PALO ALTO, CALIF.

C. W.—4ua, 4va, 5xd, 5za, 6cu, 6cv, 6en, 6ka, 6kc, 6ku, 6ky, 6ny, 6pe, 6tw, 6aag, 6aat, 6aby, 6agp, 6aif, 6alu, 6akw, 6aur, 6awp, 6awv, 6bcd, 6bjc, 6bmn, 6xad, 6xaq, 6zb, 6zf, 6zz, 6zac, 7ab, 7dp, 7na, 7nn, 7xz, 7zu, 8bdb, 9db, 9dva, 9zaf, Can. 9bd, cl8.

Spark—5xd, 5xu, 5yq, 6bv, 6ec, 6fh, 6gt, 6hy, 6ic, 6iv, 6kc, 6kd, 6km, 6lc, 6od, 6ol, 6ud, 6up, 6aak, 6aau, 6abm, 6acy, 6adl, 6adg, 6adp, 6aeh, 6agt, 6agp, 6ain, 6ajh, 6ajr, 6ald, 6amn, 6ans, 6ark, 6asq, 6avd, 6avr, 6awi, 6awx, 6bak, 6bbc, 6bdz, 6bfr, 6bjv, 6bjy, 6bmp, 6bnf, 6bnu, 6zz, 6zal, 6zam, 7bk, 7ck, 7ed, 7gj, 7iw, 7ju, 7kj, 7mf, 7nw, 7nz, 7ot, 7wg, 7oz, 7ya, 7ys, 7yl, 7yj, 7zj, 7zk, 7zm, 7zn, 7zp, 7zs, 7zt, 7zy, 8cmi, 9avz, 9ye, Can. 9bd, cl8.

AT 9BJI, F. L. HICKS, 3935 W. 30TH AVE., DENVER, COLO.

C. W.—4bq, (5za), 5oi, 5mt, 5la, 5jb, 5yg, 5fv, 5aac, 5bm, 5zv, 5hb, 5ku, 5lj, 5un, 5sf, 5ic, 5nk, 5zu, 5ci, (5kp), 6vm, 6zx, 6tw, (6za), 6zb, 6xa, 6zi, 6xh, 6zg, 6df, (6zz), 6zs, (6awp), (6xad), 6xaq, 6ada, 6bge, 7zo, 8uk, (8vy), 8agz, 8arw, 8bke, 8xak, 8aiv, 8box, (9sl), 9zl, (9pi), 9dv, 9jg, (9wn), 9qf, 9iz, 9kp, 9ze, 9oa, 9vk, 9ve, 9yf, 9wa, 9uu, 9xi, 9xm, (9fm), 9il, (9qe), 9wq, 9hl, 9sg, 9ps, (9nx), 9jl, 9oo, 9zy, 9bey, 9aou, 9aeq, 9bsg, (9awm), (9ajh), 9aas, 9aay, 9amu, 9ays, 9aap, 9agn, 9asf, (9dof), 9aau, 9aks, (9aor), 9akd, 9abf, 9aog, 9axf, 9arz, (9aua), (9ajp), 9asl, 9aiy, 9apw, 9avn, 9aic, 9ari, 9anz, 9axa, 9avf, 9bed, (9bow), 9bum, 9boq, (9bbf), 9baf, 9bdy, (9bik), 9blo, 9brl, 9bmd, 9dqm, (9dzq), (9dzj), 9dts, 9dta, 9dsm, 9dky, 9dtf, 9dyz, 9dun, 9dug, 9dhb, 9dgq, 9bvy, 9cao, (9yak), (9yam).

Spark—5xu, 5xd, 5xb, 5fo, 5hk, 5ew, 6zam, 7lu, 7zv, 9drw, 9arq, 9amq, 9aig, 9wi, (9yak), 9ayw, 9aeg, 9avz, 9dze, Can. (4cb)-cw.

AT 7RC, MYRTLE POINT, ORE.

6ac, 6af, 6al, 6an, 6cc, 6dd, 6dp, 6ek, 6en, 6ex, 6go, 6gl, 6ib, 6pi, 6ala, 6ale, 6amb, 6amk, 6ars, 6asj, 6xla, 7bh, 7fu, 7fl, 7hi, 7iw, 7km, 7mf, 7ma, 7mu, 7nn, 7nu, 7nz, 7st, 7sc, 7vo, 7wg, 7ys, 7nl.

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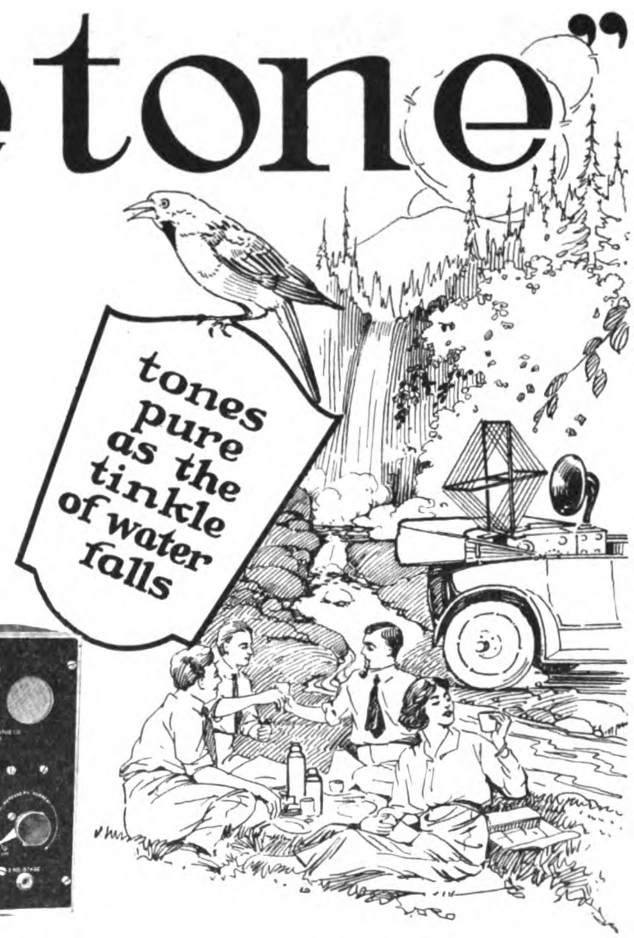
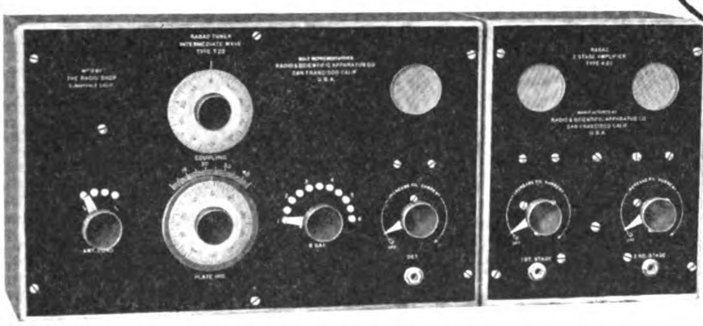
—*TUNER and AMPLIFIER comprising the new RASAC PURETONE*



receiving set



Designed by Ralph M. Heintz. Licensed under the Armstrong Patent No. 1,113,149. Manufactured by the Radio Shop, Sunnyvale, Calif
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With recent improvements that minimize "mush"

The most outstanding advantages possessed by the new RASAC TUNER are its ability to eliminate the aggravating scratches, hisses and clicks which usually accompany the reception of "radio," its extreme selectivity, and the purity and resonance of its tone.

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Prices and Specifications

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Panel—of heavy formica, highly polished and engraved. *Cabinet*—your choice of solid mahogany or solid walnut, both with beautiful lustrous finish. *Dials*—engraved, silver finish. *Condenser*—mica dielectric. *Antenna Inductance*—space—lattice basket weave. Tubes and batteries extra.

THE NEW RASAC PURETONE AMPLIFIER—Price $60. A 2-stage amplifier designed and finished as a companion piece for use with the new RASAC tuner.

IMPORTANT—The new RASAC apparatus described above is now available for delivery. Dealers are invited to write us for prices and full particulars. Retail purchasers are invited to write us for new RASAC folder describing this apparatus more in detail. Such requests should include the name of some radio dealer through whom they desire to purchase.

Radio & Scientific Apparatus Co.

606 MISSION STREET—SAN FRANCISCO, CALIFORNIA

HARMO-RADIOPATHY

Continued from page 25

THEIR thoughts sped back to the historic crisis in the earth's harmonic affairs, many years before when, driven almost insane by hideous jazz and its ramifications, it had sought a sane solution. Hawaiian orchestras of Carolina negroes had taken to fox-trotting, Swiss Yodlers, born of Swedish parents in Cincinnati, essayed Scottish folk songs. The conglomeration of vibrations, beating upon defenseless brains, was producing endless confusion of ideas and emotions. Something had to be done and that quickly. So said the great men—savants, psychologists, and alienists of that day.

The famous Musical Demobilization Conference, held at Fort Said, in 1940, had been the result. The nations of the world at that congress had mutually agreed to disarm their musicians. In the interest of world sanity, a League of Harmony was formed, whose principals would control the tonic output of the globe. Yap, a former cable station, was taken as the broadcasting center for international music. From there, day and night, an orchestra composed of players from the best musical circles of each country, would send forth by wireless, a fundamental theme to be received by the separate countries and translated into national programs.

There was wild rejoicing when the results of the conference became known. Great bon-fires of grand pianos were built in public squares. Riotous mobs smashed phonographs in the streets. The gutters of cities ran with harmonicas, concertinas, flutes, saxaphones and ukuleles. Even in far off Palestine, camels were loaded down with tons of jews-harps and driven into the Red Sea. There was universal enthusiasm. It was felt that a great stride forward toward the goal of human happiness had been achieved.

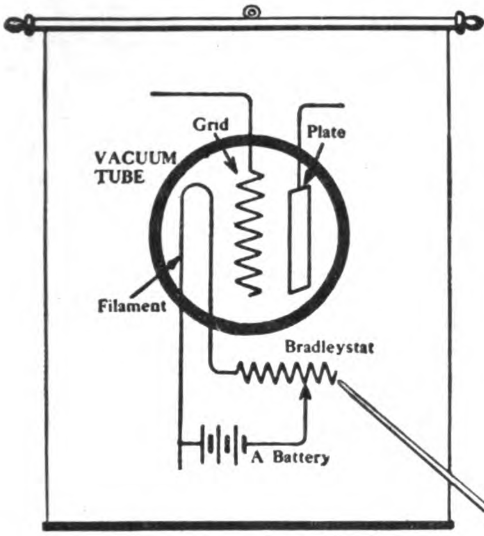
In France, on the nights that the Yap orchestra played the patriotic motif, the French people would tune their instruments to the fundamental wave and "Le Dernier Centime" would burst forth to send them into ecstacies of appreciation. In England, the same motif wave would render "God Save the British Manager." In America, the wave would be read as "The Coin Spangled Wall Street"—a melody that brought every school child to attention.

Did the citizens of Germany, listening to the love motif wave from Yap which above the Rhine was interpreted as "The Swan Song of Solvig The Chiropodist" from "Das Blunderbuster," desire to find the same thought in Italian environment, they had but to touch the international transposition key of the receiving instrument, and instantly the lyric

Continued on page 46

Science is Explaining

the delicate action of the audion bulb



"This is the vital part,"
says the radio engineer,

"of the receiving set. The heavy circle on the chart is the audion bulb, sometimes called a detector or vacuum tube. It has three wonderful parts—filament, grid, and plate.

"The filament becomes white hot when connected to the "A" battery, and sends out a fairy rain of invisible, electrified particles, which pass through the grid and strike the plate just as a spring rain is driven through the bare twigs of a hedge fence.

"The telephone receivers detect the slightest variation in the rain upon the plate. The broadcasting waves run from the antenna to the grid and interfere with the fairy rain like the leaves on a hedge interfere with a summer shower. So you see, by interfering with the fairy rain, the broadcasting waves make the telephones sing and talk.

"Since it is the fairy rain from the filament which does the trick, it is all-important that you provide noiseless, stepless, and extremely accurate control of filament current. The success of your set will depend upon the quality of your filament rheostat."

For further information, address

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Electric Controlling Apparatus
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Manufacturers of graphite compression rheostats for 20 years

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PERFECT FILAMENT CONTROL

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A single knob applying pressure upon graphite discs provides the amazingly accurate and noiseless control of the Bradleystat. No wire coils, no sliders, no verniers, and no loose contacts to "fry." And above all, the most precise control is available.

The Bradleystat is without equal for filament control of ½ and 1 ampere receiving tubes and sending tubes up to 2½ amperes. A guarantee of one year against factory defects is back of every Bradleystat.

Continued from page 44

strains of "El Piccalo del Manuel" from "La Blowedor" came pleasantly to their ears. It seemed that the dreams of universality were to be realized.

There was one shadow, however, which overhung the perfect understandings of the musical conference. That was the split-tone demands of the Far East—China, Japan and India, over which the delegates had argued for many days without arriving at any satisfactory decision. The Occidental world had held out for a tonic scale of fifths and sevenths. The Orientals demanded a chromatic arrangement. Being of a lazy temperament they had consistently refused to straddle the distances between fifths and sevenths, preferring to slide along from note to note, up and down the scale.

The Far East claims for harmonic recognition were overridden however, toward the close of the Congress, by an agreement that after ten years there should be a readjustment, and the chromatic scale given a hearing in the musical world. With this amendment the great ten-power musical pact had been signed. Thereupon, the world entered upon an era of peaceful, jazzless routine that had satisfied beyond all expectations.

SUCH was the status of things, on this particular night as, with all the world tense with expectancy and puzzlement, a little group of men sat in the conference room of the world's international musical center at Yap, their faces grim with the sinister import of the problem confronting them. For, while the rest of the globe had laughed, and played oblivious to impending trouble, the Orient had demanded its tithe of blood. On this night, the ten-year armistice had expired!

At the head of the table sat the international manager-general of Yap. At the foot was the chief operator of the Allied Harmonic Power Council. Beside him was Wang Yu Yuck, ambassador of the Fu-Suffragette dynasty, his expressionless face masking his inner thoughts—on his head his vanadium thought insulator that kept his mental processes from registering on the collectograph of the World Press Association's cylinders at Berne.

"Gentlemen!" The director general broke the silence. "Wang Yu Yuck has something to say to us!"

The emissary of the Far East bowed politely. High over his head the great sun-flower spirals of the massive projector through whose pyramided antennae the vast waves of harmony were thrown to a listening world, yawned silent and expectant. Behind closed doors in the great orchestral hall, adjoining, two hundred famous musicians

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Continued from page 46

sat with poised instruments—awaiting the verdict from within. Two billion people in the outer world were waiting —tense, nervous. Silence within the marble halls of Yap for the first time within a decade. It was a dramatic moment!

"Gentlemen," began Wang Yu Yuck in his faultless English, "please do not think me greedy, but we of the East have waited patiently for this hour—the moment of our triumph. We have receded much before the stride of Western civilization—given in cheerfully to the caravan of progress. Tonight we come before the world seeking our reward—justice."

He paused and a slight shudder ran through the concourse of assembled delegates.

"From this spot," he went on inexorably, "there has been played the motif of love, of adventure, of joy, of sorrow, of passion and discord. These and the motifs of the Occident—purely. But they are not the motifs of the Orient. To the Far East alone, from ancient times, belong the motifs of insinuation, of seduction, of allurement, of suggestion and fantasy. Their only expression is the half and quarter tone, unknown to the music of the Occidental world."

He paused and for a moment seemed overcome with feeling. Then in a steady voice he continued:

"For ten years, gentlemen, we have had no expression for our emotions. Try as we would, the genius of our great men of science has been wholly unable to translate the motif of the Occident into the feeling of the Orient through the existing scale. Our instruments, tuned to the finer themes of the chromatic scale, do not respond to the fundamental wave sent out from this station. We have been a race cut off from the benefits of harmony—pariahs from the realm of melody. We stand alone—musicless!"

There was something terrible in his words that brought a chill into the heart of every listener. As though unaware of this Wang Yu Yuck went mercilessly on.

"The East is in open revolt," he said. "In Bagdad, a sailor was found manufacturing a hornpipe in an attic. In Cairo, a dancing girl was caught strumming the woof of a carpet machine. In Burmah, a holy fakir was detected beating upon the ribs of a starving pilgrim, and singing an ancient verse of "The Alimony Blues." In China a seven-year-old child was seen to nail a hair across a crack in a window to obtain an aeolian harp in spite of the law."

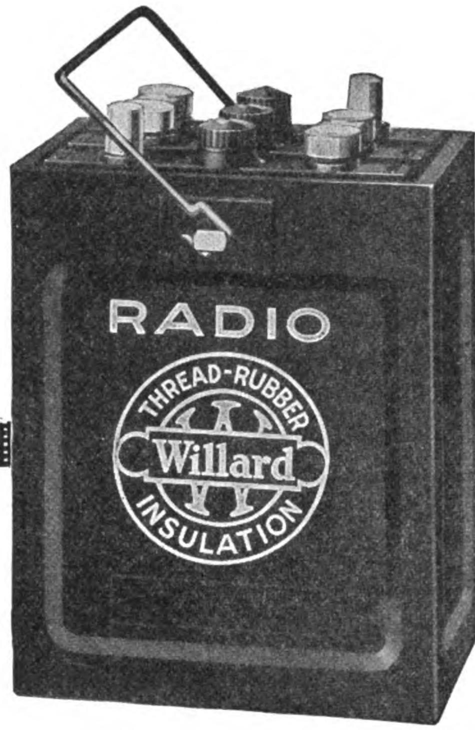
His voice went up.

"Such," he challenged, "Is the effect of the ten-power harmony pact. Sedition is everywhere. My people are in

Continued on page 50

Stop that Leakage!

The Willard All-Rubber Radio "A" Battery (shown at the right) is not an automobile battery adapted for Radio use, but is a special radio battery built for the reception of C W and spark messages. The reduction of the weight of connectors, the increase in thickness of plates, the special radio type of Threaded Rubber Insulation are all features that are necessary to an efficient, economical battery of this type.



You'll have to admit it's annoying to have a radio concert or a conversation interrupted by noises that sound as if all the animals in the zoo had cut loose at once.

Some of these noises can't be stopped by even the most careful tuning. They can be ended only by removing the leaky cell or the leaky battery that's responsible for them.

One of the most important features of the Willard All-Rubber Radio Battery is that it is absolutely leak-proof. Battery case and jars are cast in one solid piece of rubber, eliminating the possibility of leakage either from cell to cell, or to ground. Every case is tested at 24,000 volts.

The Willard All-Rubber Radio Battery has the same Threaded Rubber Insulation as the Willard Threaded Rubber Automobile Battery. The Willard Radio "B" Battery is a 24-volt rechargeable storage battery, with leak-proof glass jars and Threaded Rubber Insulation. Assures freedom from frying and hissing ground noises. Ask for particulars from your dealer, or at the nearest Willard Battery Station.

WILLARD STORAGE BATTERY COMPANY, Cleveland, O.

Made in Canada by the Willard Storage Battery Co. of Canada, Limited, Toronto, Ontario

Willard THREADED RUBBER BATTERY

Continued from page 48

open revolt. We can no longer hold them back with empty promises. They have grown restless, and uncontrollable. Their's is the cry of stifled hunger—an innate thirst for harmonic expression. Revolution is smouldering at our doorsteps, and we sit calm and indifferent."

Dramatically he waved both arms over his head.

"Gentlemen, I tell you unless we are given the latitude promised by the treaty of Port Said—unless the people of the East can have that which they crave, that for which they have patiently waited, that for which they are aflame with desire, there will be heard for the first time in half a century the thunderous tread of marching men, sweeping down from the barbaric heights of self-denial upon the voluptuous indifference of civilization."

He clinched his hands.

"I alone cannot hold them back. Only you—trustees of the great harmonic station of Yap, here assembled, can do this thing. Choose! On the one side—chaos and disaster. On the other—peace. In the name of Twang, our ancestral God of Music, I demand the fundamental Motif G.-777—the motif of split tones, half tones, quarter tones, eighth tones and sixteenth tones. I ask this in the name of my people, who stand, tense and menacing on the border. I can hold them back until 4 o'clock of next week but no longer!"

There was a deathly silence as Wang Yu Yuck sank into his seat. The international manager ran his eye around the circle. Before him sat the dictators of the world's music—men within the hollow of whose hands rested the harmonic fate of the globe. Would they see this thing as Wang Yu Yuck saw it? Would they grant the claims of the Far East, guaranteed under the treaty of Port Said?

"Gentlemen!" He put the question quietly. "What is your will?"

The representatives of the plutocracy of Greenland arose. He was the Esquimoses of the North—the leader of Refrigeration party and a patron of wireless thinking.

"There is no other way," he said slowly, "What Wang Yu Yuck has said is the truth. The East is aflame. Itinerant musical critics have stirred the people into revolt. Besides, there is the promise of 1940. It must be done. I move the request be granted."

The international manager raised his gavel.

"Unanimous?" he queried.

A nod ran around the table. For a second there was silence. Then came the crash of the gavel in the quiet room like the thud of an executioner's knife upon a headsman's block. Wang Yu

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Yuck raised his head. His eyes were brimming with tears, his features illumined.

"My people!" he murmured. "My people!"

IN the great orchestral room, the leader of the world orchestra jumped to attention as a gong clanged in his ear. Far beneath him in the huge resonance pit, the whole orchestra sat upright. Into the intense stillness came the vowelless syllables of an order from the international manager, spoken in the secret code of the Harmonic Conference.

"Czkrpqmx!" rang the words from the noiseless annunciator.

The leader's face paled.

"My God!" he exclaimed. "Motif G-777!"

He stood with ashen face as the significance of the order was borne home. Then remembering his oath of office, remembering the great trust imposed in him by those who had elected him to his office, remembering the money he had spent to achieve that distinction, buying votes, corrupting election officials, and padding returns the night he defeated his British opponent, he raised his baton and with all the great courage of a soldier going over the top, gave the signal that plunged the orchestra into the devilish insidious, mal-harmonic allocation of hoots, jeers, cat-calls, wails, squeals, clamors, roars, bawls, whoops, howls, bellows, screams, screaks, shrieks, squeaks, squeals, squalls, whines and yaups that stood for Oriental music. In other words the orchestra played Motif G-777 in all its ravishing beauty!

There are two parts to the awful motif of G-777. The opening prologue covers the entire gamut of Oriental misery. But the second portion—the main theme—deals with the battle spirit of Klam Chow, the great warrior epic of the Bamboo era. It fairly sizzles with excitement and dynamics. It effervesces with explosives. It concusses the ear with the native enthusiasm of a playful volcano. To hear it is like listening at the keyhole of an interdenominational hell.

As the first crash of sound went hurtling from the radiators of the Yap station into every crack and crevice of the earth with its terrific, ear-splitting cadences, millions of listeners who had been patiently awaiting the meaning of the unusual silence, jumped to their feet aghast. Wives clutched at husbands. Mothers hugged children. Animals lit out for the foothills, and a convention of Orthodox and Bonded Prophets and Soothsayers who had just passed a resolution abolishing the Almighty as a non-taxable utility, laid down their rabbits-feet and hurried into Kansas, U. S. A., where comfortable cyclone cellars could be bought on the installment plan.

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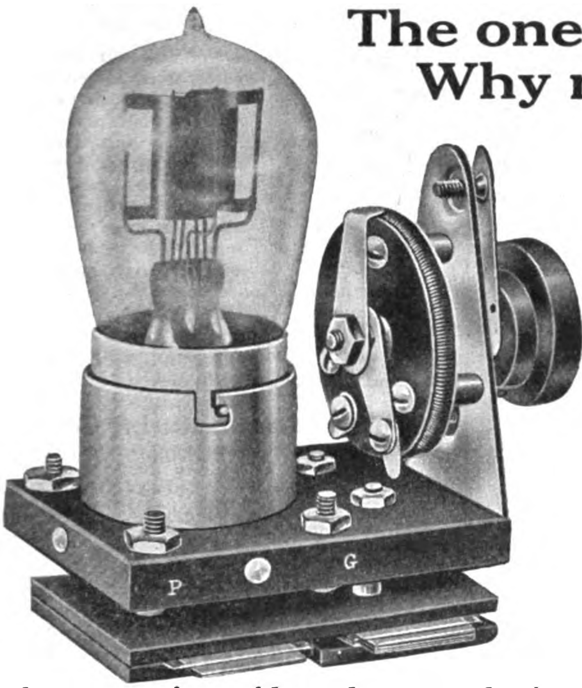
QUALITY



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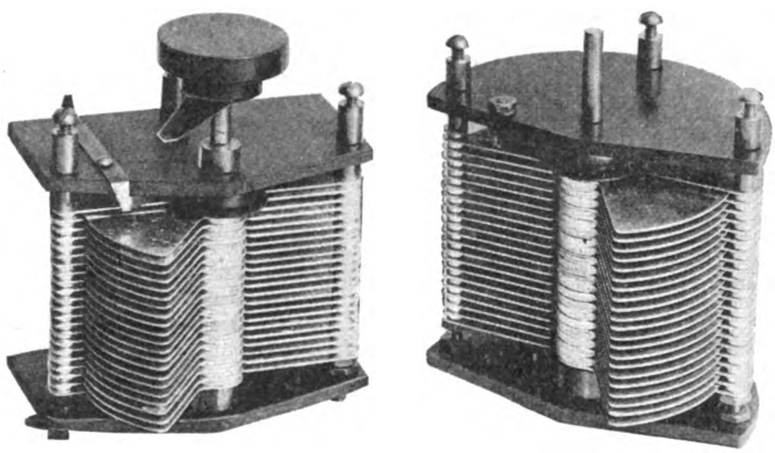

When you buy a variable condenser, you want the product of a real instrument shop. Of the many different instruments used in radio work, the variable condenser and head receiver are two that must be made right, by men that know, and have passed through the experimental stage. "Wireless Shop" variable condensers have an enviable reputation for "QUALITY", and this reputation has been honestly earned by strictly high grade material and workmanship. We have been manufacturing variable condensers for nearly eight years, and have developed a special line of equipment for performing each and every manufacturing operation required. "QUALITY" not "PRICE" is our slogan. The "PRICE" is as low as is consistent with "QUALITY". The 23 plate, No. 230, sells for $3.60. The 43 plate, No. 430, for $5.25. Twelve other sizes are fully described in our bulletin No 1. Ask for it.

THE WIRELESS SHOP
A. J. EDGCOMB

1262 West Second Street Los Angeles, California

Continued from page 52

Like a Banshee with its tail caught in a wringer, Motif G-777 with all its exquisite chromatic suffering went shrieking and cavorting through Domesticoriums, Religioriums, Concertariums, Cabaretoriums and Operariums. It broke the Windililium, Stringilium, and Vocalium controls on the great Temperamentoriums. It set towers to vibrating as in a wind. It rocked skyscrapers as does an earthquake. Its screech drove milling crowds into a frenzy. In the space of a few seconds, the world had changed from a haven of peace into an abode of insanity to the degree that an opera singer rushed into the street in Vienna and offered to sing for nothing.

HARDLY had the world begun to realize the awful thing that had leaped at it out of the silences when a new note intruded itself into the ensemble — a roar, a rumble — like the growl of distant surf. Within the Arctic Circle, where the University of The North had its polar laboratories, a little bent spectacled man—Professor Credo Nemo—raised his head and listened. He alone, of all the earth's startled, frightened millions, knew the answer.

He was the wizard of all known science. For nearly a century he had spent his time stealing ideas and developing them as his own. He knew the width of the fourth dimension, the thickness of the inch, and the ultimate parking place of Time. He had lived on the top of the earth for years to be next to Infinite Space in case anything went wrong with Creation and the services of an expert were needed. To him the growl that had crept into the awful Motif G-777 meant but one thing.

"Static!" he whispered. And again—"Static!"

It was even so. The great carrier wave, flung from the giant projectralia of the Yap station, carrying in its bosom the frequency of Oriental chromatics, was taking in every known vibration. It was heterodyning with the inner forces of Nature, the other force of the Universe, the surf beat of planetary oceans. Now it had become intuned with static, the great ocean of all Time and not even Professor Credo Nemo could predicate the result.

Acting on an impulse, the professor reached for his Vocaphone, an invention of his own. The twist of a knob and a sound ray, more powerful than any known wave, raced toward the assembly had at Yap, where the international trustees clung to each other with staring eyes, paralyzed by the terrible bedlam they had started.

"Beware!"

The words were those of Professor

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Nemo whose voice was familiar to every man in that vast auditorium.

"Beware," he said, " of the . . . Aurora Borealis!"

He had no need to finish. Stark staring horror clutched the trustees by the throats. The Aurora Borealis! Dull, sodden terror gripped them as the full significance of his words was suddenly driven home. If the awful thing they had started—that climbing, chromatic of Oriental harmony, mounting upward through a crescendo vibration scale ever heterodyned with the oscillation of the giant aurora as it crashed its great streamers of static hundreds of miles into the infinite spaces of the polar night. . . . if that titanic exhaust from the earth's magnetic dynamos was tapped, the terrible aurora would become a destructive agent, turned upon its parent. There would be annihilation . . . complete extinction.

The international manager mopped his brow and for the first time in twenty-five well-guarded years, the perspiration trickled down his face unheeded.

"Nemo!" he gasped — "Professor Nemo . . . " He went stumbling across the room, clawing at the radiophone of the Polar Exchange. He jerked the receiver from the hook with a shaking hand.

"Nemo, Nemo!" he shrieked into the transmitter.

There was a whirr, heard faintly above the awful grind of the ascending Oriental theme . . . .

"Yes?" It was the calm voice of the professor speaking.

"For God's sake, man . . . tell us . . . . tell us what to do!"

The international manager's tone reflected something of the terror that gripped them all—masters of the world's music yet in the great lap of science—children all. "Tell us!" he pleaded.

For an instant there was silence, although no one present was in the least conscious of it. Then . . .

"The Fundamental Note—that is your only hope!"

The international manager repeated the words dully.

"The Fundamental Note . . . !"

With a scream of delirious joy he dropped the radiophone. In one stride he crossed the room and stood before the huge iridiscium vault—the burglar-proof, processed safe, built from an improved formula for restaurant pastry, in which the fundamental note of all music, placed there by the Association for the Betterment of Harmonic Standards and Melodic Welfare, reposed in a plush case—the most precious and vital possession in the world.

"It shall be done!" he exclaimed.

The others did not hear his words, on account of the din without. But

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they sensed his meaning. Wang Yu Yuck sprang to his feet.

"Not that!" he screamed, "not that!"

This was the one thing he desired to prevent—the use of the fundamental note. It was the note upon which the entire tonic scale of the Occidental theme was built. Once that note was sounded—once its clear purity was sent forth into the world, there would be a revulsion against Oriental chromatics and the great cause of the East would be lost. And yet . . . the Aurora Borealis!

Even while he stood with outstretched hands, seeking a solution for this awful dilemma, feeling as he struggled for an answer that there was none, the international manager twirled the knob on the front of the vault, flung back the doors and from a shelf within removed the plush case. For a second he fumbled with the catch. The next instant he fronted the room, a tiny silver pitch-pine at his lips. In that instant Wang Yu Yuck made his decision.

Thrusting aside the detaining hands spread before him he jumped toward the international manager. But he was too late. Even as he poised, the clear, flute-like note of the whistle cut sharply through the room. The monster projectors overhead caught up the tiny vibration, magnified it, amplified it, regenerated it, patted it on the back, and shot it forth, cavorting around the globe through the storm of discords that raged and screamed in all corners of the sphere.

For an instant no change could be noticed and the international trustees, their faces white, their hands clenched, leaned forward and waited. Then there came a slack in the hideous crash of sound without. Gradually it began to die away, to slow down, to dissipate. A moment more, one could hear himself talk in the room. Another moment, the racket had died away all together. The next — there was silence — complete — unanimous!

With a great sigh the international manager walked to a huge auditorium where the world's great musicians clung to each other in bunches and wept. He spoke sharply to the leader, leaning against his music rack, his baton twisted into splinters.

"Give me that Oriental theme!" he said.

Without a word the leader turned and handed his music to the speaker. From player to player went the latter, collecting every scrap and atom of the awful chromatic music—with all the variations for piccolo, flute, organ, harp, harpischord, piano, banjo, ukulele, horn, violin, cello, viola, jews-harp and zither as well as the eighty-four copies held by the drummer. With the heap in his arms he returned to the trustees' room where a fire burned cheerfully in the grate.

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Without a word he hurled the mass into the flames, watching the fire lick them up greedily. When the last scrap had been burned, when the pile of what had almost marked a millenium in world affairs had been reduced to a grey ash, the international manager turned back to the guardians of the world's musical destiny. His voice was a bit shaky, but he did fairly well, considering what he had been through.

"Gentlemen," he said, "that was a narrow escape. Five minutes more and we would have been responsible for the grandest display of fireworks this world has ever seen." He paused and his eyes fell on Wang Yu Yuck, his head pillowed on his arms on the great mahogany table.

"Wang Yu Yuck," he said sternly. "Go back to your people!"

The delegate from the Far East raised his head. He was aged and broken—a crumbling remnant of a man. He lifted his arms.

"Yes—I will go back," he said. There was infinite sadness in his voice. "Back . . . empty handed!"

The international manager shook his head.

"No," he said. "You shall not go back empty handed. You will go back with this!"

He held out—the little silver whistle. Wang Yu Yuck stared at him, uncomprehending.

"Go back to your people," repeated the international manager. "Bring them the message of the Occident—of pure harmony. Tell them that the theme of the Orient is gone forever. Tell them that trying to impose it on the Western world missed converting the earth into a hell by a margin of seconds and a couple of oscillations. Become a prophet and a teacher of your people. And whenever you see an enthusiast from Thibet to the Ganges who seeks to revive anything resembling Chinese music, take this little silver whistle out of your pant's pocket and blow—blow for the peace of humanity and salvation of your race!"

His words rang with dramatic force throughout the room. Slowly Wang Yu Yuck staggered to his feet, clutching the whistle in his hand. For a moment he seemed about to speak, and then with his face working convulsively, he turned from the little group of men around the table and staggered to the door and so out into the yawning maw of the Far East—a quivering, palsied exponent of a decadent epic.

As the door closed behind him, the international manager touched a button on the table. In the great auditorium, the splintered baton of the world's orchestra leader clicked for attention. He semaphored a design in the air. In-

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TRESCO

Seven Years in Radio

—*Think What That Means!*

TRESCO SECTIONAL UNIVERSAL

Licensed Under Armstrong U. S. Patent No. 1,113,149

The Tresco Tuners were among the first ever made under the Armstrong Patent. They are found in all parts of the world, giving satisfactory service. The sectional idea is original with us.

The instruments are identically the same as those we have been manufacturing for seven years—but we have made their casings on the plan of the sectional bookcase—each a separate unit which, when put together with a top and base, forms one complete section.

The set consists of three units:

1. Tuner and Detector.
2. Two-Stage Amplifier.
3. Case for "A" Storage Battery.

The sections are of oak, finished in French gray, making an extremely attractive piece of furniture—something you will be proud to have in your home, beside your phonograph or piano. No wires or battery on the floor.

PRICES

Tuner and Detector Unit without vacuum tube, head set or "B" Battery	$ 50.00
Two-Step Amplifier Unit without vacuum tubes or "B" Battery .	35.00
"A" Battery Unit for holding "A" Battery	9.50
Top and Bottom, which, when added to the three other units, make a complete section all in one. Each, $5.00; both . . .	10.00
Complets set of five units—Total	$104.50

The units when assembled make a cabinet 40 inches wide, 15 inches high and 10 inches deep.

We do not furnish vacuum tubes, batteries or head sets.

TRESCO SECTIONAL UNIVERSALS are being supplied to dealers and jobbers just as fast as possible. Order from your local dealer. If he cannot supply you, we will fill your order upon receipt of prices as given.

Dealers and jobbers are rapidly finding out that TRESCO is one of the very few manufacturers who is actually in position to take care of large volume orders for immediate shipment. Liberal discounts are given to jobbers and dealers for quantity orders. We do not furnish vacuum tubes, batteries or loud speakers.

TRESCO RADIO

Used All Over The World

J. Matheson Bell, Sales Mgr.

Davenport, Iowa, U.S.A.

Continued from page 58

struments swung to position. The next instant, there burst from the giant oscillators—far-flung into the waiting instruments of an anxious world, a message of confidence from the dictators of music to their subjects—the popular paeon of universal peace and harmony—"Middle E Uber Alles!"

The crisis of October, 1950, had passed!

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of the country. The broadcasting of a direct personal message such as President Wilson made to Congress on the day we declared war would have made America's position immediately known to the world. It is unlikely that any international broadcasts will be sent out by the Naval stations except experimentally or in the event of a declaration of vital national importance.

Radio time signals sent out from the Annapolis station have been heard at the Antipodes, or half-way around the world. According to C. E. Adams, official astronomer and seismologist at the Hector Observatory, Wellington, New Zealand, time signals sent by radio from the Naval station at Annapolis, Md., were heard distinctly by him. Another report received by the Naval Observatory from Australia stated that the time signals had been heard there within a fraction of a second after their transmission, apparently coming both ways around the world.

Of course the electric light lines are the property of the lighting and power companies, and objection may be registered by these companies if their lines are used as antennae for receiving without their permission, but in the event that they do, it is possible that they may themselves establish broadcasting stations.

CALLS HEARD

AT 1PR, NEWTON, MASS.

C. W.—1aco, (1adl), 1agi, 1aip, 1ajp, (1ary), (1awo), 1azw, (1azx), 1bdc, 1bdi, (1bet), (1bkq), 1bpz, 1bqe, 1bql, (1brq), 1bsd, 1bym, (1cak), 1cct, 1cik, (1cpn), 1css, (1ee), 1ii, (1lz), 1on, 1pb, (1qp), (1uj, (1vt), 1xz, (1yb), 1ze, (2aab), 2aif, 2aja, 2alw, 2aqh, 2aqi, 2awf, 2awl, (2axk), (2ayv), (2azz), 2bcf, 2bea, 2beb, (2beh), 2bgi, 2bgf, 2bjq, (2blp), (2bnz), 2bqd, 2bqu, 2brb, 2btj, 2cbw, 2cft, 2ciz, 2dk, (2dx), (2fc), 2fp, 2kp, 2lo, 2lh, 2nz, 2ry, 2sq, 2wxm, (2zk), 2zk(ph), 3ajd, (3all), (3alu), (3aln), (3any), 3aqh, 3atg, 3aj, 3ba, 3wt, (3bec), (3bij), (3bnu), (3btk), 3buv, (3bz), 3cc, 3em, (3fm), 3gh, 3il, 3ir, (3iw), 3nh, 3qz, (3vw), 4by, 4gl, 4ili, nx4, 4za, 4ze, 5da, 5fv, 5la, 5nz, 8afj, 8agk, 8ago, 8ahq, 8ahk, 8alt, (8amk), 8anb, 8aqf, 8aqz, (8ark), (8asv), 8auh, (8avl), (8awm), 8awx, 8axb, 8axc, 8axy, 8bcl, 8bdu, (8beo), 8bef, 8bgd, 8bil, 8bjs, 8boo, (8blx), 8blt, 8bny, 8bqv, 8bsy, 8bso, 8bu, 8buq, 8bux, 8cbj, 8cfp, 8chx, (8cmm), 8cnn, 8cql, (8coo, 8cpc, 8cpg, 8ctz, 8dv, 8ev, (8hj), 8jj, 8ks, 8nb, 8oz, 8pn, 8pt, 8uc, 8uk, 8vj, (8vv), 8xe, 9aap, 9adx, 9aiy, 9aja, 9ajh, 9ark, 9avg, 9ayh, (9axf), 9blc, 9ct, 9dax, 9dky, 9drq, 9dzq, 9fz, 9km, 9pf, 9wu, (9uh), 9zl, Canadian 2bg, (3bp), 3iz, 9al.

Daylite—(1ary), 1bdc, (1lz), (1bkq), (1qp), (2aab), (2azz), (3bec), (3iw), (8amk), (8awm), (8beo), 8xe, (9blc).

Spark—1adc, (1ary), 1azk, 1bhr, 1bop, 1boq, 1bpz, (1brq), 1fm, (1yb), 1yd, 2aje, 2aqi, 2awf, 2ct, 2dn, 2fp, 2jz, (2pv), (2sz), 2ts, 2wb, 3aj, 3ba, 3wt, 5fd, 8acf, 8ahq, 8axo, 8axy, 8bsy, 8mz, 8vq, 8xe, 8zo, 9aaw, 9arg, (9axf), 9aza, 9dzi, Canadian (3bp), 3fo. Daylight 1ary, (2pv), 8zo.

REACTANCE AND SUSCEPTANCE DIAGRAMS

Continued from page 22

is shown as b_{10}. The corresponding reactance diagram is shown as X_{10}. This circuit has three resonance points, two of zero reactance for 410 and 650 kilo-cycles respectively and one of infinite reactance for 520 kilo-cycles.

Fig. 11 illustrates the diagrams for a series resonant circuit and a parallel resonant circuit in series. X_3 is the reactance diagram of the series resonant circuit (L_1C_1) and X_4 is the reactance diagram of the parallel resonant circuit (L_1C_1). The reactance of the entire circuit is the algebraic sum of X_3 and X_4 and is shown as X_{11}. The corresponding susceptance diagram is shown as b_{11}. This circuit has three resonance points, two of zero reactance for 260 and 680 kilo-cycles respectively and one of infinite reactance for 410 kilo-cycles.

Fig. 12 illustrates the diagrams for a series resonant circuit and a parallel resonant circuit in parallel. b_3 is the susceptance diagram of the series resonant circuit (L_1C_1) and b_4 is the susceptance diagram of the parallel resonant circuit (L_1C_1). The susceptance of the entire circuit is the algebraic sum of b_3 and b_4 and is shown as b_{12}. The corresponding reactance diagram is shown as X_{12}. This circuit has three resonance points, two of infinite reactance for 260 and 680 kilo-cycles respectively and one of zero reactance for 410 kilo-cycles.

While all the foregoing diagrams have been drawn to scale and the results are more or less accurate, one of the greatest advantages of this method of analysis is that qualitative results may be obtained by drawing the diagrams roughly. For example, consider the circuit illustrated in Fig. 13. The *shape* of the reactance diagram for the first portion of the circuit is the same as X_3 (see Fig. 3). The *shape* of the diagram for the rest of the circuit is the same as X_{12} (see Fig. 12). The reactance of the entire circuit will be the algebraic sum of X_3 and X_{12} and is shown as X_{13}. This circuit will have five resonance points, three of zero reactance and two of infinite reactance. The exact points at which resonance occurs cannot be determined from such a rough diagram, but the general characteristics of the circuit can be clearly seen.

A study of the foregoing figures reveals many interesting facts. For instance, connecting any type of circuit in series with a parallel resonant circuit will not change the resonant frequency of the latter (See Figs. 4, 5, 6, 9 and 11), while connecting another circuit in series with a series resonant circuit will change the resonant frequency. Connecting any type of circuit in parallel with a series

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resonant circuit will not change the resonant frequency of the latter (See Figs. 3, 7, 8, 10 and 12), while connecting another circuit in parallel with a parallel resonant circuit will change the resonant frequency. If a circuit has two or more resonant frequencies, points of zero and infinite reactance will alternate (See Figs. 5 to 13, inclusive).

There are many other things of interest which may be learned from a careful study of these figures. While one can construct his own diagrams, those shown here for several typical circuits will be found to be useful, particularly when only qualitative results are desired.

NEW RECORDS BY 6ZAC

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system as well as his apparatus layout. The antenna is directly back of his home, and is unobscured, in the direction of the United States. The transmitter, which was described in detail in the May issue of RADIO, is shown mounted on the table, to the right of the receiver, which is of the regenerative type, with detector and two stage amplifier. The whole arrangement of the apparatus is with the purpose of obtaining the greatest possible efficiency, and the lowest possible antenna radiation resistance, which he appears to have accomplished in a very satisfactory manner.

Mr. Dow maintains a regular schedule with such stations as 6ZQ, Oakland, Calif., 6ZAF, Berkeley, Calif., 6XAF, Piedmont, Calif., 6ZZ, Douglas, Ariz., and 7ZU, Billings, Montana and numorous others. Since the summer static season has already arrived, it is indeed remarkable that such low power as is represented by the above stations, none of whom employ more than 100 watts, is able to cover the distance to Hawaii. Mr. Dow is now after the scalps of those who won the recent Transatlantic tests, and hopes soon to be reported in England and Western Europe, when the long cold nights of Fall and Winter roll around.

C. W. ASSOCIATION NOTES

Due to the press of business, practically the entire C. W. Association staff has been absent for the past few weeks, with the result that considerable correspondence has remained unanswered. However, with the return of Mr. Griffeth, correspondents can expect replies to their queries in a very short time. Great interest has been expressed by many in the plans of the C. W. Association for Transcontinental and Transpacific tests in the near future, and those desiring to participate in these experiments are invited to write to Mr. G. G. Griffeth, Secretary, The C. W. Association, 602 California St., San Francisco, Calif.

WITH THE RADIO MANUFACTURERS

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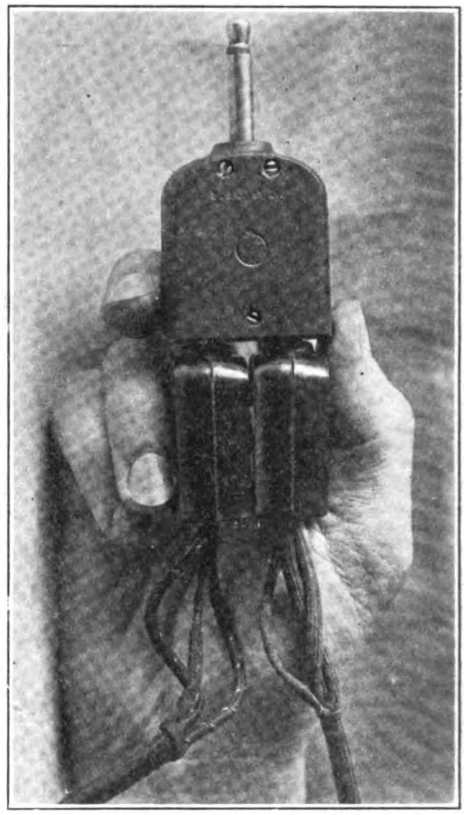
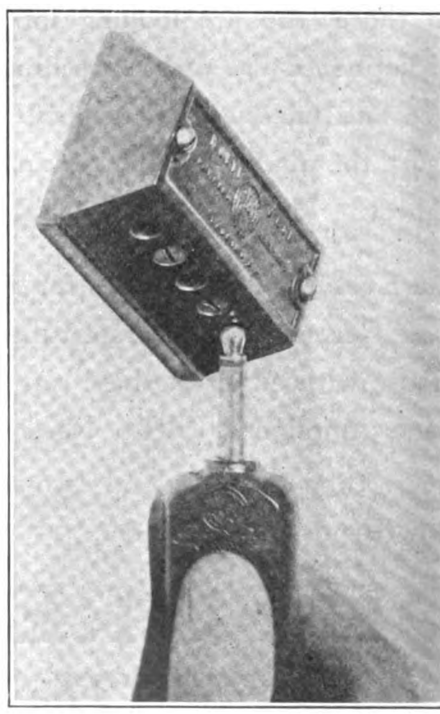
TWO NEW RADIO ESSENTIALS

Those who use radio receiving outfits know how troublesome and unsatisfactory it is to pass a single pair of phones about so that more than one person can listen in. If two sets of phones are available with only one jack on the receiver, the phones can be placed in the circuit only after much trouble and



Pacent Twin Adapter



The Pacent Multijack

inconvenience. This problem has brought about the need of a Twin Adapter which will allow two phone connections or a phone and a loud speaker connection to be made with a single jack. To fill this need the Pacent Twin Adapter has been brought forth by Louis G. Pacent and with it one jack can be made to serve the purpose of two. Thus the receiver can be tuned with the phones and the loud speaker can be plugged in. The Twin Adapter will also be found very serviceable when making rapid connections and changes in C. W. work. The Pacent Twin Adapter is provided with heavy phosphor bronze spring connections and it is beautifully finished in polished brass and velvety black composition. The Pacent Twin Adapter, although made especially to accommodate Pacent Universal Plugs may be used with plugs of other make.

The Pacent Multijack is really three jacks built into one. This new development followed closely on the heels of the Twin Adapter and it may be used in connection with the Twin Adapter and the Pacent Plug. The three jacks which make up the Multijack are built into a beautiful composition base that may be attached to the side of a receiving cabinet or to a testing board or table. The ends of the Multijack are flat so that a number of them can be placed end to end where a large number of connections are necessary. If three Pacent Twin Adapters are used in connection with a single Multijack as many as six connections can be made. Both the Pacent Twin Adapter and the Pacent Universal Plug fit into the Multijack. Like the Twin Adapter, the Multijack is provided with heavy spring contactors that are sure to form low resistance connections.

DAVISTONE HORNS

Davistone is a patented composition which is claimed to be non-susceptible to vibration and therefore well adapted for a horn which will not distort sound waves. Tests made with Davistone horns in comparison with horns made of other materials prove its superiority in radio work, both as to the quality and volume of what was transmitted, just as it had in the phonograph. A small Davistone horn 1 ft. long produced far clearer and more satisfactory reproduction than a wooden or metal horn four times its size.

A company has been organized to market Davistone for radio loud speakers, phonograph tone chambers and for the many other uses to which it can be put. Their factory is already in production and it looks as though the company will have a tremendous growth from the start. The Davistone horns will be sold in attractive cabinets or mounted on metal bases. They will come equipped with or without receivers. Davistone horns will also be furnished unmounted to firms who desire to assemble their product with these horns at their factory. The Davistone Company's temporary address is 4037 Harrison Street, Chicago, Illinois.

The Central Radio Laboratories, at 303 Sixteenth St., Milwaukee, has established production on one of its initial products, a filament rheostat, at the rate of 1000 per day. The president of the company, E. R. Stoekle, Ph.D., has resigned as physicist of The Cutler-Hammer Mfg. Co., in order to assume active charge of the business. Mr. Stoekle was formerly associated with the Western Electric Laboratories on research and development work in connection with vacuum tubes for radio telephony. He was also at one time connected with the Physics Department of the University of Wisconsin. C. R. Hammond is the sales manager of the new company.

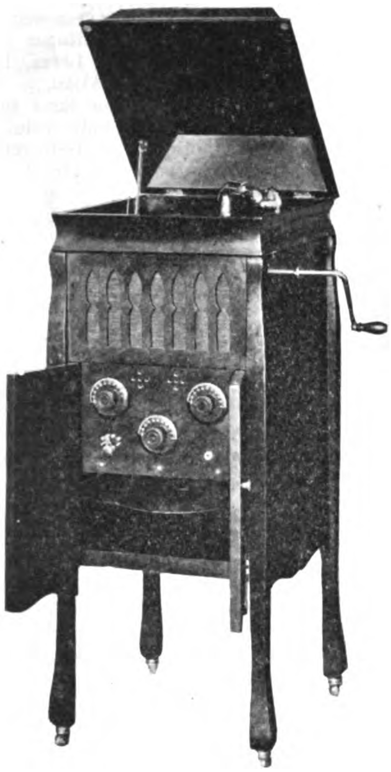
BONE DRY "B" STORAGE BATTERY

A radio "B" storage battery with rubber gasket seal and threaded rubber insulation, which can be shipped to dealers bone dry, thus insuring a brand new battery for the radio operator, is the latest product of the Willard Storage Battery Company of Cleveland. This latest "B" battery, besides being unusually quiet and overcoming several of the present difficulties most commonly attributed to "B" battery, resembles the more rugged, heavy duty automobile batteries made by the same company. It is said that none of the noise due to polarization in dry cells occurs in a liquid electrolyte battery. Electrical leakage between cells has also been overcome by wide separation of the cells and the use of individual glass containers.

The cells used are miniatures of the heavier types in many points of construction. The plates are insulated with threaded rubber insulation and the whole group assembled on a hard rubber rest which holds plates and insulator tightly in place at the same time affording ample space for the accumulation of sediment.

The plate posts pass through the covers in close fitting, soft rubber gaskets, similar to those recently adopted by the Willard Company for all of its batteries. The gaskets fit into a deep well on the under side of the cover and are firmly cemented to the posts making a tight leak-proof joint which can be easily removed when occasion arises. Shipping bone dry makes possible the delivery of a perfectly fresh, fully charged "B" battery, one which has not been slowly deteriorating during the interval between manufacture and purchase by the user.

This feature made possible solely by these threaded rubber insulators has met with a very favorable reception in connection with automobile batteries and there is every reason to believe it will be appreciated by the radio operator also.



Peerless "Radiofonograf," Combining a Phonograph and Detector with Two-Stage Amplifier and Using Common Phonograph Horn.

ERRATA NOTICE

The announcement of G. M. Proudfoot in May RADIO should have given the price of the Proudfoot detector and two stage amplifier, non-filament control, as $45, and of the detector and one stage amplifier as $35. G. M. Proudfoot is now engineer and manager of the radio department of the Cruver Mfg. Co., 2456 W. Jackson Blvd., to whom his business was recently sold because additional manufacturing facilities were needed to meet the demand for the Proudfoot instruments.

RADIO NEW CATALOGS

Bulletin C-3 from The Colin B. Kennedy Co. of San Francisco is an attractively printed publication giving illustrated descriptions, specifications and prices on Kennedy receivers, amplifiers and radio accessories.

The National Radio Institute of Washington, D. C. has discontinued the publication of "National Radio News" in connection with their correspondence course in radio and are advising their students to subscribe to RADIO as a desirable supplement to the N. R. I. instruction.

American Hard Rubber Co., of New York City, has issued a booklet on "Ace" hard rubber sheets, tubing, rods and moulded parts for all radio purposes.

Bulletin No. 22 from the Burgess Battery Co., of Chicago, is devoted to "B" batteries for wireless. Illustrations and descriptions are given of 4.5 volt, 18 volt, 22.5 volt and 113 volt dry batteries.

BOOK REVIEWS

"Radio Handbook," by J. H. Dellinger and L. E. Whittemore. Published by Lefax, Incorporated, Philadelphia. Price $3.50.

The compilers of this handbook have succeeded in assembling in one handy volume, every detail which applies to modern radio in the home. The authors are Dr. J. H. Dellinger, Chief of the Radio Laboratory of the U. S. Bureau of Standards, and L. E. Whittemore, Alternate Chief. These men, with all the resources and information of the U. S. Government at their command, would be expected to turn out an excellent piece of work, and they certainly have succeeded in producing a comprehensive source of accurate data, which at the same time is in no way complicated. Everyday language is used throughout, and all technical terms are so clearly explained that any average individual will experience no trouble whatever in understanding them.

The handbook is pocket-size and carefully indexed for easy reference. The fundamental principles of both radio telephone and telegraph are treated in an unusually interesting way. Actual practice of both receiving and transmitting sets of various types is explained in detail, and the exact functions of every piece of apparatus is excellently explained. This last point, especially, is something of great interest to almost everyone who is interested in improving their radio results. Different types of antenna are contrasted in one chapter in a way that shows an excellent grasp of this important subject.

The handbook is loose-leaf and new pages which can be added will be issued every month, free of charge, to all owners up till July 1st, 1923.

THE RADIO "IF"

By W. T. BURFORD

(With apologies to Mr. Kipling.)

If you can keep your nerve when all about you
Are stations jamming hard and blaming you;
If you can "hold the air" though others flout you,
Until you get the longest message through;
If you can send, and not grow weary sending,
Nor over-tire the man who has to read;
If your mistakes are rare, but prompt their mending,
If you believe that haste is never speed:

If you can calmly contemplate the chatter
Of greenhorn operators fresh from school;
If you can sit with messages that matter,
And wait until they've finished—and be cool;
If you can read through half a dozen stations
The weaker signals that are meant for you,
And pick 'em out, with few interrogations,
Yet never feel ashamed to ask those few:

If you're a jack-of-all trades, tinker, tailor,
If there is scarce a thing you cannot do;
If you're an electrician and a sailor,
Telegrapher, accountant, lawyer, too;
If you're propelled by energy that's tireless,
If you don't fear a job that's never done:
Then, take my word, you're fit to work at wireless,
And anything you get you'll *earn,* my son.

CODE REVISIONS

Continued from page 23

tion companies install radio antennae and apparatus for persons who are not familiar with electric wiring. This will tend to insure the installation of antennae and apparatus in a strong and durable manner. It is important that antenna wire be used in such size and tensile strength as to avoid its coming in contact with any electric power wires whatsoever.

The size and material of which the antenna is made should depend, to some extent, upon the length of the span which the antenna must bridge. It is suggested that for the ordinary receiving antenna about 100 ft. long No. 14 soft drawn copper wire can safely be used. If other materials are used, the size which is chosen should be such as to insure tensile strength at least equal to that of the No. 14 soft copper wire suggested above.

The requirements covering splices and joints in the antenna span are for the purpose of avoiding accidental falling of such wires upon light or power wires, of less than 600 volts where it is found necessary to cross such lines. The rules, it will be noted, permit crossings with lines of 600 volts or less, if they do not happen to be trolley wires or feeders to trolley wires. In such a case, it is desirable to use wire of a larger size than No. 14 in order to minimize the chance of accidental contact of the antenna with the power wires.

The interchangeable use of copper and of approved copper-clad conductor is suggested on account of the fact that these two kinds of wire are practically equivalent in their conductivity for high-frequency current.

b. Lead-in Wires. No mention is made of the insulation from the building of the receiving antenna or lead-in wire except that this lead-in wire should be run through a bushing. The latter provision is chiefly to protect the wiring against the possibility of short-circuiting with electric power lines which many run in the wall and whose location may be unknown to the persons installing the radio equipment. This requirement serves also to protect the antenna lead-in wire against contact with metal lath or other metal parts of the building.

From a signaling standpoint, it is desirable to use insulators for receiving antennae in order that wet weather may not cause the antennae to become partly short-circuited to the ground.

c. Protective Device. The requirement for a protective device to be connected between the antenna and ground terminals of the receiving set is for the purpose of carrying lightning discharges or less violent discharges caused by in- the ground with a minimum chance of duction or by atmospheric electricity to damage to the receiving apparatus, building, or operator. A fuse is not required as a part of the protective device, though lightning arresters which are provided with fuses will not necessarily fail to receive approval. If a fused lightning arrester is used, it makes it less likely that the antenna terminal of a receiving set will be put at a high voltage in case the antenna falls upon an electric light or power wire. The absence of the fuse, on the other hand, makes it possible for the antenna, if it accidentally falls across the power wires, to become fused at the point of contact and thus fall to the ground and eliminate the hazard. The antenna terminal of the receiving set should be connected to the point of junction of the fuse with the arrester.

Lightning arresters may be used inside the building, and in such a case they will receive better protection from moisture and mechanical injury than lightning arresters placed on the outside of a building wall.

Protective devices of reliable manufacture are approved by the Underwriters' Laboratories, and can be depended upon to operate at the required voltage. The use of a cheaply constructed home-made arrester, is not recommended, since it may easily get out of order and fail to operate at the low voltage which is desirable. Arresters should be inclosed in such a way as to protect the breakdown gap from dust. One disadvantage of the vacuum tube type of arrester is that it may cease to function without giving warning that it is inoperative. A list of the approved protective devices and ground clamps is contained in the "List of Inspected Electrical Appliances," published by the Underwriters' Laboratories. This list is revised semi-annually and may be consulted upon application to the principal office of the Underwriters' Laboratories, Inc., 207 East Ohio St., Chicago, Ill., and at offices and agencies throughout the United States and Canada.

While an arrester connected between the antenna and ground is regarded by many as sufficient protection, it is somewhat safer to install a switch in parallel with it as an added protection. Particularly if the arrester is inside of the building and the ground connection is made to a radiator, it is desirable to use in addition the outside ground connection.

If the antenna is properly connected to the ground, such connection prevents the antenna from becoming a hazard to the building and its contents and may act to supplement the protection given by lightning rods. The arrester should have the most direct connection to the ground which it is feasible to make, otherwise the antenna may become a hazard with respect to lightning.

d. Protective Ground Wire. While it is desirable to run the protective ground wire in as direct a line to ground as possible, it is more important to provide a satisfactory contact at the ground itself than to avoid a few bands in the ground wire.

f. Receiving Equipment Ground Wire. If the ground wire of a receiving set passes through a wall, it should be insulated for the same reasons as the antenna lead-in wire referred to in paragraph *a* above.

If the ground wire is exposed at all to mechanical injury it should be of larger size than the minimum permitted under the rules and certainly not smaller than No. 10 B. & S. gage. It should, for mechanical protection, be enclosed in wood moulding or other insulating material. Ground wires should not be run through iron pipe or conduit because of the choking effect at radio and lightning frequencies.

TRANSMITTING EQUIPMENT

j. Protective Ground Switch. On account of the larger size of the ordinary transmitting antenna, it is more likely to be subject to damage from lightning; and on account of the high voltages produced by radio transmitting equipment, it is desirable to provide for the use of a double-throw switch for connecting the antenna either to the transmitting apparatus or to the ground. The use of this switch makes it possible to entirely disconnect the antenna from the transmitting apparatus when not in use.

The objection to slate-base switches is chiefly from the radio engineering viewpoint, on account of the absorption of water by many kinds of slate and the presence of conducting streaks.

Under this rule one has the choice of the standard 100-ampere 600-volt single-pole, double-throw switch or a special antenna switch using 60 ampere copper which has an air-gap distance of at least four inches.

o. Protection from Surges, etc. On account of the difficulty which has been experienced by the induction of voltages in the supply lines of a transmitting station, it is advisable to use a protective device across the terminals of each machine or transformer connected to this power line. It would also seem desirable to connect a similar protective device across the power line and near the point of its entrance to the building and on the house side of the meters.

It is desirable that research on the performance of protective devices and the means for avoiding surges and "kick-backs" in the power supply lines be promoted.

RADIOTORIAL COMMENT

Continued from page 9

astounding records will be made—especially in the carrying powers of C. W. and I. C. W.! The return voyage will be conducted in the same manner.

We feel sure that the shipping companies, operating vessels to the Orient, would be glad to co-operate in this effort at obtaining further scientific data, for the good of radio progress in the U. S.

We also think that there are many manufacturers of receiving and amplifying apparata, who would be willing to *loan* a complete equipment for this test—that would become historic in the annals of amateur radio effort.

Arrangements could doubtless be made whereby the representing operator would be given permission to put up a single wire, of proper length, on board—for the test—in order that he should, in no way, interfere with the regular radio operations of the vessel.

There are many little details to be filled out, of course, but we believe the test to be very well worth while, and—to this end—we ask that all operators who desire to ascertain JUST how far they are reaching out, notify the Editor. We suggest that all stations who are interested, contribute to the expenses of sending an operator, say $5—or $10—each, for a first class passage to the Orient and return, together with a sufficient sum for incidental expenses, and so forth.

We furthermore propose that the receiving equipment shall NOT consist of "super-heterodyne's"—nor shall it have more than 3 steps of amplification—at the most! This for the reason that the test is not to be made for any *especially-built* apparata! Rather is it one that is undertaken for the purpose of showing that which amateurs can accomplish with such apparata as lies within the financial reach of the majority.

In the first available number of RADIO—after the representing operator's return—will be published, in full, all details of the test, together with the names of all who have contributed toward making the effort possible.

It is urged that those who think well of the idea, so inform the Editor at the earliest possible moment. And be it understood that the proposition is by NO means limited to Pacific Coast stations! *Any* operator, who has cause—by his former DX results—to believe that he can reach out over Pacific waters—is *welcome!*

LET'S GO!

MAJOR LAWRENCE MOTT.

THE NEW YORK RADIO SHOW

By L. D. McGEADY

Z-Z-Z — Br-Br-r-r —— Screech —— Yow-Yow. That is a somewhat harsh sound to convey to the reader's mind, but it is a fairly accurate reproduction of the noise made by most of the receiving sets before the exhibitor shut off his set at the late Radio Show, at the 71st Regiment Armory, running from May 22nd to 27th. The show was the fourth this year to be held in New York City, making an equal break between Brooklyn and Manhattan, each having had two of their own.

The first New York Radio Show early in the year brought out all of the amateurs in the Second and Third Districts. The last Radio Show succeeded in attracting all of the Finale Hoppers within a hundred miles radius; and some even brought their poodles.

The event of the week was the wireless telegraph receiving contest held Wednesday evening, May 24th, in the Armory. All honors were carried away by Theodore R. McElroy, of Boston, an employee of the Western Union Telegraph Company, with an official receiving record of 57½ words a minute for two minutes with one error, which error, as it later developed, may have been the faulty machine used in sending. This is setting up a new world's record. Mr. McElroy carried away a twelve inch loving cup representing first prize.

The man to carry off second honors was also a Western Union man, J. R. Smythe, of New York City, with a record of 49 words a minute to his credit. Third at the finish of the contest was E. G. Seutter of the New York *Times* staff with 46 words a minute officially credited him. These three men are ready to defend their records, so any amateur getting his receiving record up above the record should not fail to arrange a contest.

New radio attachments and devices in large numbers were shown at the show. Many of these were of wide interest; some of less general interest, but of great importance.

Another event which aroused the interest of the fans at the show was the amateur construction contest. All amateurs were invited to take part in constructing a set which would receive radio. The results were gratifying. Some of the sets were built into a lobster's claw, a ring finger, and all sort of small contraptions which made them look like the weavings of a spider more than the handiwork of an amateur. The smaller sets, however, did not come in for the big prize money. The first prize of $100 for construction, originality and effectiveness went to Rudolph Knopp, of Cedar Grove, N. J. Second prize money of $75 was awarded to A. Faske, of Brooklyn, N. Y., third prize of $50

going to Walter Ostman, Ridgewood, N. J. Besides these there were fifteen other smaller prizes.

Another record set at the show was in the number of aerials on the roof of one building, there being 20 receiving aerials of exhibitors at the show and three permanent aerials belonging to the service men occupying the armory and used for both sending and receiving practice and instruction.

Grasp the proportions of the show from the following data: There were nearly one hundred individual exhibitors' booths. An estimated figure of the number of visitors to the show is over sixty thousand. The exhibition building covers in all one entire block facing on four streets. This probably sets a record for the country as the largest radio show ever given.

One of the interesting exhibits was the one maintained by the United States Navy Radio service. Through working models and maps it was shown just how a ship is brought from the three mile limit, right up into the lower bay of New York. When a ship reaches the three mile limit, the navigator sends out the call "NAH" (the compass control station at New York City), and requests "QTE," "What is my bearing?" NAH replies with K. The navigator then sends his own code letters signal test and within one minute four separate compass stations are taking their turns sending him reply messages, which by turning his wave direction compass on he can safely guide himself into port. The four compass stations are located at Amaganssett, Fire Island, Sandy Hook, and Mantoloking.

COMMERCIAL BROADCASTING IN CANADA

Radio broadcasting on a large commercial scale will soon be in progress in Canada. John Lowry, telephone commissioner, announces that the Manitoba government telephone system is now preparing facilities with which to carry on a substantial business throughout the province. Similar steps are being taken by other provinces. Laws governing the activities of amateur radio machines so that best results may be obtained by commercial sending and receiving stations will be sought at the next sessions of the Western Canada legislatures.

Agricultural economists declare that the radio is destined to work wonders for Western Canada. Hundreds of settlers are pouring into the rich mixed farming districts of the prairie provinces. While Western Canada is noted for its telephone service, which forms a network of wires across the prairies, there is an inevitable delay in wiring new districts. With the rapid advancement of the radio science, the farmer in the most remote section may for a few dollars throw up a small receiving set that will keep him linked continuously with the broadcasting stations at Winnipeg.

QUERIES AND REPLIES

Continued from page 34

The circuit accompanying an article entitled "The D. X. Bringer-in," on page 23 of April RADIO, does not show where the loading coils should be placed. Please show the correct place for these coils.—B. O., Youngstown, Ohio.

The small crosses at the places where loading coils should be inserted for long waves were omitted on the original diagram, so we are reproducing it herewith, in corrected form. See Fig. 4.

(a) In the C. W. transmitter for C. J. Dow, described in May RADIO, is the rheostat connected so as to place the windings in series or in parallel, and will either of these arrangements carry the current of the two tubes? (b) Will the rheostat, when connected in parallel, have sufficient resistance to keep the voltage of the tubes at ten volts? (c) What is the purpose of the binding post on the upper right hand side of the panel of the transmitter?—J. P., Staten Island, N. Y.

(a) The rheostat windings are in parallel, in order to carry the current of the two tubes, without heating. (b) Yes, the rheostat is sufficient to bring the voltage down to eight volts if necessary. (c) This binding post is not used, being merely placed there to preserve the symmetrical proportions of the panel.

Please inform me how the limit of power from an amateur C. W. transmitter is reckoned.—R. J. B., Pine Knot, Calif.

Until the new regulations now being prepared by the Dept. of Commerce are put into effect, the rule of 1 K. W. maximum input into the transmitting apparatus is still in force.

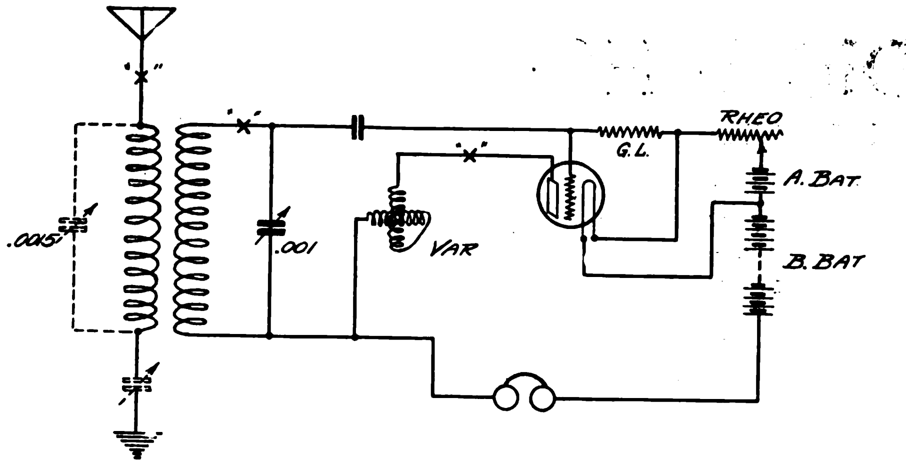
A chemical rectifier for charging storage batteries can be made by filling a pint mason jar to within an inch of the top with a concentrated solution of borax and by suspending a 1-in. strip of ⅛-in. sheet aluminum and a similar strip of lead on either side of the jar. The solution is made by stirring about half a pound of borax into a pint of warm water until no more can be dissolved. The metal strips should be long enough to just clear the bottom of the jar and should be bent at the top so as to hang over the edge of the jar and thus be suspended in the jar. The aluminum strip should be connected to the positive battery terminal and to one of the alternating current wires, being sure to have a 100-watt lamp or equivalent resistance in series. The other ac. wire is connected to the negative battery terminal. Before using the rectifier cut the battery out of the circuit and turn on the juice for five hours so as to "form" the plates.

ORANGE COUNTY RADIO CLUB

The Orange County Radio Club of Fullerton, Calif. has elected as president—Malcom Atherton, vice-president—Cecil Yates, Sect'y treasurer—Ray Hancock, and traffic officers—J. E. Waters (6EC) and (6AHA).

Every meeting is taken up by a lecture or moving picture. A debate is in progress on "Whether Spark is better than C.W."

The spark set and the telephone set at 6BIK (Club Set) is now in operation, and advice as to modulation, etc., will be appreciated. All letters answered. No regular operating hours have been assigned yet. Laurance Babize, excommercial operator, Cecil Yates, Ray Hancock and Walter Bruce are the operators for the Club Set.



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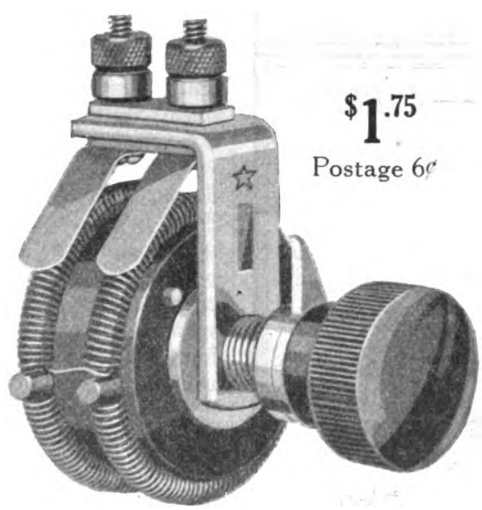

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1626	Plain.	8x6⅝x3	10	45	3.75
1626	Variable. . . .	8x6⅝x3	10	45	4.15
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EMPIRE RADIO CORPORATION
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ELIMINATING STATIC

Continued from page 15

electrical system acting as a huge receiving antenna.

In receiving by this method, Dr. Cohen pointed out, the interference of static is less, although much static is still present, but by connecting in the resonance coils in combination with certain circuit arrangements perfected by him and Major Mauborgue, it was found that the static was practically all eliminated. The resonance wave coil method, he added, had also been found applicable for use as an ordinary aerial, through experiments conducted last summer.

Describing the device, known as resonance wave coils, briefly, Dr. Cohen said that it was practically a long coil, the length of the wire used being comparable to the length of the wave which is being received. The coil which stands vertical is enclosed with short metal tubes which slide up and down the coil, and are grounded through certain circuit arrangements which act like a drain for the static currents but permit the signals desired to be received to pass through to the detecting instrument. The device can be used either with a lighting circuit used as a receiving antenna as described by General Squier, or in connection with a regular receiving aerial.

According to the Bureau of Standards, a great deal of work has been done by radio engineers and scientists in an effort to reduce the interfering noise caused by static and strays. Certain devices are in use by means of which strays are considerably reduced, but the apparatus now employed is usually too elaborate to be used at the ordinary amateur station.

One method which the amateur will find helpful in reducing certain types of strays, is to use, instead of the usual elevated antenna, a coil antenna and a more sensitive receiving set. A coil antenna may be constructed by winding a suitable number of turns of wire with proper spacing on a square wooden frame about 4 feet square. Certain types of strays seem to come from a particular direction, but many strays have no directional properties. The coil antenna has the property of receiving a strong signal when pointed in the direction from which a signal is approaching, and receiving only a weak signal when pointed at right angles to that direction. Thus by rotating a coil antenna to the proper position the directional types of strays can be greatly reduced. The strength of signals picked up by a coil antenna is much smaller than the strength of signals picked up by the ordinary elevated antenna, and good results should not be expected from a coil antenna unless three or more stages of amplification are used.

Some relief can also be obtained by persons having good amplifiers by using a "ground antenna." This is a long insulated wire run in a shallow trench or on the surface of the ground. The ground wire should be run in the direction of the station from which the most signals are to be received, and should preferably be several hundred feet long.

RADIO COMPASS STATION

The Navy maintains along the coast of the United States 62 radio compass stations, the total cost of which is not more than $1,000,000. It is estimated that during peace times the value of ships saved from destruction during three months of bad weather will more than offset the total cost of installation and maintenance of all the radio compass stations of the Navy.

These stations are not only of immense value during peace times but of the greatest assistance during war. Every time an enemy ship within 500 miles of the coast sends a radio message the coast compass stations can immediately determine the direction of this message. This direction in degrees is sent to a central office where the exact position of the enemy can be plotted.

The radio compass is also used continuously by aircraft flying up and down the coasts. In bad weather the aircraft frequently finds its base by asking the radio compass station there for a bearing, and upon receiving the bearing of the station the pilot flies directly toward it.

LETTERS TO THE EDITOR

COMPRESSIBILITY OF WATER

Sir: I wish to call your attention to an error which occurs in a technical article in your May issue. Charles K. Fulghum, in his article on "The Radio Wave," page 17, states:

"If a point is chosen beneath the surface of the water and a careful study made under the conditions which take place in this medium during such a disturbance as cited above, we find that the water is not moved along, but is merely *compressed and rarefied,* corresponding with the wave motion which takes place on the surface."

The author probably had in mind the compression and rarefaction of the air caused by a sound wave in it, as mentioned in the next paragraph of his article.

The fact is that water is practically incompressible, an enormous pressure being required to produce any apparent decrease in volume. The particles of water in a water wave have been found to move in circular orbits which become smaller and smaller as one goes further below the surface.

Yours truly,
EDWARD W. KIMBARK.

Evanston, Ill.

Sir: In reply to Mr. Kimbark's letter of May the third, concerning the error in my article on the Radio Wave, I have this to state.

Mr. Kimbark is in error when he states that water is practically incompressible. That is the popular belief, but the fact is that it is compressible and this property is being made use of in a very novel manner at the present time. (See May issue of Scientific American, "Transmitting Power in Fluid Waves.")

Were water not compressible a sound propogated at a point beneath the surface of a body of water would be heard simultaneously at any point no matter how far distant it was from the source of sound. (This is considering the use of proper microphonic instruments as detectors beneath the surface of the water.)

In the case of a disturbance such as was referred to in the article, vis., a stone dropped in a pool of still water, the writer was not referring to the surface waves but to the waves which are formed that are points of rarefaction and compression. Mr. Kimbark's statement that the particles of water, presuming he has meant molecules, move in circular orbits, is proof in itself that there must be differences in the density of the water as the wave progresses through it, for no matter how small, these particles have a certain inertia which is the cause of the formation of these waves which are characterized as points of rarefaction and compression.

I trust that this letter will clear up any question which has occurred in the minds of any readers over this point which is here discussed.

Very truly yours,
CHAS. K. FULGHUM.

Delta, Colo.

TRANSMITTING ON GALENA

Sir: In your May issue of RADIO, on page 20, is an article by L. F. Seefred on "Transmitting on Galena."

This article is very interesting as it shows that Mr. Seefred's antenna was able to absorb enough energy from the two receiving stations heterodyning each other to be able to modulate their beat frequency by pure absorption. Please have Mr. Seefred give a little data on this phenomena such as distances between the three stations and plane of each antenna. I imagine his station was located quite close to one of the other stations in order to absorb enough energy to modulate its output.

Continued on page 86

He states that just as soon as one of the stations would turn off its bulb, his (Mr. Seefred's transmitter) would be dead. I think that is not quite the case as I believe he could still modulate the output of the other station by absorption, but as he was using galena he of course could not get a beat without the third station heterodyning.

I see no reason why Mr. Seefred could not accomplish voice transmission by putting a microphone in series with his antenna and modulating the output of the near station by voice. This would require a fourth station with a non-oscillating receiver to hear the voice, or the third station could hear it with a straight detector.

Yours truly,
V. H. BROWN.
Brooklyn, N. Y.

Sir: Mr. Brown is correct in saying that one of the stations must have been close to mine as I will admit that he was approximately 50 or 60 feet from me, while the other was two blocks away. Both antennas were at right angles with mine. No doubt voice *could* be accomplished in this form as per Mr. Brown's letter. I have not had the opportunity to try voice modulation as yet, but would like very much to see published in RADIO, some experiments carried out by others along this line. I know of two amateurs in this city now who claim to be talking to each other at a distance of four blocks by making their sets oscillate and inserting a microphone in the ground lead, altho Mr. Brown's idea is a different experiment, and should prove successful to my estimation.

I have a friend in Texas who claims that he picks up quite a lot of the long undamped wave stations on both the Pacific and Atlantic Coasts. Also hearing POZ, and all this done on galena and a long antenna. There probably were two stations heterodyning on each other to make the third one audible on crystal at the fourth station.

I remember on one occasion when we copied the Great Lakes Naval Radio Station (undamped wave) on crystal, Saturday, Sept. 16, 1916, at 1:05 A. M.—P.S.T. NAJ was calling NPL on 6,000 meters. I have some very rough sensitive galena that is not seen at any of the stores and which probably accounts for the success I have had with receiving and transmitting on galena.

Very truly,
LYNDON F. SEEFRED.
Los Angeles, Cal.

The Altadena Radio Laboratory, operated by Paul F. Johnson at Pasadena, Calif., has outgrown two stores during the past year and on July 1st will move to 562 East Colorado St., where they will have twice their present room.

The Northwest Radio Service Co., of 1637 Westlake Avenue, Seattle, has expanded its activities to include large-scale manufacturing of instruments, under the trade name of "Puget." Shops in the Flatiron Building, adjacent to the store headquarters in the Times Square Building, have been completely fitted out, and are now engaged in working to capacity on three types of receiving sets and on Puget headphones. A large corps of radio mechanics have been put to work, and the demand is so strong that additional men are being added practically every day. The Northwest Radio Service Co., will extend the scope of its business to include wholesale relations with western and national dealers, according to V. I. Kraft, manager of the company. The company resumed broadcasting schedules early in May, when it reopened its station, KJR, with a 100-watt set.

250 WATT POWER AMPLIFIER

Continued from page 13

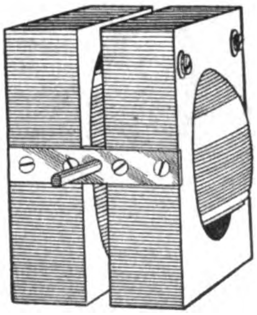
on the vertical sub-panel. The process of soldering Litz is considered in detail in a subsequent chapter.

The filament voltmeter, V, which has a scale reading to 12, the milliammeter, A, with a scale reading to 250, and the radiation ammeter, I, with a scale reading to 10, are standard equipment.

It will be seen in Fig. 58 that there are three posts marked "FIL." These provide for filament heating by either alternating or direct current and, of course, the former is to be preferred because of the resulting greater tube life. When alternating current is employed for this purpose, post number 18 is the mid tap to the filament transformer secondary. To eliminate the impedance of the transformer secondary to the high frequency pulsating currents flowing from the filament, a 0.5 microfarad paper dielectric condenser should be bridged across posts number 16 and 18, and 18 and 17. When direct current is used for filament supply, connect posts 17 and 18 together and apply the filament heating current to posts 16 and 17.

Neglecting the broken lines of Fig. 58, the device is connected for use as an amplifier of any high frequency pulsating or alternating current impressed upon the input terminals. It will be noted that the flexible leads to the variable output inductance are connected to posts numbered 1, 2, 4, 8, and 9. Post number 2 is a blank, and serves merely to support the flexible lead when its use is not desired.

To use the instrument as an oscillator or C. W. transmitter, shift the flexible lead from post number 2 to 3 and the one from post number 4 to 5 and connect posts 5 and 6 together. This will form a Hartley oscillating circuit which will be found to operate most efficiently.



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For the amateur who wants to wind his own variometer, we furnish the wooden parts and all necessary wire, screws, hardware, etc.

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Wire, etc.—Complete set of all wire, screws, and hardware needed to wind and assemble the complete variometer as shown in illustration above, postpaid, per set **70c**

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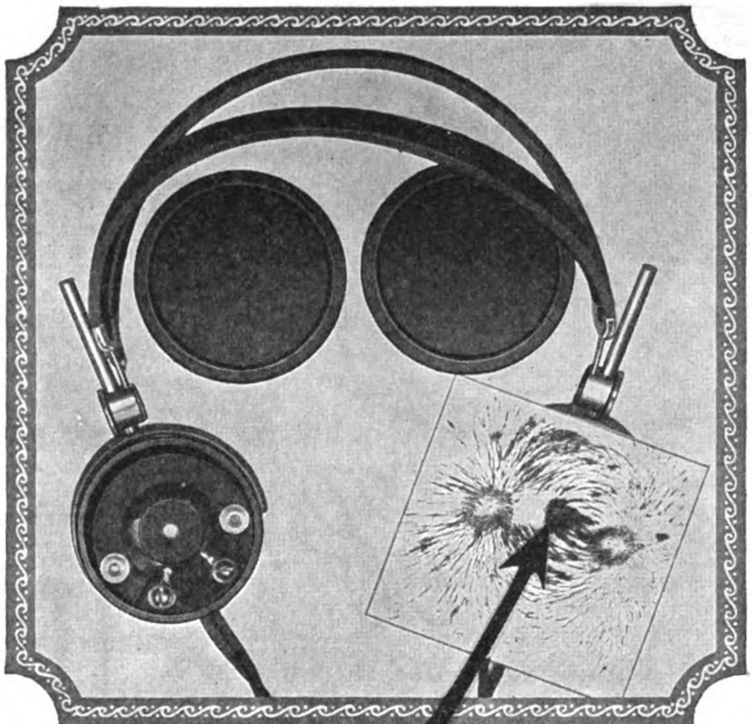

A STRONG PULL AT THE ONE PROPER POINT

WHEN the forces exerted on the diaphragm of a telephone receiver are applied at two points, there is a tendency for the diaphragm to vibrate in sections, producing false overtones and distortion to sound waves.

The PERFECTED AUTOMATIC ELECTRIC (LONG RANGE) RADIO HEAD SETS are designed with a powerful single pole electro-magnet. The pull is at the *exact center of the diaphragm,* which vibrates as a unit, reproducing clearly and accurately every shade and inflexion of tone.

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Spark—5cn, 6ajh, 6ajr, 6ark, 6avr, 6ex, 6gr, 6ib, 6im, 6mh, 6qr, 6tu, 6uo, 6oh, 6xh, 6zam, 6zu, Can. 9bd.

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C. W.—5za, (6ak), 6bk, 6cu, 6df, 6ea, 6en, 6fh, 6ft, 6ga, (6gd), (6gy), 6ka, (6ku), 6pi, 6akw, 6bkb, 6bka, 6bjq, 6bjr, 6bes, 6bfv, (6bcd), 6xad, 6zf, 6zg, 6zw, (6zx), 6zz, 7cp, 7dp, 7fl, (7mf), 7na, 7oz, 7zu, 9wd, 9amb, 9ayu, 9dtm, 9dva; qrn getting bad now.

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FOR SALE: Variable condensers: plates 4c, rotary washers 10c dozen, stationary 5c, shafts 25c, supporting rods 5c, tops and bottoms 25c pair, knobs 15c. Parts 23 plate $1.85; 43 $2.85. Assembled $1.00 extra. Tool and die work. Gravenstede, 84 Hancock Ave., Jersey City, N. J.

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For this month only, anything standard or if it's radio, less 15 per cent. Moulded Bakelite socket 50c, 7/22 tinned antenna wire 65c per 100 ft. Detector panels $4.50 each. Amrad crystal sets $13. Rush your list of apparatus wanted today. Dealers write. Henry Kulikavaski, Ansonia, Conn.

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MISCELLANEOUS

RADIO SPECIAL: Switch lever, knob, 12 contacts, 2 stops, 2 binding posts, $1.00; those excellent Eveready B Batteries all sizes, postpaid; a neat sturdy 23 plate variable, .0005, $3.75; moulded and nickel plated sockets, 90c and $1.00. Immediate delivery. Also a receiver-detector with 2 step $125.00 and a single circuit receiver-detector 1 step in same cabinet, $50. Pacific Radio Equipment Co., Box 27, Station "A", Berkeley, Calif.

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CABINETS. We manufacture all sizes, from any variety of wood desired. No lock-box corners. Only high grade tongue and groove or double tongue joints employed. Prices low. Prompt delivery guaranteed. Boxtoy Company, 2000 E. Vernon Ave., Los Angeles, Calif.—(2T-J&A)

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SIGNAL

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"Ame'ica has gone wild over radio.

"There has been 'created' an overwhelming demand for any old thing that will receive radio-phone speech and music.

"Manufacturers, jobbers and dealers were unprepared for the onslaught of orders.

"Manufacturers have doubled, trebled and quadrupled production facilities.

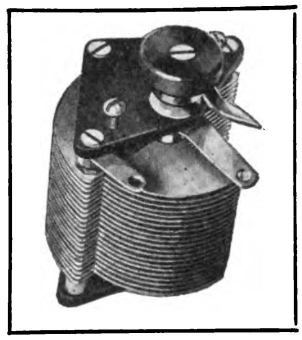
"Meanwhile men who know little or nothing about radio are busily making Chinese copies of old stuff to be sold to an unsuspecting public, at fabulous prices.

"Such a time of wild, crazy enthusiasm calls for cool heads and words of caution."

You who are in radio for profit or pleasure realize this; you know the very future of the industry, and possibly your own business, depends greatly upon the ability and stability of radio equipment to GIVE SERVICE. Therefore, keep a "cool head." Investigate, analyze, compare before you tie yourself to any one make or manufacture.

RADIO EQUIPMENT MARKED "SIGNAL"

is not new, nor untried. It has stood the test of time. SIGNAL Wireless Equipment served the United States Signal Corps efficiently and well. SIGNAL Radio Materials have been developed by SIGNAL Radio Specialists in SIGNAL Laboratories, and are built in the SIGNAL Factory, according to the best commercial and government standards. It is Radio Insurance to specify "SIGNAL."



"Signal Variable Condenser"

SIGNAL BACK MOUNTED VARIABLE CONDENSER

A typical "SIGNAL" product built for service. For example; where ordinary amateur construction calls for plates only .015" in thickness, SIGNAL plates are .026" thick. You can drop SIGNAL Condensers No. 76 and 77 from a considerable height without injuring plates or spoiling adjustment.

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RADIO

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With her *A-P Set,* petite little Henrietta Turner of Stockton, California, is enjoying a radio concert from Seattle, over 900 miles away. Miss Henrietta, though only 7 years old, has no difficulty whatever in tuning in on even the most distant points. She knew her radio telegraph code before she could write her alphabet. Because she is so ardent an A-P enthusiast, we call her *"Our Radio Girl."*

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Type AR-2 manufactured by Oard Radio Laboratories. Licensed under Armstrong U. S. Patent 1,113,149 for amateur and experimental use only.

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When you buy Cunningham Tubes you KNOW that the reputation of one of the world's greatest scientific laboratories is behind them—you KNOW that the highest human and manufacturing skill is combined to insure clearness of reception of all radio messages.

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Type C-300
$5.00

The trade mark GE is the guarantee of these quality tubes. Each tube is built to most rigid specifications.

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Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed only for amateur or experimental uses in radio communication. Any other use will be an infringement.

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BURGESS "B" Batteries assure clear receiving, increase the efficiency of any receiving set, and they are cheapest in hours of service.

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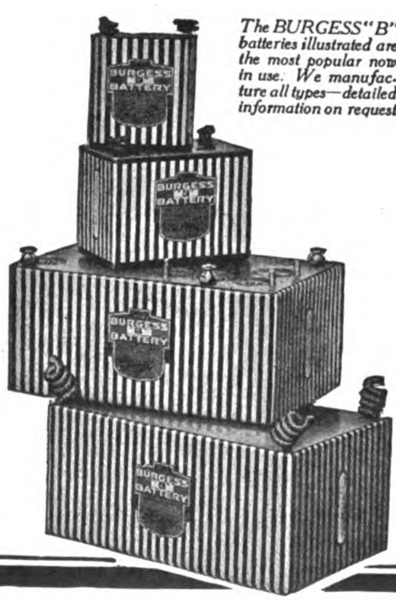

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RADIO

Established 1917 as Pacific Radio News

VOLUME IV — SAN FRANCISCO, AUGUST, 1922 — NUMBER 8

Contents

Published Monthly by

Pacific Radio Publishing Co., Inc.

Pacific Building, San Francisco

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LAWRENCE MOTT, *Associate Editor.*
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25c a copy. Subscription price $2.50 per year in the U. S., $3.00 per year elsewhere. Instructions for change of address should be sent to the publisher two weeks before the date they are to go into effect. Both old and new addresses must always be given.

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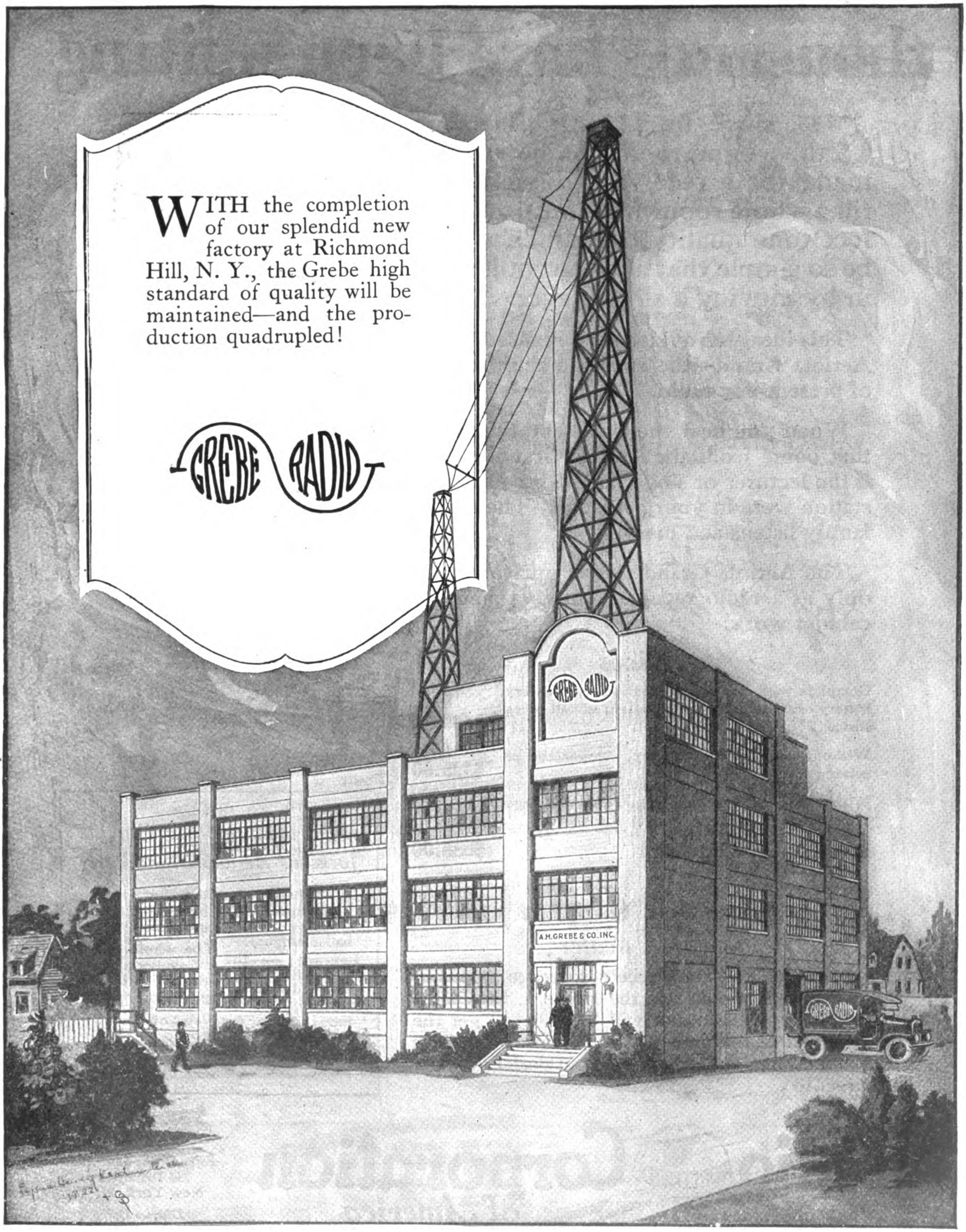
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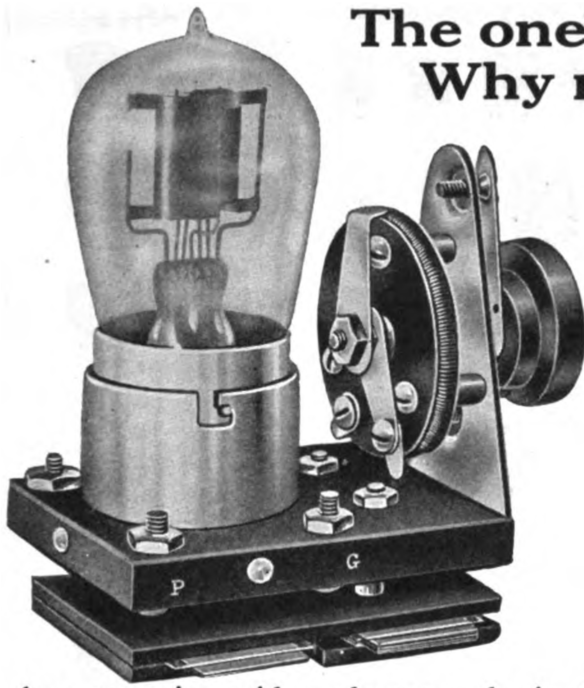
QUALITY



The one thing you pay for in the end
Why not get quality when you buy

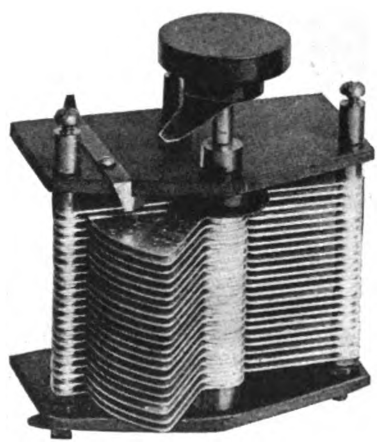
Your First Radio Instruments
Buy
Wireless Shop Apparatus
AND BE ASSURED OF THE QUALITY

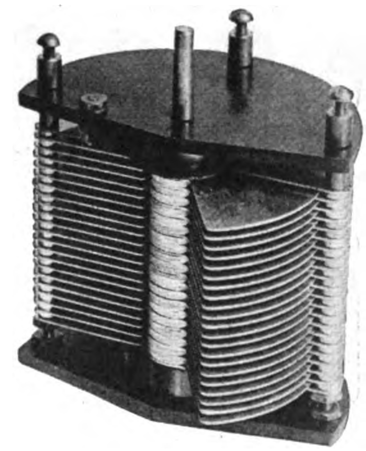
NO. 40 WIRELESS SHOP DETECTOR UNIT

A complete detector control, designed for back of panel mounting. By using this new unit it is very easy for the novice to build up a receiving set. All that is necessary is to drill three holes in your front panel, mount the unit and wire it to your tuner. Unit consists of socket for tube, rheostat, mica grid condenser and mica by-pass condenser. The bulb is not included. And the price is so low that you cannot afford to assemble the separate instruments yourself. A knob and pointer is supplied. Price (postage extra) $5.00

The No. 40 detector unit and No. 41 amplifier unit is fully described in our bulletin No. 3, which will be mailed for the asking.

Variable Condensers





When you buy a variable condenser, you want the product of a real instrument shop. Of the many different instruments used in radio work, the variable condenser and head receiver are two that must be made right, by men that know, and have passed through the experimental stage. "Wireless Shop" variable condensers have an enviable reputation for "QUALITY", and this reputation has been honestly earned by strictly high grade material and workmanship. We have been manufacturing variable condensers for nearly eight years, and have developed a special line of equipment for performing each and every manufacturing operation required. "QUALITY" not "PRICE" is our slogan. The "PRICE" is as low as is consistent with "QUALITY". The 23 plate, No. 230, sells for $3.60. The 43 plate, No. 430, for $5.25. Twelve other sizes are fully described in our bulletin No 1. Ask for it.

THE WIRELESS SHOP
A.J. EDGCOMB

1262 West Second Street **Los Angeles, California**

Tell them that you saw it in RADIO

August, 1922 RADIO Vol. 4 No. 8

Radiotorial Comment

THERE are parasites that feed upon every vigorous, growing thing, and, in this respect, radio is no exception. The radio parasite is the unscrupulous promoter, the type of man that has made oil stocks a by-word and a stench in the public nostrils. These men see an opportunity to capitalize the public interest in radio by exciting the cupidity of small investors with impossible promises of large returns.

Nearly two thousand new companies have been formed to manufacture and sell radio apparatus during the past six months. Half million or million dollar radio corporations are formed overnight around some local "expert" as a nucleus with a flock of salesmen to peddle the stock at ten cents a share to the credulous. The wildest days of the Comstock excitement or oil gushers in new territory are tame compared to the rush to "radioland."

Of course some of these wild cat ventures will survive, but the great majority are foredoomed to failure. With increased production facilities by the old-established companies the supply of equipment will soon catch up with the demand. The owners of patents that are being carelessly infringed have already sounded warnings of prosecution. In the war for survival the "fittest" will be those concerns with real engineering advice, sound financial backing and proper distribution facilities.

So let the investor study any radio scheme as carefully as he studies investment in any other line of industry. The old Roman slogan, "caveat emptor," applies as well to the financial insecurities as to the junk apparatus with which the market is being flooded. Otherwise it is not investment, but simple gambling with the cards stacked against the player.

GREAT harm is being done to radio by the unwarranted interpretations that some of the fire underwriters' bureaus and inspectors are making of the National Electric Code rulings on radio installations. Actually there are only two hazards from an outside aerial: contact with light and power wires and lightning. As regards the former, the warning is well founded, but as regards the latter an aerial lightning switch is better than a lightning rod or other means as a protection. A wire clothes line, a tin roof or a telephone wire is just as "dangerous" as an aerial. As pointed out by "Electrical Magazine" of New York, which has energetically taken up the cudgel of defense, "an ordinary radio receiving set involves about as much fire hazard as a white enamel bath tub."

The fault lies not in the rules themselves, but in the alarmistic interpretation thereof and in the threat that rates will be raised or insurance canceled if aerials are erected. In the face of such a threat it is natural that dad or the landlord should forbid the boy to put up an aerial.

That such threats are idle as regards enforcement is shown by the fact that "any attempt to cancel insurance because of code violations, would wipe out half to three-quarters of the fire insurance business," because that number of houses already contain violations of the code in their electric wiring.

But as only a few people realize the publicity of such threats, thousands are being unnecessarily scared about a danger that does not exist. The continued repetition of this "cry of wolf" eventually will prove a boomerang to the inspectors, for when a real need for caution arises their warning will not be heeded. We believe that they will soon see that it is to their self-interest to desist in the attempts which can only temporarily retard the onward advance of radio into every home.

THE idea of a trans-Pacific test of amateur radio transmission, as suggested in July RADIO, has been taken up by the C. W. Association of America. Plans are now under way to carry on such a test this Fall, under the auspices of the Association. With such an organization of radio enthusiasts behind the plan its success seems assured.

We believe that the contest will be conducted in the broadest sort of a spirit so that every amateur, whether spark or C. W., may be assured that his signals as heard will be carefully logged. With this point in mind, our readers are invited to send in their suggestions and contributions to the secretary of the association. The preliminary announcement in this issue will be followed by a complete statement of rules and regulations in September RADIO.

THE thanks of the editor is extended to the hundreds of readers who filled out and mailed the questionnaire published in a recent issue. It is interesting to note that the grand average of all answers as to what kind of material our readers prefer to see published in these columns, coincides with what is now being published, or was already under consideration for early publication. It is hoped that all readers will continue to tell the editor what they want to read, as it is our purpose to endeavor to supply the demand without trying to too greatly simplify or "technify" the principles of approved radio practice.

Some subscribers have asked why relatively more attention is devoted to continuous wave transmission than to spark sets. The reason is two-fold; first, that the details about spark sets are readily available in simple language in the text books, while comparatively few books publish C. W. information that is understandable to the average amateur, and secondly, because C. W. is destined to supersede spark sending as amateurs become better acquainted with its simplicity of equipment, lack of interference and efficiency.

Military Radio

By Lieutenant-Colonel Robert Loghry, Signal Corps Reserve

IT is absolutely necessary that Army commanders in the field have efficient communication at all times. In certain instances, victory or defeat has hung upon the transmission of a single message and the importance of communications is so great that no engagement can be successful without a well planned system of communication. The branch of the Army, specifically charged with furnishing the major part of communication and the development of equipment to keep this communication up-to-date, is the Signal Corps. In the Regular Army, part of the Signal Corps is scattered throughout the United States and organized into companies, where from six to eight hours a day are devoted to training the personnel in communication methods and military duties, to prepare them to take the field as the first line of defense on short notice.

The Signal Corps has built, operates and maintains the only communication we have to and in Alaska. This communication is by means of submarine cable connecting Seattle with Southeastern Alaska, about one thousand miles of telegraph lines in interior Alaska and about fifteen high power radio stations. These facilities practically tie all points of importance in Alaska directly to our immense commercial telegraph systems in the United States. This system was built entirely by Signal Corps personnel in 1901-1903, and is a monument to the skill and resourcefulness of these pioneer Signal Corps men who had to put up with the extremely severe hardships of that country in its infant days in constructing these lines. This system is run and managed entirely by the Signal Corps, today, and there is no more efficient communication system in the world.

At the present time the Signal Corps is arranging to replace the old type radio spark sets, throughout Alaska, with the latest type arc apparatus, and an officer is now enroute to Alaska with apparatus and personnel to install these stations. Some of these new stations will be built further north than any other radio stations in the world and the plan covers radio communication to Pt. Barrow on the extreme north coast of Alaska.

Some of the other functions of the Signal Corps include the installation, maintenance and operation of military cables, telephone and telegraph lines, radio and meteorological apparatus and stations and electric time service.

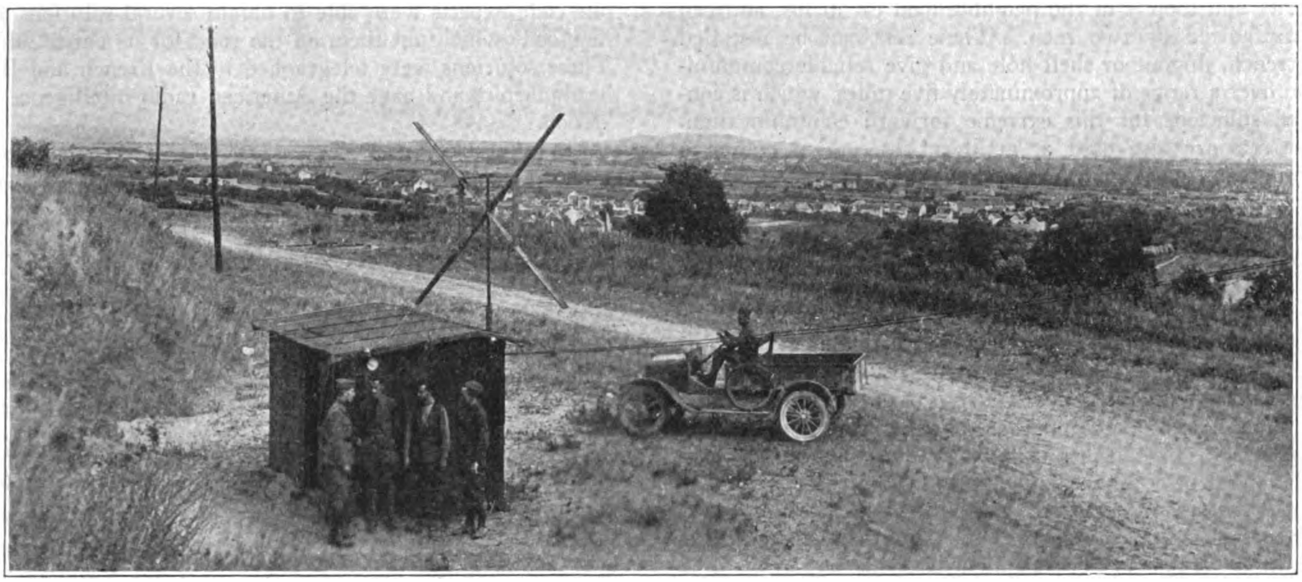
Radio is one of the main means of military communication and has almost entirely superseded visual signalling. In order to keep abreast of this rapidly advancing art, the Signal Corps has a complete radio research laboratory at Camp Alfred Vail, Little Silver, N. J., where the development of radio apparatus for the several branches of the Army is perfected. At this point a number of America's best radio engineers are constantly engaged in radio development, which does not generally get out to the public for a year or two afterwards. Due to the extreme simplicity, efficiency and mobility requirements of military radio apparatus, it is necessary that this be done by trained military radio engineers, and it is to Camp Alfred Vail we may look to solve our future military radio needs. A school for Signal Corps students is also conducted at Camp Vail. The different Signal Corps organizations throughout the United States are called upon to send students to this school annually, and upon graduating a man is fitted to become a high class military communications specialist and also prepared for a successful vocation when he returns to private life.

At the present time, the Signal Corps is just finishing the installation of a system of the latest type 1½ kw. vacuum tube stations connecting the military centers throughout the United States. For the Washington-San Francisco circuit, stations have been established at New York, Washington, D. C., Indianapolis, Omaha, Salt Lake City, San Francisco, and one now nearing completion at Cheyenne. Similar stations have been installed at Atlanta and St. Louis. In addition, all the important Army Air fields will be connected to this system. Most of these stations are equipped with remote control apparatus which allows the operator to be located a distance from the transmitting station proper and receiving to be done with loop antenna and six stage radio-audio frequency amplifiers. The main method of communication with these sets is continuous wave telegraphy but the stations are also equipped for radio telephony and buzzer modulated radio-telegraphy.

The importance of radio for an Army in the field can be realized when you consider that during the operations of the First American Army in the Meuse-Argonne battle, where about thirty divisions were engaged, a total of approximately

Signal Corps Telegraph Station at McCarty. In the Extreme Interior of Alaska on the Tanana River.

General Ferrie, Chief of Radio French Army, Lieut. Colonel Robert Loghry, Radio Officer First American Army, Professor Abrahams, Sorbonne University, and Major Edwin H. Armstrong.



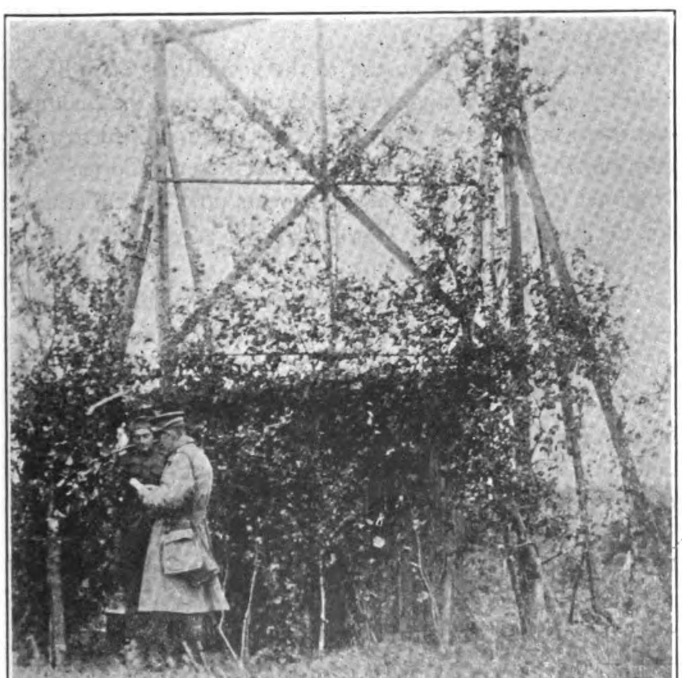
Signal Corps Continuous Wave Station Twenty Miles West of Paris After the Armistice to Communicate With Spa, Coblenz, Treves, Antwerp and American General Headquarters Replacing Telegraph Lines Which Were Turned Over to French. As High as Eight Thousand Words Were Handled by This Station in a Day. Note the Loop for Reception to Eliminate Interference.

six hundred transmitting-receiving radio stations were necessary and approximately six hundred purely receiving stations for receiving from airplanes fitted with radio. For the operation supply and maintenance of this radio equipment, the services of approximately five thousand radio specialists were required. The greater portion of these were men picked from our amateur radio ranks at the beginning of the war.

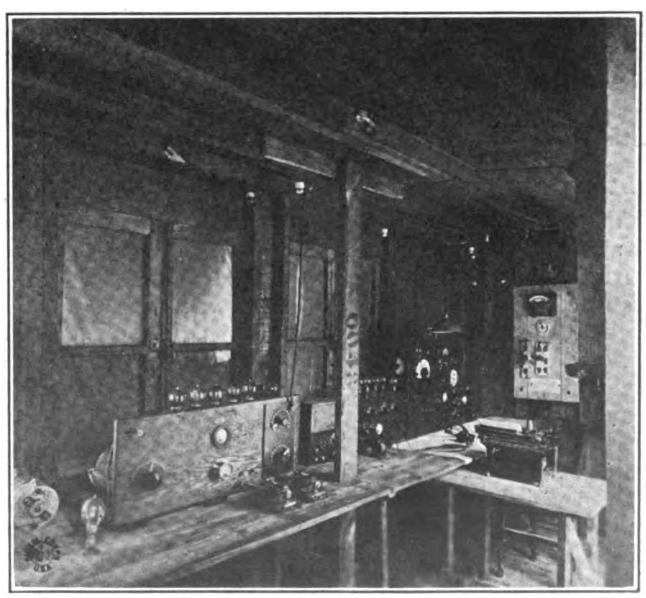
The most important need for radio in an army is that between infantry regiment and battalion. In stabilized warfare, such as we had in Europe, the telephone lines in this area were constantly interrupted due to shell fire and bombing, rendering it necessary to resort to radio as a sure means of communication. As you go farther to the rear, the importance of radio diminishes and the lines are of a more permanent construction and cannot be as readily destroyed by the enemy. Here the radio becomes more of an auxiliary or secondary means, but all plans of an Army require a radio system to be installed and kept up in an efficient manner to supplement the telephone and telegraph system when emergency demands.

At the present time, with but the single exception of brigade-regiment communication, which is spark radio, all ground radio within an Army is vacuum tube or continuous wave equipment.

At Army and Corps Headquarters, as well as the larger Army Artillery and Air Service Units, large vacuum tube sets installed on tractors are used. In the divisions and other minor units, down to the regiment compact chest type vacuum tube sets are provided. In the more advanced locations, V shaped antenna about 20 ft. high, with small light weight bamboo masts, are used. For the communication between battalion and regiment, the Signal Corps has developed a small portable loop set, using vacuum tubes for both transmission and reception. The loop on these sets is about 3 ft. square, and when not in use folds up in a small bundle and is attached to the apparatus chest. These sets are operated by storage batteries. The total weight of operating chest,



American Direction Finder Near Front Lines Day Previous to St. Mihiel Attack by American Troops. These Stations Were Located About Five Miles in Rear Front Lines and Twelve Miles Apart. The Hut and Loop Are Camouflaged in Order That the German Aviators Cannot Locate the Station. Loop Used is Ten Feet Square.



Interior of Station Near Paris. Portable Radio Huts Were Used by the Signal Corps in France.

batteries and loop is in the neighborhood of 50 lbs. and can be transported by two men. These sets can be installed in a trench, dugout or shell hole and give reliable communication over a range of approximately five miles, which is considered sufficient for this extreme forward communication. These sets are also used at artillery observation points to communicate with the batteries and other points where an easily portable set which can be located out of sight of the enemy is needed.

For cavalry purposes the Signal Corps has developed a very efficient pack radio set to be carried on pack mules. Vacuum tubes are used in this set for both transmission and reception. The transmitting power is furnished by a hand-driven generator giving 350 volts. A feature of this set is the use of low filament current consumption tubes for the detector and two stage amplifier, current being supplied by dry batteries. These tubes take about .25 of an ampere each on the filament. The complete equipment consisting of operating chests, masts, generator, tent, spare parts and everything pertaining to a complete radio station is packed on three mules and weighs in the neighborhood of 600 lbs. The normal range of these sets is about sixty miles but they have carried from 150 to 500 miles under good conditions. A collapsible umbrella antenna is used with this set.

Other work of the Signal Corps includes the development of the radio telephone and telegraph apparatus for the Air Service. Wonderful strides are being made in radio telephone equipment for use on airplanes. The importance of this communication to an airplane engaged in reconnoissance over the enemy lines, in being able to communicate directly and instantly with headquarters cannot be over estimated.

Another function of the Signal Corps is the development of radio direction finding apparatus. This feature is receiving the attention of the best engineers and is near perfection. Imagine an airplane hovering over an enemy fleet, sending out signals to enable our direction finders to follow its exact location and the airplane giving a special signal when directly over a picked element of the fleet; the artillery would know the exact location of that element immediately. This is absolutely possible today. Another use of radio on airplanes is to enable an airplane to hover over the enemy's lines and keep our batteries informed of the effect of their shots. It would take only a few shots till "Rastus would be hit square in the eye."

A feature of our radio work in France and one which became very spectacular was our Radio Intelligence section. During the war nothing was known of the work of this section. It was a sort of "spy" system on the enemy's radio. Radio direction finders were located along the front about five miles from the front lines and twelve miles apart, which took hearings on the enemy's radio stations; sent these hearings back to our headquarters where they were plotted, resulting in our knowing practically the exact location of every enemy radio station at all times. Radio intercept stations were also located at each Army Headquarters which copied all the enemy's radio messages, and which, by the way were always in code, telegraphed them back to General Headquarters where a corps of code experts decoded them, and in this way our Army was able to secure valuable information on the enemy's intentions and movements. On one occasion in March, 1918, when the Germans made their great offensive against the British Army, the code along the entire enemy front was changed overnight, rendering the old code which had been known for some time, valueless. It so happened that a German Commander sent a long radio message in the new code to a subordinate commander, the subordinate replied by radio that he had not received the new code and asked that the message be repeated in the old code. In a short time the same long message was repeated in the old code. Our intercept stations copied all these messages and sent them back to General Headquarters with the result that our code experts were able to obtain several solutions of the new code which put them on the road for its entire solution. These solutions were telegraphed to the French and British headquarters and gave the American radio intelligence a big "scoop."

On numerous occasions, messages were intercepted, decoded and the troops in the front lines notified of planned attacks by the enemy before the attack took place, enabling them to prepare for it.

Another class of radio intelligence stations were known as listening stations. These stations were located in dug-outs in the front line trenches with amplifiers, and wires radiating out to grounds in "No Man's Land" and in some cases actually tied on to the enemy's telephone lines. These stations would pick up the enemy's telephone talk by induction and the results obtained were wonderful. These stations also served to pick up any stray telephone conversations from our own lines and was the reason for our not extending out telephone communication to the front lines, as it was known the enemy had a similar system and could spy on our lines as well.

We also had efficient intercept stations at our General Headquarters which picked up all radio code traffic handled between the enemy countries and to some of the neutrals. This gave our Intelligence Section of the General Staff an insight into what was going on between the belligerents and neutrals.

During our participation in the war a total of 73,000 enemy messages were intercepted and 175,000 bearings were taken on enemy radio stations by our direction finders. At the signing of the Armistice about four hundred radio men were engaged in this spy work, approximately seventy per cent of whom were ex-amateurs, and their extreme loyalty to the cause was so great that not a single leak of their special work ever occurred. The amateurs are certainly deserving of our country's highest appreciation and thanks for this great work.

There is practically no end to the possibilities of radio for military uses, and young men who wish to serve their country can do so in no better way than to become qualified in radio and join the National Guard or Signal Reserve Corps. The National Guard is open for enlistments now but enlistments for the Enlisted Reserve Corps have not as yet been authorized by the War Department.

There is no more interesting study for a young man than radio, not that he necessarily take it up as a profession but as a means of general education. To understand radio, a man must study electricity and this is something everyone should become familiar with in this electrical age. Some of our best and most successful radio engineers today started out as amateurs. "Eddie" Armstrong was an amateur at Columbia University, studying under Prof. Pupin, when he invented his famous "Feed Back" which has brought him fame and fortune. Others can do as well for the ether will remain with us for some time to come.

The foregoing paper constitutes an address given before the Signal Section Association of the Army of the United States and invited guests at State Armory, San Francisco, Calif., 8:00 P. M., May 15, 1922, by the author and read before the Sunset Radio Club, San Diego, Calif., June 10, 1922.—EDITOR.

Rectifiers of Plate Supply Current for Transmitting Vacuum Tubes

Eighth Installment of "The C. W. Manual"

By J. B. Dow, Ensign U. S. N.

THE ELECTROLYTIC RECTIFIER

DURING the early history of electro-chemistry it was found that when a plate of aluminum and a plate of lead or carbon were immersed in certain conducting solutions a current could be made to flow in one direction only. In other words, the combination acted as a valve which soon found a practical application as a rectifier of alternating current.

Essentially, such a rectifier consists of a lead and an aluminum plate immersed in a solution of ammonium phosphate or sodium borate. Both of these substances dissolve in water quite easily. The efficiency of such a device decreases as the current to be rectified increases, especially when such currents cause an appreciable temperature rise of the solution, and seldom exceeds 50 per cent. However, in radio work, where large currents are not required, the device generally operates at a maximum of efficiency and lends itself

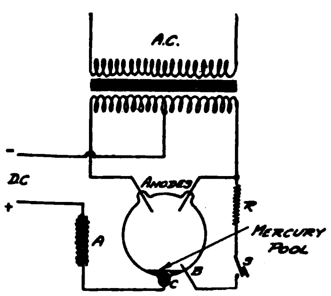


Fig. 61.
Mercury Arc Rectifier Circuit

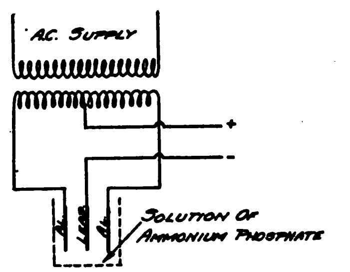


Fig. 60.
Simple Electrolytic Rectifier Circuit

quite well to the task of supplying a high voltage direct or pulsating current.

The simplest form of electrolytic rectifier circuit is shown in Fig. 60 wherein one cell, consisting of two lead plates and one aluminum plate, are immersed in the solution of ammonium phosphate.

A single cell rectifier of this type is incapable of rectifying more than 50 to 70 volts effectively and where much greater voltages are to be rectified recourse must be had to additional cells in series as shown in Fig. 40-C wherein one cell is used for each 60 or 70 volts to be rectified. This limitation results from the difficulty in obtaining a sufficiently heavy film upon the aluminum plate which is the governing factor in the matter of output e.m.f.

The circuit of Fig. 40-C is one in which both sides of the alternating current cycle are rectified, with a result, insofar as construction is concerned, that twice as many rectifier units are required as would be the case if only one side of the cycle were rectified.

The advantage in rectifying both sides lies in a more nearly constant output e.m.f., which is desirable in radiophone work. Utilizing the entire cycle in this way makes it possible with a suitable smoothing out system to obtain a current that is only slightly pulsating.

The rectifier units mentioned above are quite inexpensive to construct since all the materials required are used to a great extent commercially. However, considerable time is required. As stated in Chapter V, pint Mason fruit jars may be used to good advantage in constructing the units, although small jars 1 in. by 1 in. by 6 in. deep inside will lend themselves to compactness more conveniently. The larger jars, of course, contain more solution, and heating, which lowers the efficiency of the rectifier very appreciably, is not so apt to occur.

Fill each jar to about three-quarters of its height with a saturated solution of ammonium phosphate or sodium borate (borax) and immerse in each a plate of aluminum and one of lead. For the small currents required for vacuum tube work (equipment employing not more than two of the 50-watt tubes) these plates should not be wider than 1 in. nor immersed in the solution to a depth greater than 3 in. and should be separated from each other at least ½ in. and not more than 2 in.

To "form" the aluminum plates, which consists in depositing the white crystaline rectifying film upon them, each unit should be connected to a rather high voltage source which will ordinarily be most convenient in the form of

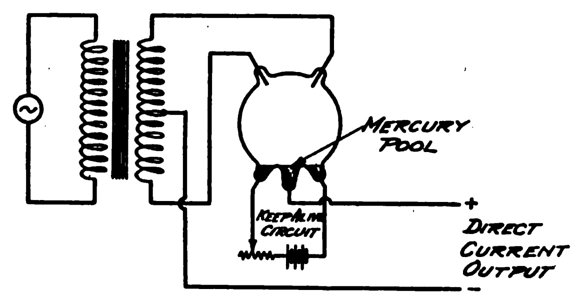


Fig. 62. Mercury Arc Rectifier With "Keep Alive" Circuit

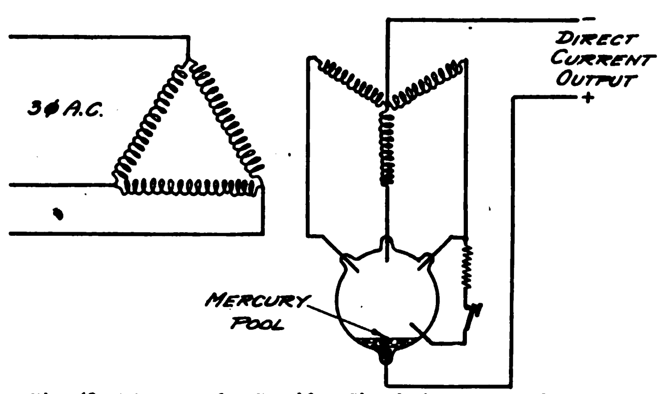


Fig. 63. Mercury Arc Rectifier Circuit for Three Phase Supply

alternating current from the transformer which will ultimately supply the current to be rectified. A secondary winding supplying 500 volts on open circuit will work very well, since during the initial "forming period" the voltage drop in the winding will govern the current flow and as the film is formed the voltage will rise gradually. When the plate is sufficiently well formed, sparking will be noticeable over its surface. During this process, the electrolyte should be kept cool by circulating water around the unit. This step is very important; likewise, it is imperative that pure aluminum plates be used.

MERCURY ARC RECTIFIER

Of late, mercury arc rectifiers have presented themselves in the field of radio as a means of obtaining the much sought high voltage direct currents, and every application points to success. One argument favoring such a device is based upon the fact that the mercury arc is an article of commerce. These have been used for a number of years in connection with series arc light projects in many localities and, coincidently, they have been developed to function efficiently in just the power outputs and voltages that are required for high power vacuum tube work. As an example, a 4 ampere 3500 volt mercury arc rectifier is more or less standard and one of these could quite easily supply ten 250-watt tubes. Smaller rectifiers of this type could readily be developed for lower powered tube installations if the demand warranted it, and no doubt we shall see them on the market soon.

The simplest form of mercury arc rectifier circuit is shown in Fig. 61. Near the top of the figure is the alternating current transformer which steps up the voltage to the desired value. The extreme ends of the secondary winding terminate at the anodes of the valve, while the mid tap forms the negative lead of the direct current output circuit. The positive pole or negative electrode of the valve is at C, Fig. 61, and the rectified current flows from this terminal thru the sustaining coil, A, to the direct current power consuming device which, in the case under consideration, is the vacuum tube transmitter.

The resistance, R, and the auxiliary electrode, B, comprise the starter for the arc. To start, the tube is tipped to one side, causing the mercury to close the circuit CB thru the disconnect S. The spark or arc thus formed volatilizes some of the mercury, which lowers the resistance of the conducting path between the anodes and the cathode and this breaks down, forming the necessary arc. During half of the cycle the current flows from one anode to the cathode and during the remaining half it flows from the other. Were it not for the inductance, A, which must be of the order of several henries, the arc would have to be restarted by means of the auxiliary circuit after each half cycle.

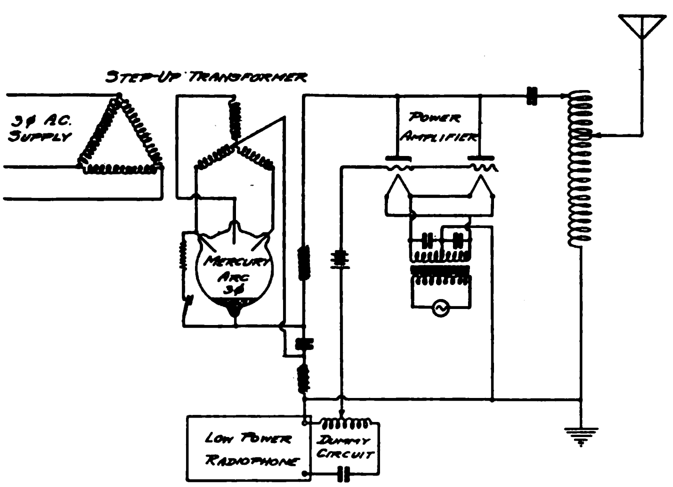


Fig. 64. Circuit Diagram of High Powered Tube Transmitter Employing Three Phase Alternating Current Pre-rectified by Means of a Mercury Arc Rectifier.

Upon the collapse of the magnetic field around this inductance, following an extinction of the arc when the alternating wave reaches zero in value, an e.m.f. is impressed across the anode and cathode sufficiently great to re-ignite the arc, and the other half cycle is rectified in the same manner.

Unless the tube is being operated at its designed output the inductance, A, will not function properly. To overcome this, some rectifiers are provided with a "keep alive" circuit wherein the mercury is continuously being volatilized. Such a circuit is shown in Fig. 62. In radio work where the load is not constant this latter type of rectifier is used. Inductances and capacities are used also in the rectifier output leads to smooth out any irregularities in the direct current.

For radio work which requires a very constant direct current source, three phase mercury arc rectifiers are often used. Such a circuit which requires no "keep alive" auxiliary is shown in Fig. 63. In this case the mercury arc is not extinguished because the potential across the tube never reaches zero value.

A high power tube circuit of the power amplifier type wherein the mercury arc rectifier is employed, is shown in Fig. 64.

THE KENETRON RECTIFIER

The kenetron or vacuum tube rectifier has, of recent years, been receiving considerable application in C. W. work with tubes. The theory of such apparatus is so simple that little explanation is necessary. This theory is, of course, based upon the unilateral conductivity of a vacuum tube comprising a heated filament and a cold plate. Fig. 65 illustrates the simplest form of such a circuit wherein an alternating current source, A, supplies power to the trans-

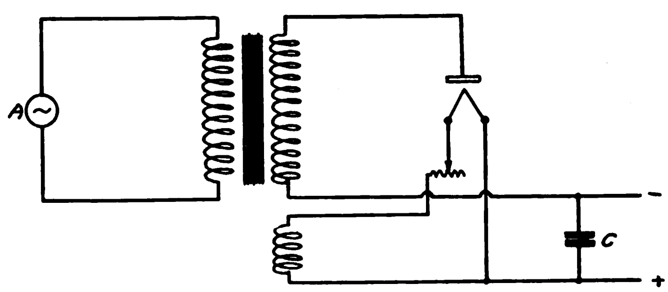


Fig. 65. Simple Thermionic Rectifier Circuit

former, T, which steps up the initial e.m.f. to that required in the form of direct current for the plate supply of the oscillator tubes and modulator tubes of the transmitter. The transformer, T, has two secondaries, one of which supplies a filament heating current for the rectifier tube.

By virtue of the above mentioned unilateral conductivity of the rectifier tube a current flows across the ionized path between plate and filament only when the plate is at a positive potential, the result being that a pulsating direct current is supplied to the condenser, C, where it is stored as energy and delivered to the transmitter as required. Such an arrangement provides for the rectification of only one-half of each cycle and the other half while not lost, is not used.

Fig. 40-B shows a previously explained circuit wherein both sides of the alternating current cycle are utilized.

To be continued

Readers of RADIO will undoubtedly be pleased to learn that Jennings B. Dow, author of "The C. W. Manual," has been commissioned a Lieutenant (J. G.), U. S. N. His promotion from Ensign to the higher rank became effective during the latter part of June. He is now serving in the capacity of Communication Officer on the U. S. S. *California*.

Capacity Measuring Wavemeter

By G. W. Cattell

MOST radio enthusiasts are already familiar with the construction and use of a wavemeter. For the benefit of those who are not familiar with the ordinary wavemeter, it may be described as being a calibrated tuned circuit with some means to indicate resonance. The tuned circuit usually consists of a fixed inductance coil and a variable air condenser connected in series. The wavemeter is usually calibrated by comparison with another meter whose calibrations are known.

The device to indicate resonance is usually a sensitive hotwire ammeter (or thermo galvanometer) or a crystal detector and a pair of telephone receivers. Some meters are equipped with both. The meter is generally used for strong signals and the detector and telephone receivers for weak signals.

To measure the wavelength of high frequency oscillations, the wavemeter is placed near the circuit carrying the current and the condenser varied until there is a maximum deflection of the meter (or maximum sound in the telephone receivers). The wavemeter is then tuned to the same wavelength as the oscillations. By referring to the calibration curve of the meter, the wavelength can be ascertained. Another method of wavelength measurement was described in the February RADIO under the title of "The Click Method of Determining Resonance."

The usefulness of a wavemeter is greatly extended by the addition of some means of exciting the circuit, causing it to become a source of high frequency oscillations having a wavelength corresponding to that for which the wavemeter circuit it turned. A buzzer is frequently used for this purpose. Fig. 1 illustrates a schematic diagram of a wavemeter incorporating the above mentioned features.

It is often very desirable to know the capacity of a given condenser or antenna. If enough data are available, the capacity can be computed, but such calculations are likely to be unsatisfactory, especially in the hands of the inexperienced. There are, however, several methods of measuring the capacity either directly or indirectly. Next to the use of the Western Capacity Meter (which requires 500 cycle current at 220 volts), the capacity bridge is the easiest and most reliable.

It is a simple matter to modify an ordinary wavemeter (such as shown in Fig. 1) so as to incorporate the capacity measuring feature. A scheme of connections is shown in Fig. 2. The only addition to the circuit is the resistance unit $R'R''$.

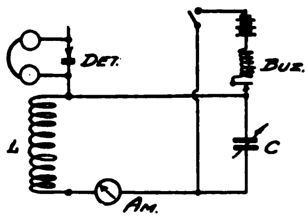


FIG. 1

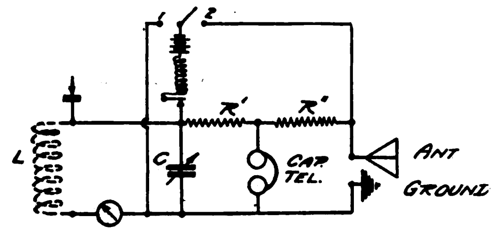


FIG. 2

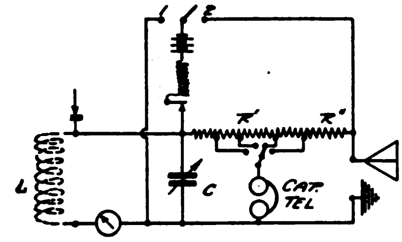


FIG. 3

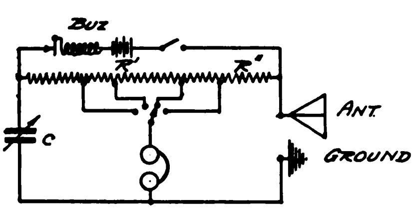


FIG. 4

The resistance of both branches (R' and R'') should be as nearly equal as possible and should be approximately 10 ohms each. An easy method of accomplishing this is to cut off a piece of small resistance wire having a resistance of 20 ohms, double it in the middle, then wind this double wire as a single wire on a piece of stiff cardboard about 1¼ in. wide and 2½ to 3 in. long. The resistance unit thus built will have three terminals, one the common point between R' and R'' and the other two the other ends of R' and R'' respectively which are connected as shown in Fig. 2. The object of winding the coil in a flat form is to minimize the reactance which is necessary for satisfactory operation.

To operate the bridge, the inductance coil L must be removed or disconnected, the telephone receivers connected to the binding posts marked *"Cap. Tel."*, the capacity to be measured connected to the terminals *"Ant."* and *"Ground,"* the buzzer is then started by closing the switch in No. 2 position. The buzzer note will be heard in the receivers. By varying the condenser setting, a point will be found where the buzzer note is no longer heard. The bridge is then balanced. The unknown capacity is approximately equal to that corresponding to the wavemeter condenser. For the most accurate results the bridge should be calibrated by placing known capacities of various values across *"Ant."* and *"Ground"* and plotting these values against condenser degrees.

It is evident that the range of capacities that can be measured is the same as the condenser used in the wavemeter. In order to extend the range so that it is possible to measure capacities larger than the wavemeter condenser, taps can be taken off the resistance unit and connected to a switch. For example, if R' is three times R'', the capacity of the unknown condenser will be approximately three times that corresponding to the wavemeter condenser setting when balance is obtained. In a similar manner any number of ratios of R' and R'' can be obtained and utilized. As before, for the most satisfactory results, the bridge should be calibrated against known capacities instead of relying solely on the ratio of R' to R''.

The capacity as measured by the bridge is the "true capacity" or "capacity for uniform current distribution." The true capacity of an antenna is always lower than the "effective capacity" except when the antenna circuit is loaded up with inductance until its wavelength is several times the natural wavelength, under which conditions it approaches the true capacity.

In order to use the wavemeter as the regular buzzer excited driver, remove the telephone receivers, replace the inductance coil L and close the switch in No. 1 position.

If it is desired to construct a capacity bridge alone, some of the usual wavemeter apparatus may be omitted and the connections can be made as in Fig. 4. Suggested values of constants which could be used are shown directly on the diagram. Such a bridge is suitable for measuring capacities up to .003 mfd.

If the resistance of the capacity being measured is very different from that of the condenser used in the bridge, it may be impossible to get an exact balance. This is because it is necessary to balance for resistance as well as capacity reactance. For most work, however, especially when the capacity is small, a minimum sound in the receivers will give sufficiently accurate and satisfactory results.

A 200-Watt A. C. Radiophone Transmitter

By I. R. Lounsberry

RADIO Station, 2BH, owned by Mr. W. R. Seigle, Mamaroneck, N. Y., was formerly equipped with a 1 kw. phone set, employing a motor generator. This was found to be very cumbersome and unsatisfactory in operation. In the search for better methods it was decided to build an alternating current phone with a filter.

The tests of the set were conducted at 2BB, owned by the writer, at Ossining, N. Y. The resultant circuit was tested during December, January and February with excellent results. The filter designed was so effective that in almost every case we were reported as using a motor generator for plate supply instead of rectified a. c.

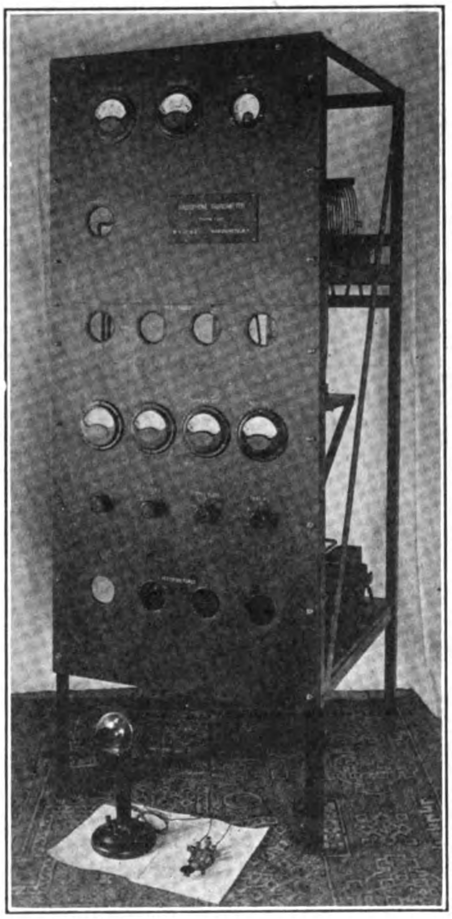
Voice transmission was used entirely with the exception of one night, at which time the I. C. W. was heard by 5ZA at Roswell, New Mexico, a distance of 1800 miles. The voice was often heard in Florida, Kentucky, Tennessee, Missouri and as far north as Nova Scotia. The best voice distance was Fairmont, Minnesota, where it was heard plainly, a distance of 1400 miles. 5XK at Knoxville, Tennessee, reported night reception often, and also daylight work occasionally. Operating for an hour and a half one night eighteen stations were worked—many of them five hundred miles away, and fifty-six reports were received during the next few days via mail, reporting the speech reception. Inasmuch as no broadcasting was done, the results of the tests are much more valuable. Operators, due to briefness of conversation, had little opportunity for close adjusting, so that it is safe to say that with better tuning time the results would have shown much better distance.

The Colpitts oscillator circuit was found to give better results under existing antenna conditions than any other. The modulating system consisted of the Heising circuit with the voice amplifier.

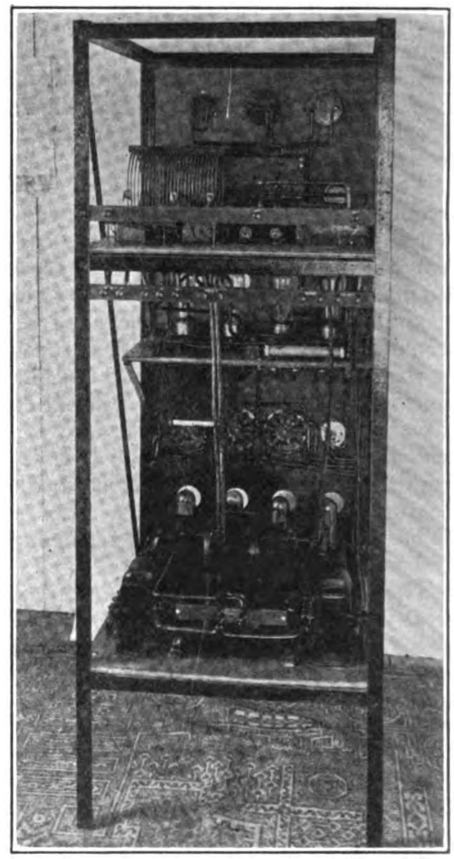
Alternating current was used throughout the entire circuit except for relays and microphone. Four 50-watt Radiotrons were used in radio circuits and a 5-watt Radiotron was used for the voice amplifier. In the rectifier circuit four 50-watt Kenotrons were used. The filaments of the rectifiers were connected in parallel and run off an Acme 300-watt transformer designed for a 12-volt potential at its output terminals. Control of the output was effected by five taps on the primary winding. The four Radiotrons were operated in a like manner together with the 5-watt tube. In the 5-watt tube circuit a 2-ohm rheostat was inserted in the filament side of the transformer to drop the voltage to 8 at the tube. The high voltage transformer was a special type built for us by the Acme Company. At 1500 volts a load of 600 mils could be safely drawn. The transformer was of the double winding type to work on both halves of the cycle and was tapped in the secondaries at 750, 1000, 1250 and 1500 volts.

Design and Arrangement

In designing the instrument the following points were strictly adhered to—neatness, symmetry, separation of circuits, proper spacing of wires, ruggedness and ease of control. By referring to the photographs it will be seen that the instrument is assembled in a heavy frame made up of angle irons. The overall dimensions are 5 ft. 6 in. high, 24 5-8 in. wide and 25 in. deep. Two full shelves are used, together with a half shelf. On the bottom shelf the complete power circuit is mounted. The high voltage transformer, the filament transformers and the filter condensers are mounted on this shelf. On this same lower shelf, close to the front, the four Kenotron rectifier tubes are mounted. The panel contains four portholes, through which the operation of the Kenetrons can be seen at all times by the operator. Above these portholes are the controls which from left to right are the amplifier filament rheostat, radio filament tap switch, supply plate double tap switch and rectifier filament tap switch. Above each control is a meter to check each adjustment.



200-Watt A. C. Radiophone Panel



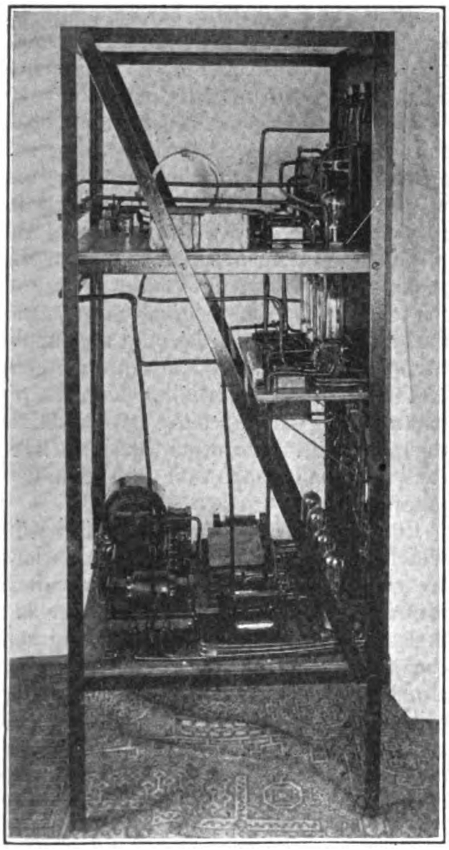
Rear View of Radiophone Set

The half shelf holds the four 50-watt Radiotrons together with "local" grid resistances for each tube, the main grid leak resistance, grid condenser and two insulating condensers in plate and filament radio frequency circuit. These latter two condensers are for protection to the power circuit should the antenna and ground become shorted. The "portholes" for these tubes are cut directly above the voltmeters.

The upper shelf contains the balance of the radio circuit, voice circuit and also the relay circuit. The speech amplifier tube is mounted at the left. On the right side, near the panel, is the relay control circuit made up as one unit. The helix is mounted in back of relay unit, together with the variable-tap condensers used in the antenna-grid circuit and also a series antenna condenser for working on low waves. The modulation transformer, modulator-amplifier coupling condensers, plate and grid reactors, resistance rods and "C" batteries are mounted back of the amplifier tube in good wiring order.

The panel is made up in two sections, the bottom one being 21¼ in. x 24⅝ in. x ½ in., and the top is 33 in x 24⅝ x ½ in. The panel is engraved in complete explanatory of meters, controls, etc.

All connections are made in back of panel. Two terminal strips are provided. The top one for antenna, ground and



Side View of Radiophone

receiver connections; the bottom one for 12-volt battery, 110 volt a. c. 60-cycle supply, C. W. telegraph key, microphone and relay control wires.

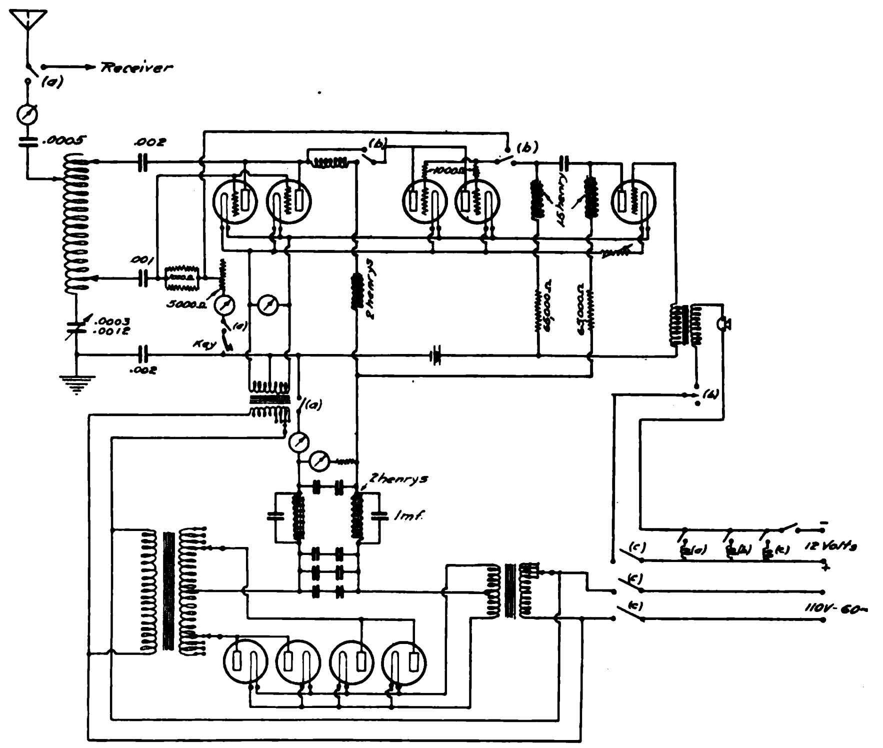
The installation cost of this type of set is very low as the 110-volt, two-wire, line is the only power lead to the set. The batteries can very nicely be placed under the "lower shelf." The microphone and C. W. telegraph key are mounted on operating table. The complete connections are provided for with an eight-wire cable.

All wiring in the set is done with No. 6 weatherproof wire. The covering is painted with glossy, black enamel to add to its appearance and for protection. Careful attention has been paid to separation of circuits and wiring so that a minimum of loss is accomplished. The wires are rugged and short as possible.

The meters, with the exception of the antenna meter, are all of the new type Weston, models 429 and 431, flush mounting. Two 0-15 volt a. c. meters are used for measuring filaments of radio tubes and rectifier tubes. An 0-10 volt a. c. meter is used to measure the filament of the voice amplifier. An 0-2000 volt d. c. meter with an external resistance as multiplier is used on the high voltage to measure the potential applied to the radio tubes. An 0-800 d. c. milliammeter measures the total plate current of all radio, modulator and amplifier tubes. An 0-150 d. c. milliammeter measures the grid current of the radio tubes. In the antenna circuit a Weston model 301 thermo-couple ammeter, 0-5 is used.

Three 20 ohm relays are used to actuate three power switches. These switches are each three pole double throw and are mounted up as one unit and controlled from the base of the microphone. It will be noted that no manual control switches are used, (except a main power line cut off switch (fuse) that cuts off the main supply power feed wires to the set). One of the relay switches controls both sides of the 110 volt a. c. supply and one side of the storage battery supply to the microphone and is "dead" in the back position. Back positions are accomplished by mechanical springs so that power is consumed from the batteries only when the relays are worked. The second relay throws the antenna to the transmitter when relay circuit is closed. It also closes the plate and grid circuits of the tubes. On the back stroke the grid is opened first to prevent a heavy surge when antenna is broken. In the back position the antenna is connected to the receiver, leaving plate and grid circuits open. The third relay throws the modulators to the radio frequency circuit when I. C. W. is used and disconnects the microphone battery supply. In the back position, which is the "talking position," the grids and plates of modulator tubes are in modulating circuit and battery circuit is completed.

The microphone is a western electric desk type. Four switch buttons have been put in the base to control the power relays. One button acts as master and will trip as many relays as are "set." The remaining three are "sets." Each one operates a relay. An example of the efficiency of this method is received from the following: If I. C. W. telegraph is desired three relays will have to be thrown. These buttons are pushed down and automatically "set," then the full control is effected by pushing and releasing only the master during complete operation. When voice is used only the power and antenna transfer relays are "set," etc. Inasmuch as a. c. is used this is the quickest change-over from transmitting to receiving possible. When receiving the transmitter is completely dead. The power is available instantaneously.



Schematic Diagram of Connections for 200-Watt A. C. Radiophone with Filter

FILTER

Regarding the filter system, which has made this set so effective, the following points are enumerated: (a) Referring to the schematic circuit it will be seen that a two-coil transformer is used as a filter. These coils are 2 henries each. The first important thing of note is that higher capacity is used on the high voltage transformer side of the circuit. The new type Radio Corporation condensers are used in series parallel. It was found that the most effective filtration was accomplished by having this side high. Additional capacity on the radio side of the filter transformers was hardly noticeable. One-half microfarad is used as the final capacity there, and 1½ m. f. d. on the transformer side of the circuit. (b) The new feature of this filter

Continued on page 68

The Arc

By L. R. Felder

IN spite of the ever growing importance of continuous wave transmission and the recognized advantages of continuous wave over damped wave transmission, very little literature on one of the first and most important C. W. transmitters, namely the ARC, appears in the amateur journals. Occasionally there appears a photograph or description of an arc set, but that is about all. Next to the radio frequency alternator the arc is the most important means of continuous wave transmission on the high powers, and it is also of great importance on low power sets, such as used on ships. Radio presents a broad field and it is therefore not a wise policy for the amateur to limit his reading and study to bulbs only, as seems to be the case at present. This article therefore aims to present to the amateur the fundamental principles of the theory and action of the arc transmitter.

In order to understand the action of the arc as a generator of radio frequency oscillations it is necessary first to know the general physical and electrical characteristics and properties of arcs. The arc, as generally used in radio, is formed by two carbons or by one carbon and one copper electrode. The arc is struck by connecting a source of voltage across the arc terminals, bringing the electrodes together in order to close the circuit and then separating them. The current through the electrodes, when they are in contact, is so great that the heat generated at the contacts is sufficient to make the terminals incandescent and thus vaporize the carbon. Upon separating the electrodes it is this vaporized gaseous carbon which acts as the conductor of the arc current.

Like all other electrical conductors, the arc has its specific characteristic, that is the relationship between its terminal voltage and the current through it. This characteristic is the well known falling one shown in Fig. 1. One very important feature is to be noted in which the arc differs from most other conductors of electricity; namely, that whereas an increase of current through most conductors is accompanied by a corresponding increase in its terminal voltage, an increase in current through the arc is accompanied by a decrease in its terminal voltage. In other words the greater the arc current the lower the arc resistance becomes. The physical reason for this is that the greater the arc current becomes the greater is the heat generated in the arc. Consequently vaporization and ionization increase, resulting in lower arc resistance. It is this characteristic of the arc which is the basis of its operation as a generator of radio frequency oscillations.

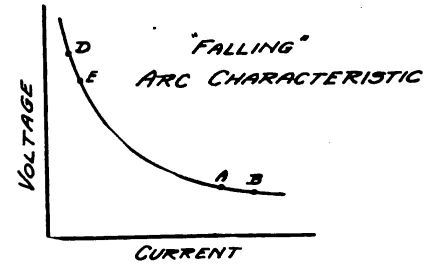


FIG. 1

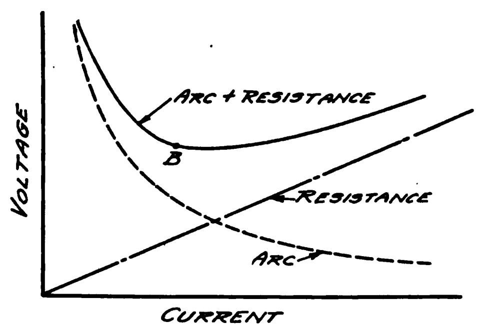


FIG. 2

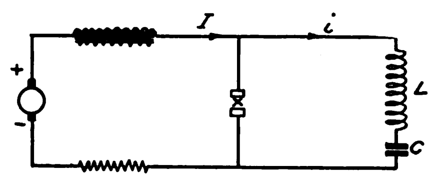


FIG. 3

The arc itself connected across a source of electro-motive force is unstable. For a stable system is such that an increase in e. m. f. results in a proportionate increase in current, and a decrease likewise. Consider for a moment what would happen in an arc circuit if there were a fluctuation in the e. m. f. across its terminals, let us say a decrease in e. m. f. This would cause an increase in the arc current, according to the characteristic of the arc, which in turn would cause a further drop in arc e. m. f., and so on until the arc current is so high that a short circuit condition would exist. On the other hand, if the fluctuation were such that an increase in arc voltage took place, the arc current would decrease and progressive diminution if arc current would take place until the arc was extinguished.

In order to guard against such changes and thus control the arc it is necessary to utilize stabilizing resistance and choke coils. The effect of a series resistance is shown in Fig. 2, in which the full line is the characteristic of arc plus resistance. It will be seen that the arc is stable after point *B*, and unstable before point *B*. By altering the value of the series resistance the value of current at which stability results can be easily controlled.

The stabilizing action of the choke coil depends upon an entirely different principle. The supply circuit to the arc is shown in Fig. 3. A fluctuation in current in the supply circuit would result in a counter induced e. m. f. in the choke coil, which would tend to restore the current to its original value, and thus have the effect of keeping the supply current approximately constant. In general both these stabilizing factors, resistance and choke coils, are used, although many generators combine both resistance and choke coil in the inductance only.

Let us now consider the manner in which the radio frequency oscillations are generated. The oscillating circuit is connected in parallel with the arc, and as explained in the previous paragraph the supply current to the arc is kept almost constant by means of the choke coil. At the instant of closing the arc circuit a voltage is suddenly impressed in the radio frequency circuit, and therefore an oscillatory current must flow in their circuit, due to the impulse action. If the arc were not present this oscillatory current would die out, due to the damping of the circuit, leaving the condenser *C* charged to a voltage *E*. However the presence of the arc results in maintaining the oscillation in the following manner.

Considering Fig. 3 again assume that the oscillatory current flows at the start in the direction shown. This oscillatory current must come from somewhere, and since the choke coil keeps the generator supply current constant it is evident that the only source of this oscillating current must be the arc. That is, the arc is robbed of current equal to the value of the radio frequency oscillating current, as a result of which the current through the arc must be decreased by that amount. Since the arc current is decreased its terminal voltage must increase, due to its falling characteristic. This rise in arc voltage results in a further decrease in the arc current, or in other words an increase in the radio frequency oscillating current, which increases the charge on condenser *C* and raises its voltage. This action continues until condenser *C* is charged to a potential considerably higher than that of the arc, at which time the condenser *C* begins to discharge through the arc. This discharge current now adds to the arc current, resulting in a fall of arc potential, which still further assists the discharge of the radio frequency circuit since the condenser voltage is higher than the terminal arc voltage. As this action continues the condenser voltage decreases until its potential is lower than that of the arc, when this cycle of events is again repeated, thus maintaining the radio frequency oscillations.

From this description of the happenings in the arc it is clear that when the current flows from the arc into the oscillating circuit and charges the condenser *C* oscillating energy is being supplied to the radio frequency circuit. On the other hand, when the condenser *e* is discharging through the arc the radio frequency circuit is giving back this energy to the arc. The condition, therefore, for building up radio frequency energy in the oscillating circuit for radiation is that the amount of energy supplied by the arc be greater than that returned to the arc. It will now be shown that this is the case, and the conditions will be given for making this difference a maximum.

In order to show that the oscillating energy given by the arc to the radio frequency circuit is greater than that given back to the arc we must consider the relationship of the arc terminal voltage and the oscillating current in the arc. The oscillating energy in the arc is, in any case, given by the product of *Ei,* where *E* is the arc terminal voltage and *i* the oscillating current in the arc. Now the oscillating current in the arc, when the steady state is reached, is the same on both charge and discharge, but the arc terminal voltage is not. When the radio frequency circuit is charging up we saw that the arc terminal voltage was higher than normal, and when it was discharging through the arc we saw that the arc terminal voltage was lower than normal value. Consequently the product of *Ei* on charging is greater than the product on discharging, or in other words, the arc supplies the radio frequency circuit more energy than is given back to it. Hence there is available energy in the radio frequency circuit for radiation.

This difference in the amount of oscillatory energy given by the arc and given back to the arc can be graphically shown by a consideration of the important dynamic characteristic of the arc. The general shape of the dynamic characteristic of the arc, that is when taken on alternating currents, is shown in Fig. 4. The two axes of current and voltage correspond to the normal values of the arc current and voltage, and the dynamic characteristic shows how the values vary, due to the superimposing of the oscillating current. Now the area enclosed in the curve of the dynamic characteristic represents energy, since it represents the product of the current and voltage. In quadrant I the current and voltage are both positive (marked by two plus signs) relative to the normal values of current and voltage. In the quadrant III they are both negative (two minus signs). In both these cases therefore the product of voltage and current is positive hence *the areas in quadrants I and III represent the amount of energy supplied by the oscillating current circuit.* On the other hand in quadrants II and IV the currents and voltages are of different signs

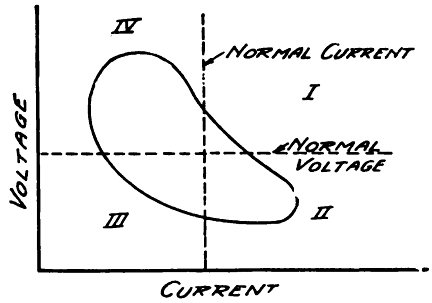


FIG 4

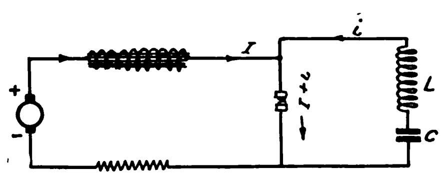


FIG 5

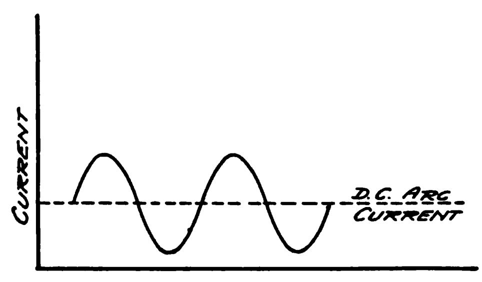


FIG. 6

(indicated by plus and minus signs). Hence the product is negative, indicating that negative energy is supplied *by* the oscillating current circuit, or in other words that positive energy is supplied *to* the alternating current circuit. Hence *the areas in quadrants II and IV represent the amount of energy supplied by the arc to the oscillating current circuit.* Therefore the areas in quadrants II and IV must be greater than the areas in quadrants I and III in order that radio frequency energy be available, and that this is the case has been shown in the previous paragraph.

It will be at once evident that any factors which make the area in quadrants II and IV larger than the areas in quadrants I and III will result in larger radio frequency energy available, that is in larger radio frequency current. One of the factors which makes this difference in areas greater is the steepness of the arc characteristic. The steeper the arc characteristic the larger will be the areas in quadrants II and IV and the smaller the areas in quadrants I and III. Hence the arc must be designed to secure steep characteristics.

The most important factor in arc design relative to the steepness of the characteristic, discovered by V. Poulsen, is the atmosphere in which the arc is burned. It was found that burning the arc in hydrogen or a gas rich in hydrogen yielded a characteristic much steeper than would otherwise be obtained. This is the reason for the use of hydrogen in commercial arcs. Frequently instead of hydrogen some liquid such as alcohol is allowed to drip into the arc chamber where, due to the intense heat of the arc, it immediately vaporizes liberating hydrogen gas.

The use of a hydrogen atmosphere in the arc chamber has moreover two other important advantages. In the first place, as will be more fully explained below, for best operation of the arc it is essential that the arc electrodes be cooled. Hydrogen has a very high heat conductivity, and will therefore rapidly conduct the heat away from the electrodes, thus cooling them. In the second place by resulting in a steeper characteristic of the arc, it enables generation of lower wave lengths than would otherwise be possible. This will be clear from the following analysis.

The amount of high frequency energy stored in the shunt condenser C is given by the expression $E=\frac{1}{2}CV_2$, where E is the amount of high frequency energy in the condenser C is the capacity of the condenser, and V the voltage.

Consider the arc characteristic in Fig. 1. If we work on the lower flat part of the curve between points A and B, a given change in current will produce only a small change in voltage. In order therefore to secure a given amount of energy it will be necessary to use large values of C, since V is small. Using large values of C means working only on high wave lengths. On the other hand suppose we were to work on the upper or steep part of the characteristic between points D and E. The same change in current produces here a much greater change in voltage than on the flat part of the curve. Hence for the same amount of energy a much smaller value of capacity can be used, since V is larger. This smaller capacity therefore permits operating the arc on lower wave lengths than would otherwise be the case. Thus we see that not only does the hydrogen atmosphere increase the steepness of the arc characteristic, but also enables operation on lower wave lengths and assists in cooling the electrodes.

Before taking up the matter of the

design of the radio frequency circuit for the arc and the other details in arc design, we will consider briefly the different types of oscillations which the arc is capable of generating. From a consideration of Fig. 5 it is seen that there are two currents flowing through the arc, the d. c. generator supply current, which is kept practically constant, and the oscillating high frequency current. The type of oscillations which the arc will develop depends upon the relative value of these currents. There are three types of oscillations which can be developed and these are:

TYPE I. In this type the maximum value of the oscillating current is less than the d. c. current. In this case, therefore, the total current through the arc never reaches zero, and the current wave is of the form shown in Fig. 6. The arc is not extinguished therefore, and very regular and steady oscillations are developed.

TYPE II. In this type of oscillation the maximum value of the oscillating current is greater than the steady d. c. current. Therefore when the oscillating current reaches the value of the d. c. and is opposite in sign, the arc current is reduced to zero, the arc is extinguished, and remains extinguished until the potential across the condenser builds up to the value necessary to re-ignite the arc. The curve showing the current through the arc would therefore be of the form in Fig. 7. During the time AB the arc is extinguished, the potential across the condenser is building up, and at instant *B* is sufficiently high to ignite the arc. Such operation takes place only if the arc is greater than a certain minimum length.

TYPE III. If the arc is less than a certain minimum length, i. e. for short gaps, type III oscillations take place. In this case again the maximum value of the oscillating current is greater than the d. c. through the arc, and therefore the arc current again drops to zero. But on account of the short length of the arc, the high voltage therefore across the arc, and the ionized condition of the gap, the arc immediately re-ignites and the oscillating current continues to flow uninteruptedly through the arc. On account of the shortness of the gap and the low voltage necessary to ignite a short gap the amount of energy thus developed is very low. In the second place, since the arc immediately re-ignites, the voltage across the arc has no opportunity to rise in value. Consequently this re-ignition and oscillation takes place with continually decreasing energy and amplitude until the energy originally stored in the condenser has been dissipated. The current then is zero, the arc is extinguished and the condenser again charges up through the arc with the same results. In other words there is generated a damped series of waves as in Fig. 8, which, of course, is of no use for continuous oscillations and is therefore not used in actual practice.

The actual type of oscillations employed in the practical arc set is actually neither of the types described above, but a cross between TYPE I and TYPE II oscillations. In this case the maximum value of the oscillating current is approximately equal to the d. c. through the arc.

The problems involved in practical arc design are those of increasing the radio frequency output, increasing the

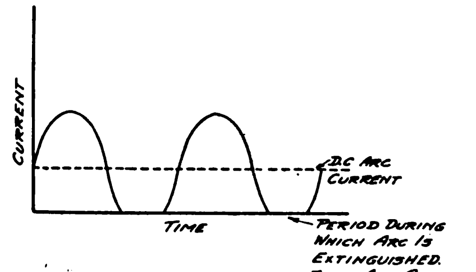


Fig 7

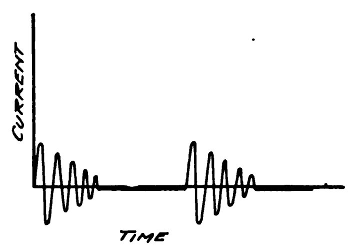


Fig 8

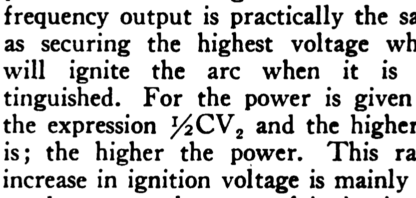


Fig 9

efficiency, and maintaining the frequency of the oscillations constant. The problem of securing maximum radio frequency output is practically the same as securing the highest voltage which will ignite the arc when it is extinguished. For the power is given by the expression $\frac{1}{2}CV_2$ and the higher V is; the higher the power. This rapid increase in ignition voltage is mainly dependent upon the state of ionization of the arc after it is extinguished. The greater the ionization the smaller will be the voltage necessary to re-ignite the arc and hence the lower will be the power. It is therefore necessary to employ means which will effect the rapid de-ionization of the gases in the arc when it is extinguished.

The means employed to rapidly de-ionize the arc space are as follows:

1. Cooling the arc space and electrodes. The colder the arc space and the electrodes the more rapid the de-ionization. Cooling is effected in several ways. First, the positive electrode is made of material having a high heat conductivity. Hence copper is used for the positive electrode. Secondly, the arc is burned in, and the electrodes surrounded by, a gas having a high heat conductivity which conducts the heat away rapidly. Hydrogen is used for this purpose, as explained in detail in a previous paragraph. Thirdly, the arc chamber is supplied with cooling fins. Finally, in the large sized arcs cooling is effected by means of cold water circulating around the arc chamber through pipes.

2. Using a "magnetic blowout." The magnetic blowout is a magnetic field whose direction is perpendicular to the length of the arc, as shown in Fig. 9. The effect of the magnetic field is to stretch out the arc and drive the gases and arc from the inside to the outside, in this way breaking or extinguishing the arc. For best efficiency it is found that there is a certain value of field strength which gives best results. Using a field strength stronger or weaker than this definite value will result in irregularity of the generated oscillations. The best value of field strength is directly proportional to the frequency of the oscillations and depends upon whether or not a hydrogen atmosphere is used. If a hydrogen atmosphere is used a much smaller value of field strength may be used than otherwise.

It is obvious that the burning of the arc makes changes in the arc electrodes. Changes in the arc length are accompanied by corresponding changes in the frequency of oscillations which is bad for transmission. To prevent this one of the electrodes, the negative carbon, is slowly rotated continuously while the arc is operating, which results in an even wearing away of the electrode.

The design of the radio frequency circuit shunting the arc consists largely in proper proportioning of the values of *L* and *C*. The following considerations apply in this case. It is evident that since the energy is proportional to the amount of capacity used that the higher the value of *C* is the greater will the radio frequency energy be. But it is not advisable to increase *C* too high for the following reasons. In the first place a large capacity requires a much larger charging current than a small capacity. This means a larger arc current with increased heating and therefore greater ionization which, as pointed out previously, is bad as it decreases the power output. In the second place the larger capacity may require so much charging current, that it will rob the arc of enough current to extinguish the arc. Consequently best results are obtained with a small value of *C* and a high value of inductance. The average value of the radio of *L* to *C* when *L* is microhenrys and *C* is in microfarads is approximately 4000. Having determined on this ratio of *L* and *C* the actual values are fixed by considerations of the wave length.

How to Make a Good Crystal Detector

By B. F. McNAMEE

A GOOD crystal detector should be easy to adjust and should keep its adjustment fairly well. The "cat-whisker" should readily reach all points on the exposed surface of the crystal, and the correct pressure should be easily obtained. Good insulation, proper terminals, and a satisfactory crystal holder, are other points which must not be overlooked.

The illustration shows a detector which possesses these qualities to a high degree. It was made by the writer (for his own experimental use). It can be easily made with few tools, and the following material:

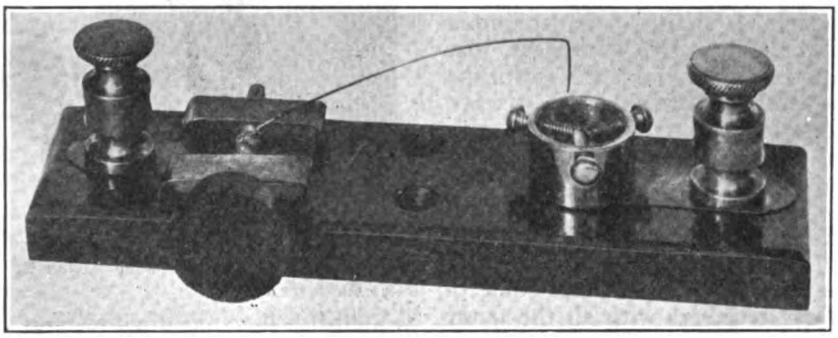
- 1 piece bakelite ⅜"x1¼"x4"
- 1 piece No. 28 gage sheet phosphor-bronze 1"x2"
- 1 piece No. 28 gage sheet phosphor-bronze ⅜"x1½"
- 1 crystal cup with set screws
- 2 binding posts
- 1 small bakelite knob threaded for insert
- 1 piece round brass rod ⅛" diam. x 2" long
- 1 piece No. 26 phosphor-bronze wire 3" long

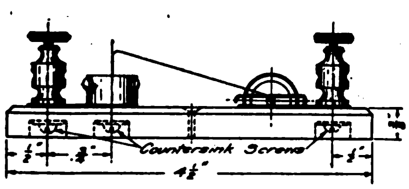
The illustration and drawings show how to cut and bend the larger piece of sheet phosphor-bronze. It is very important to do this correctly, as the success of the job depends chiefly on this piece. Be careful to keep the two strips that are bent back to hold the rod, absolutely straight, except for the slight turn-down at the ends.

The bakelite, after cutting and drilling, should be filed smooth along the edges, and then polished or sanded lightly with fine emery.

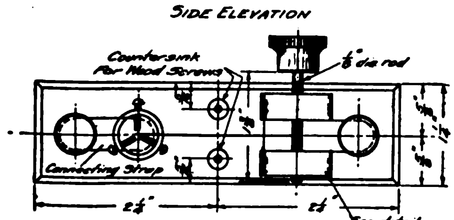
The rod is threaded sufficiently at one end to screw into the knob. By putting a little glue or shellac on the threads before inserting the knob, the latter will not become loose. One end of the phosphor-bronze wire, or "cat-whisker," is soldered to the center of the brass rod. Use a very small amount of solder, so that it does not flow around the rod and impede its turning.

When buying the sheet of phosphor-bronze ask the dealer to mark the direction of the "grain"; it must always be bent with the grain in order to get the benefit of its springiness. Phosphor-bronze will take a high polish very readily, and this will add much to the appearance of the instrument.

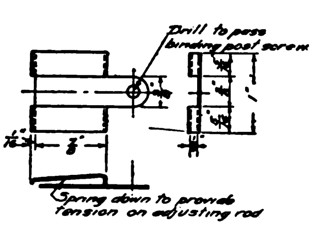




SIDE ELEVATION



TOP VIEW



DETAILS OF SPRING "UNIVERSAL"

THE RADIO SEARCHLIGHT

From Institute of Radio Engineers, New York, N. Y.

THE radio searchlight, a method by which radio waves transmitted from a broadcasting station can be reflected in any desired direction, just as light rays are directed from a searchlight, was announced by Senatore Guglielmo Marconi in his address before a joint meeting of the Institute of Radio Engineers and the American Institute of Electrical Engineers in New York, Tuesday night, June 20.

At present radio waves, upon leaving the antenna, scatter in all directions. His apparatus, which in no way resembles a searchlight but is a series of wires arranged in a special way on towers or masts, sends the message through the ether in one direction only, Marconi said. He amplified his words by a demonstration in the hall. Messages transmitted were picked up clearly on one side of the room but could scarcely be heard with similar receiving apparatus on the other, and vice versa.

With his system of reflectors, Marconi stated that he had successfully conducted radio telephone conversations between London and Birmingham, a distance of 100 miles. This is a record in long distance radio transmission and reception with very short waves. In all these experiments the wavelength varied from one to twenty meters.

The reflectors make it possible for the receiving station to reproduce a telephone song or speech about two hundred times louder than is now possible and without distortion. The transmitting aerial can be used both for transmitting and receiving at the same time.

"In these days of broadcasting, it may still prove to be very useful to have a practically new system which would be to a very large degree secret when compared to the usual kind of radio," said Marconi.

Marconi described a revolving transmitter and reflector which acts as a kind of wireless lighthouse or beacon. "By means of the revolving beam," he stated, "it is possible for ships to ascertain in thick weather the bearing and position of the lighthouse."

In wireless, electric energy is flashed into space in waves. The distance from one wave crest to another is called "the wavelength" and is usually expressed in meters. In these days, when radio is the hobby of millions, the wavelength may be anything from 200 to 20,000 meters. In other words, the ether of space is shaken into terrific billows compared with which the mightiest upheavals of the ocean are mere ripples.

Continued on page 38

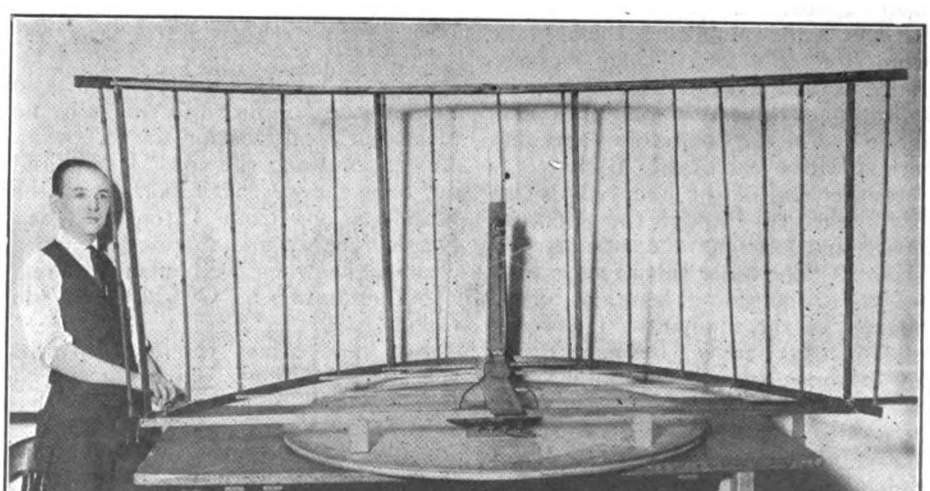
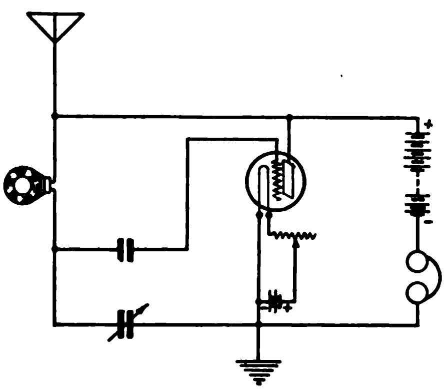


Photo by International

An All-Wave Receiver for Short-Length Pocket-books

By David P. Gibbons

THERE usually comes a period in the life history of every radio bug when all the world, which to him of course means all the radio world, assumes that dark blue tinge, when he grows very weary of turning the little trick switches and adjusting the micrometer controls of ticklers, secondary and tertiary circuits and he decides, for the 'steenth time to quit the radio game for good. Well, when it comes your turn to feel this way,



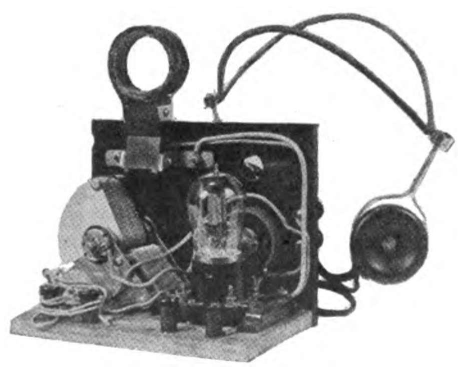
don't pile all the good old junk in the ash barrel and hurl it from a convenient dock. Just sit down again and try this on your piano. This one is the condensed essence of super-simplicity, if I do say it.

Proceed thusly. Hunt around among the ruins and pick out a variable which still condenses or condenses still. Guess that sounds rather bootleggy, but what I mean is one in which the plates don't rub. Then dig out a fixed one of small capacity, any kind of a grid condenser will do the business as a leak is not essential. Next retrieve a socket, a filament rheostat and a honeycomb coil and you have the complete collection of parts necessary to construct the most wonder—. But first to put them together.

Never mind mounting them on a panel for a start. Take a brief glance at the diagram. The aerial connection goes directly to the plate and to one end of the honeycomb and also to the positive lead of the "B" battery. The other end of the honeycomb coil goes to the grid through the grid condenser and also to one side of the variable. The other side of the variable goes to the ground lead and to the negative of the filament. The fones are connected between the negative of the "B" battery and the ground. And that's all. Absolutely. When making the connections, if at all doubtful, just take another brief glance at the diagram.

And now for the dirty work. Here are some of the poor points of this arrangement. (Ad copy writers please take notice.) For short-wave C. W. work this set is the bunk. For concert work it is *not as good* as a Grebe, a Paragon, or a Westinghouse regenerative set. And that, I think, about exhausts the defects. It brings in the concerts all right—you'll say it does—but not as well as a set built especially for that purpose. With my aerial, which has a natural period of 330, a 75 turn coil and with 15 degrees of the .001 variable, I have heard the Kennedy concert at Los Altos quite clearly when 60 miles south of the Columbia River Lightship. No amplifiers, just the one tube. Of course the size of the coil to be used for any particular wave length will vary slightly with local conditions, such as antenna length, type of coil, etc., but this is easily determined by individual experiment.

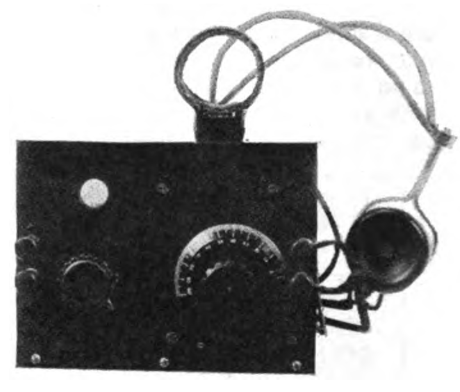
But it is on the 600 meter wave and upwards that this little outfit rises up and asserts itself. It makes some of the flossy receivers with all the fancy dewdads hide their nickel-plated heads in shame. It simply reaches out about a thousand miles or so in all directions, grabs up any and all signals regardless and slams them against your eardrums. Honest. Halfway between



The Wiring Shown in the Rear View Could Stand Considerable Improvement, But —She Perks!

Astoria and Portland KPH comes in too loud for comfort and this is by no means an ideal location for reception. Any place along the coast I can (and do) copy the weather reports from the navy stations from Tatoosh to San Diego, reliably and distinctly. On a clear night when well offshore along about midnite, Oy! Oy! how they do roll in!

But now comes the kick in this special home-brew. Take out the 75 turn coil and plug in the largest one you can lay your hands on. Vary the variable and listen to the pretty birdies. Hear them chirp and twitter! Every little old high-power arc from Marion, Mass., from far-away Nippon and to Guantanamo Bay in Cuba comes fluttering home to roost on your flat-top and fight each other to come down and whisper sweet nothings in your shell-like ear. You betcha. And sharp? Oh! boy! Why it's so sharp that—But what's the use? You



This Set Might Well Be Named the "Sphinx," It Reminds You so Much of One —So Different.

wouldn't believe me anyhow, and after you have tried it nobody else will believe you. And there you are. But I've copied WSO and WGG in the daytime while tied up at the dock at Peer 16, San Francisco, and there are not many receivers at any price in that class. On the long waves it oscillates and regenerates to beat four of a kind. The filament adjustment is not at all critical on those waves, and as all the tuning is done with the variable it is quite apparent that it is the "ne plus ultra" as far as ease of operation is concerned. Just one single knob control. Count 'em. One.

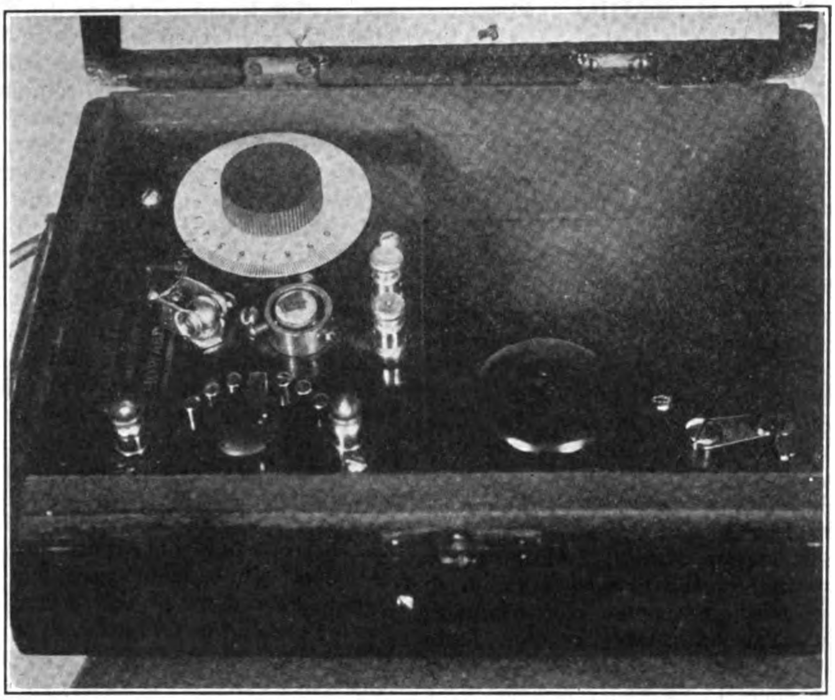
And now, if you have no objection, here is a little friendly advice from one who claims to have occasional lucid intervals. Do not try to get this hook-up patented. Put your spare money in wild-cat oil stocks, if it bothers you, but nix on the patent. The Armstrong patent covers everything except the hinges on your old cabinet. Also do not go very extensively into the business of manufacturing and selling these sets unless you can persuade John D., and J. Pierpont and Henry F. and a few more of your old college chums to come to your rescue when the U. S. marshal calls to pay an unsocial visit, as he will without fail.

The reader may have gathered from this article the impression that the writer was manifesting a slight bias in favor of this particular set, and the writer wishes to come right back at the reader and tell him emphatically, if somewhat inelegantly, "You're doggone tootin', old man."

A Practical Portable Receiver

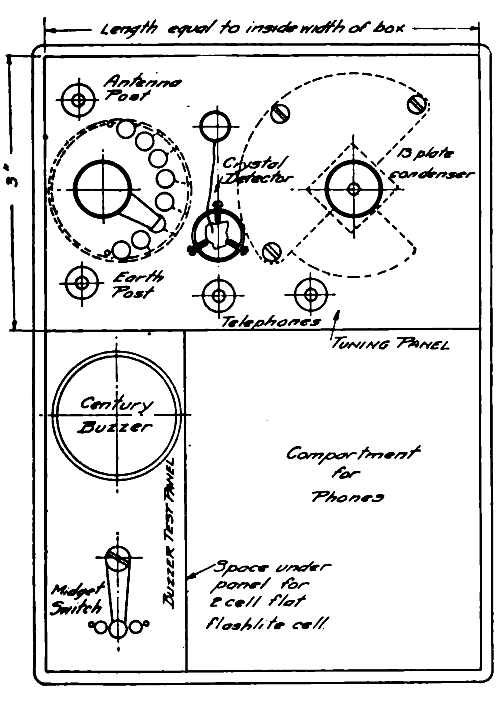
By Howard S. Pyle

WHILE a bit late in the season for portable sets to come to the fore, nevertheless, one finds many uses for such an outfit throughout the year. A portable such as described herein, can be set up at home, and the home audion connected to the antenna and earth posts of the portable, making a good little permanent installation. It is not small enough to be carried in the vest pocket, but is small and light enough to be truly portable, particularly as the fones and buzzer test with battery, are included within the case.



A Mozart cigar box, sanded, stained and varnished, forms a handy carrying case, with the addition of a suitable handle for carrying purposes. The inside of the box is also given a coat of stain to complete it.

The instrument panel carries an inductance switch, crystal detector, and variable condenser dial and knob, together with the antenna and ground posts. The panel is made of XX bakelite, 1/8 or 3/16 in. thick, in. wide and of a length sufficient to fit snugly between the sides of the case. The panel is supported by means of two small blocks, secured to each side of the case, and to which the panel is attached by nickeled wood screws. A small piece of mahogany forms a face for the compartment enclosed by the panel, and protects the under side of panel from injury. The panel is drilled as shown in the drawing, and the apparatus assembled thereon. A 13 plate condenser forms the variable capacity. The tuning inductance consists of a 2½ in. cardboard tube, 1 in. long, wound with a three layer bank winding of No. 26 cotton covered wire. Six taps are taken at equally distant turns, and together with one end of the coil, are soldered to the seven switch points. The switch has a 1 in. radius and the points used are the smallest obtainable, nickel plated.



A crystal detector of almost any small type may be used, but the ball and socket type was found most satisfactory. A small brass cup, with three clamping screws, serves to hold the crystal, which is a piece of mounted galena.

The binding posts for the antenna and ground, and for the telephone receivers, are located as shown on the panel.

A small wooden panel is next constructed to fit as shown, and serves as a buzzer test panel. On this are mounted a Century buzzer, a small nickeled switch. Under the shelf, a small flat, two cell flashlight battery is mounted for operating the buzzer.

In mounting the coil of inductance, it is slipped over the protruding screws of the switch points, from the rear of the panel, and forms a circle around them. It may be secured to the panel by small brackets if desired, but it is not necessary, as, with its connecting taps, it supports itself satisfactorily when the panel is fastened down, which holds it in place.

The single circuit method of tuning is used, for the sake of simplicity and efficiency; selectivity not being a prime factor. With the 13 plate condenser, waves from 100 to 1000 or 1200 may be reached, depending upon the size of antenna used.

The space left in the box after mounting the tuning and buzzer panels, provides carrying space for a pair of head phones; preferably of the Murdock type, as they may be dismounted thereby fitting the space better.

If it is desired to use an audion with this outfit, the leads from audion control marked *Secondary* are connected to the antenna and ground posts of the set. It will then function perfectly as an audion receiver.

FILAMENT CONTROL

Control of filament current by means of a high-grade rheostat is accepted as one of the most important operations in the satisfactory reception of radiophone messages. A word of explanation as to the function of the tube filament and radio "A" battery circuit may make this point clearer.

The tube filament when heated to incandescence gives off negatively charged electrons in all directions. These electrons are attracted to the positively charged plate when the "B" battery circuit is connected. But the "A" battery has the sole task of heating the filament and for most tubes this requires from 5 to 5.5 volts. No more electrons will be given off after the saturation point has been reached.

Scratchi Gives Some Expert Advice

By David P. Gibbons

To Editor of RADIO (Magazine which leads the monthly parade of all such).

Sir Dear:

For some time now since past my Cousin Scratchi have been enjoying extensive beach vacation and as he are quite closely approaching low water ebb of finance he decide to chase himself new opening for his radio talons. He pay visits to six or five offices and jot down name on lengthly wait lists and also fill up very blank papers with grand-mother's maid name, how often in jail, what do he like for breakfast and so on and fourth. He return himself to there every brite a. m. for many following days, but fail to hook anything — not even pleasing smile.

One foggish morning (which are not very rare for this season) I collide on street with gent who were formally radiotrician on payroll of the Daily Yowl — The Paper for People who Think they Think—but are now gone back again to old job as cobbler's assistant in Los Angeles.

"There are still opening there," he inform me, "for some dumbell." I require to know if my Cousin might insert himself in this opening. "From what I know," he crack back, "he are just the proper goof." I then make rapid homeward clatter, Mr. Editor, and smash the jolly news to Scratchi who paddle over hastily to paper office and grab this splendor position with no farther questions given or asked.

When he return home again next a. m. he gather up all past numbers of RADIO and start decomposing original articles with aid of sharp shears and high speed blue pencil. He extract sufficient for several columns but find he have large vacant spaces in southeast sector of his page, which editor have threatened to fill with strong-pulling ad for Fluxated Steel—the Tonik for Pale Pink People, None Better Brewed. So he then decide to occupy this place with special Buro of Misinformation and announce in next issue to the more or less gentle readers that he will take pleasure to give answerings and advisings on radio topix to any and every body who, might be, need it.

A few evenings after this, Mr. Editor, I am on homebound way from my daily slave-waging when I am detracted by bully voice of 80 year old newsboy who have shifted tune from broadcasting crime wave to inform all bypassers of grand scoop-up by Daily Yowl which, he say, have secure service at terrible expense the world's most tremendous radio expert, the Honorable Scratchi, who, he say, are insulting engineer to the Bestinhouse Co. and Grand Specialist in Wireless Disease, and who, he say still, are now to be found only in columns of most circular paper in country—the Yowl, morning eruption, or the Yawp, which are evening upheave of same. I buy tomorrow's spasm from this poor old newsie, who I think, Mr. Editor, have more money than next year Republican campaign bag, and turn pages quickly to avoid sticky messup of murderings, wet raidings, movie exposures, soul sobbings and other education featurings which make this paper what it are, until I arrive at absorbing page which my cousin conduct.

I give slight glance at original articles which have already made first appearance in several Radio Deadjests and then make deep study of stream of teknikle wisedom which flow so freely from gifted Neversharp of this notorious expert. I snipped off some of it, Mr. Editor and desire you should pursue same with care, as it are meant for people who have very little or no knowledge at all, if any.

Here are few of hintful helps which he expects to nab up many fresh subscribers with:

Quest.—(1) Could you tell me something about static and (2) can I catch him on my Worstinhouse, Type KO, receiver.—N. O., Branes, Gen. Del., Alameda.

Answ.—(1) I could and (2) You can.

Quest.—Whilst conducting some heavy experiments in vacuum I discover that if airy serkit resistance are reduced below triple ought one two, I don't get any harmonicas at all. I am very muchly surprised. What do you sniggest?—Eymah Frique, Fresno, Cal.

Answ.—I also am very muchly surprised, Eymah. Try adding several more oughts and then multiply this by cubic root of pie. If you still fail to get the harmonicas there must be something wrong in your uphook. Visit reliable Cheeroquackto, if possible.

Quest.—I have just took up radio for pastime and have read about new system of Captain Queer for wiring wireless waves. I desire to try this and shall connect my 5 watt fone set to the high power line which pass along in back of my yard, and broadcast latest news to the generally public. Do you think I will get results?—Ivor E. Dohm, Portland, Oregon.

Answ.—Yes, Ivor, you will, doubtless. Before you throw in switch, howsoever, send in your picture with age and so fourth to editor of vital statics column and tell your folks which kind of flowers you mostly wish.

Quest.—I require aid at once. I am greatest radio operator in my state, but cannot secure position. I spend 8 years in navy, 7 in army, 6 in wireless manufacture and last 5 all by myself. I know everything about radio and have triple first grade license and do not know why someone don't give me a job. What do you think?—Signed "Wonderer."

Answ.—I think you are just plain d — — never mind what I think. You should have slight trouble in picking up position to write catching descriptions of new receiving sets for any supply house in same state as you are.

Quest.—Please tell me how I mightbe improve the jazz which I catch on my Ambad, Type NG, Receptor. There are large hole in carpet under A battery, which I think are caused by some of the electrons which were discharged. I love jazz.—Fay Therwate Nudel, Hollywood, Cal.

Answ.—No, Fay; the hole are caused by your grid leaking. If you plug this up with teethpick and reverse B battery to make music come in backwise you will obtain very novel defect which you lack.

You can see from those, Mr. Editor, how my cousin give out personal knowledge at maximum radiation and why he are spoken about in such loud terms by all customers. I think he are headed for something big, Mr. Editor, and hoping you are likewise,

I still remain,

Your respectable reader.

HILOLI NOGO.

ISLAND WITHOUT COUNTRY HAS CALL "U S"

Off Honduras in the Carribean, lies a little piece of land called Swan Island, where Americans have lived for many years although the nationality or ownership of the island has never been decided. On this "Island without a country" the United Fruit Company has a commercial radio station and uses the call "U S" which, however, is not a United States call, but an outlaw call chosen by the company in 1909. Although Italy owns the three letter calls from U P A to U Z Z, "U S" does not come within the control of that country any more than does the island itself.

If the island came into the possession of the United States, the station would lose its identifying call, as all United States calls begin with the letter "N," "K" or "W."

STANDARD OIL USES RADIO COMPASS STATIONS

The fleets of the Standard Oil Tankers have been ordered to make use of the Naval Radio Compass stations to secure or verify their positions off the coasts, which indicates the great value these radio stations have become to merchant ships. The Standard Oil Company has directed all its "skippers" to make "full and frequent use of the Naval radio stations in determining their correct positions." In the event of running aground, the orders state that an investigation will be conducted to ascertain whether or not the vessel was near any of the Navy's 44 compass stations, and whether the Master of the unfortunate craft used the facilities. These facts will be considered in determining his responsibility.

A Soft Graft

A Samuel Jones Story

By Volney G. Mathison

"WOMAN is a deceivin' animal," sourly stated Samuel Jones, as he sat before Cunningham's office window moodily watching the white and the buff-colored ferry-boats stringing off across San Francisco Bay to the Oakland mole. "I don't see how ya can stand bein' married all th' time to one of 'em."

"Oho! I thought so!" chuckled Cunningham, with a knowing smile. "It's almost three months since you blew in from Alaska and went around into the Atlantic on the '*Western Glen*'; and I saw in the paper that you arrived in New York over six weeks ago—six weeks to make a train trip back to Frisco that other people manage in five days! I suppose you played Pullman cavalier to some fair dame, and got vamped again—as usual."

The veteran brass-pounder grunted, and rolled a smoke.

"You know me pretty well," he observed, gloomily; "but it wasn't no railroad cavalierin' racket this time."

With a judgment acquired from long experience, Cunningham waited; while Samuel Jones smoked and frowned at the pretty movie girl's face on the lithographed bill-board down on the opposite side of the street.

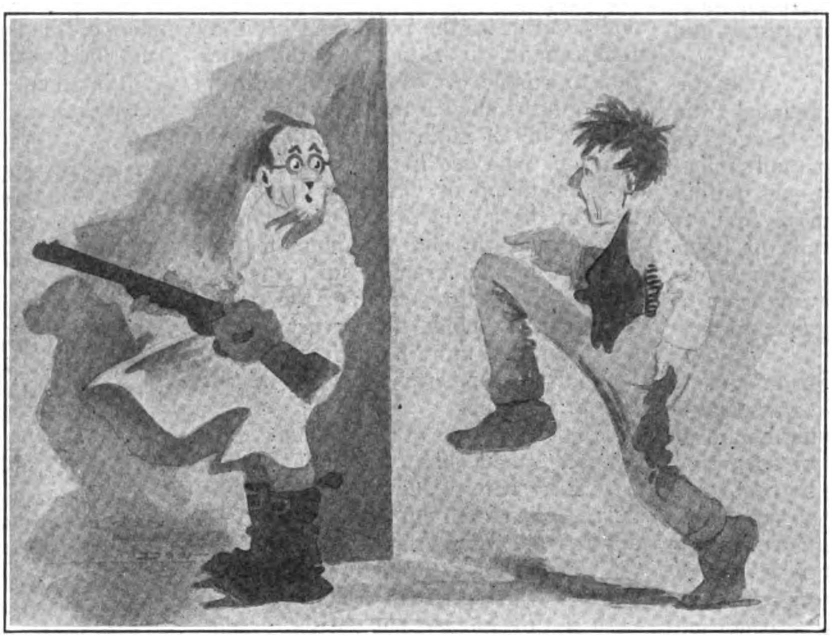
"IT was a long, lanky old hick with a dusty-lookin' sky-piece, an' luggin' a battered-up old pasteboard suit-case with th' name '*Timothy Tuggle*' an' '*Pilcher's Corners' Kansas*' stenciled on th' sides an' ends, who got me into it," at length vouchsafed the shellback operator, becoming dourly reminiscent. "He got into the same Pullman with me in th' Rock Island station at Chicago; an' when th' train pulls out, we discover we're allocated to the same berth. He starts to raise a hulla-ballo with th' Pullman conductor, but bein' such a peace-lovin' human, I agrees to take an upper. This causes him to get real friendly, an' he treats me to somethin' he was carryin' on his hip. He begins tellin' me all his private business, from which I gather that he owns a corn-an-hogs ranch at Pilcher's Corners;—an' then he wants to know all of mine.

When I informs him of my method of defraudin' th' poor ship-owners for a livin', he seems to get a lot interested.

" 'Ye're one o' them wireless hee-roes, whut git famous by gettin' drownded, air ye!' he exclaims. 'By jingo!'—an' then he stops an' begins strokin' his rangy goatee, like he was doin' some tall thinkin'.

" 'Say—air ye in any big rush about gettin' t' whur ye're goin' ter," he asks, after a while, as if he was turnin' somethin' over in his mind.

" 'Well, I guess the hills won't fall if I don't get to Frisco just on time,' I answers, wonderin'.



"Couldn't ya tell me from a sk-kunk?"

"Old Timothy sits an' thinks some more.

" 'Yep, by gum—ye're jist th' feller to cure Margy,' he says, at last, half to himself.

" 'Margy!' I exclaims. 'Who's she?'

" 'Margy's my datter,' he replies. 'A silly-brained, senseless young-un. Here a while back she runned off with a pumpkin-headed dunce round our way named Eusebius Ames—an' would'a married him, only Zoroaster Sims, th' preacher, wouldn't do it, 'count she bein' only seventeen.

'After that me 'an th' missus was keepin' a purty sharp eye on her, until one day we thought we was shet o' that consarned Eusebius. He druv up Logan Hill with a load o' hay, an' comes to a truck full'a cream belongin' ter Ebenezer Pitts, what was standin' acrost th' railroad track. Zachary Bilgiks was under th' truck fixin' suthin'; but Eusebius didn't see him, an' shoved th' truck off'n th' track,—an' it run off backwards all th' way down th' hill an' went slam-bang against Leander Blagan's hen-house, whur it upset an' spilled all th' cans o' cream. Zachary up an' hammers th' stuffin's out o' Eusebius; an' meanwhile a bob-tailed freight-train come along an' hit Eusebius's hay-wagon, an' smashed it all ter smithereens. Fancy Margy wantin' ter marry a dum fool like that!'

" 'Never can tell about 'em,' I agrees. 'They're all nuts.'

" 'They took th' durned fool t' court,' resumes Timothy. 'He gits sentenced to pay a hundred dollars ter Pete Hankins fer th' hay-wagon, an' two hundred an' thirty ter Ebenezer Pitts for th' cream an' th' banged-up lizzie-truck.

" 'Eusebius not havin' th' money, he had to work it out fer Pete at a dollar a day; then Ebenezer sent him ter his rock-quarry up t' Stonefield to work out his time fer th' cream an th' truck. Stonefield's nigh onto a hundred miles from Pilcher's Corners, so we cal'lated we was rid o' Eusebius—but we ain't, by heck!'

" 'How's that—does the girl keep mopin' over him?" I asks, wonderin' what in blazes he's drivin' at.

" 'Wull, she was nigh ter bein' over it, fer a while,' says Timothy. 'One day she runned acrost a wireless magazine; an' right off she wanted ter git a outfit. Me an' th' missis thought as how it'd be a fine thing fer to help her forgit about thet durned Eusebius, so we let her buy a big transformer an' a rack o' copper-bound kittles, an' a sparkin' wheel,—an' aujons an' truck—cost a pile o' money, too, by gum,—an' now th' hull farm's full o' oscillations an' burn-outs, an' somebody is nigh ter gittin' kilt every day.

" 'She put one o' them gol-durned ground wires onto th' pump, an' Jerry Mooly, who is one o' th' hired hands, didn't know what it was, an' took it loose. Jist as he was draggin' it off, aimin' ter nail it over a busted place in th' back fence, Margy started up thet consarned sparkin'-jinny—and Jerry ain't bin right sence. Then she put a tele-

Continued on page 46

The Keyhole of the Night

By Earl Ennis

A PHANTOM scrap of music—the lilt of harmony played by unseen hands, chattering code bits, whispering rhythmically, and an operator half risen from his chair, his face startled, tense . . . a picture clipped from the film of the night!

It was a night when static roared in . . . brittle, sharp, insistent. The tropical disturbances of the autumnal solstice were upon the season with brutal emphasis. Ship business was proceeding slowly, relayed from boat to boat. High overhead the long waves of the giant shore stations whipped and snapped in huge invisible streamers, perceptible only to the occult intelligence of crystals and lamps.

Again the music . . . The station stood on a coral reef, isolated from the rest of the world. It's range was not great—perhaps a thousand miles. There was no music near it—not within the meaning of radio distance. And yet for an instant, like a globule of light, the tones hung poised amid the blackness of the night to fade away again as they had come—ghostly, faint, intangible.

The operator reached for his tuner. It was useless. The music was gone—a memory—an elusive, pulsing breath of distant cymbals and horns, of harps and cellos. Tune as he would he could not bring it back, nor did it ever come back. Yet for that instant—like a curtain torn asunder to reveal the past mysteries of distant years, it had been there with him, in the tiny, hot, stuffy tropical operating room on an isolated coral reef—phantom music!

There was not a broadcasting station in the world, at that time, for this was many years ago when the crystal detector was still in use as a commercial instrument. Yet the music had been picked up, had been heard—music played in some auditorium, some public square, some concert hall. No wireless transmission had been used and without it, the music had carried over mountains and oceans to a lonely coral reef in a far off ocean.

There is no answer—not yet, even in the world of super-developed science and mechanistics. Radio men, consigned to far off spots, left alone with only their instruments for company, report many phenomena of this kind—mysterious music and messages and even spoken words, heard in radio receivers under queer conditions, absolutely unexplicable upon scientific foundations. With an ear to the keyhole of the night, they hear odd things.

Is there then another wave, another oscillating force—a super-carrier, greater than the radio wave, with which the world as yet knows nothing? Does the static, great mystery of the wireless, that picks and scratches at the doors of every wireless station in the country like a lonely, hungry wolf, carry the answer in its bosom?

Natives, beating on gut drums, have found something that radio men cannot fathom. The American Indian, standing with bowed head and folded arms, and closed eyes "talking" in his "spirit code" with another Indian in a distant lumber camp across the width of a lake, also has something that no radio man can explain. His system is just as sure and accurate as the radio, and yet those that can do this thing, lack the education to explain it. What is the answer?

Engineers and savants who have made a life study of radio, of the atom, of the electron, who see in the solid table, a conglomeration of vibrating parts, who hear in the twang of a guitar string a rhythm that can shatter a mountain, and who find in a kilogram of dust, potential, bottled energy greater than the output of Niagara, hold that every spoken word, and the more powerful of human thoughts register everywhere on the surface of the globe.

Hugh Robinson of New Jersey, talking to a friend only a 100 miles distant, with a set barely able to work that distance, was picked up in Scotland 1900 miles away. The cruiser California, ten years ago, lying at Point Loma and talking to a warship less than 500 feet away with a tiny buzzer and two dry cells, was copied at Mare Island station with perfect distinctness, while a whole coast marvelled at the feat, and radio men shook their heads and even then started searching for a new radio wave, greater than the one known to science.

On the threshold of super-electrodynamics, the freaks of the wireless, have developed a slow-growing conviction that up among the star-frequencies, is a new force—perhaps Corelli's "sound wave" that was hurled from the "City of Brass"—that spoke to the human ear without apparatus. Here and there are persons, already attuned to this new super-vibration—who hear radio signals and music without radio sets. Are these forerunners of a new race of the future?

What else can explain the bits of code, the scraps of phantom music that drift from pole to pole, that beat upon alien wires, high strung above the earth, that come tapping with ghostly fingers on the human consciousness, that whisper faint nothings through the key-hole of the radio, to startled ears? There is no wavelength on which they can be found, no apparatus that can bring them in or keep them when they seek to go. They are orphans of the night—the wandering Jews of the wireless—doomed to go on and on—flotsam on the surface of an ocean unknown to mankind.

The radio operator is no agnostic. He does not flout the beliefs of any man. Left alone beside his peep-hole, his finger on the control of a force he cannot hope to understand, his ears attuned to whisperings as faint as the urge of conscience, he shakes his head, and marvels. At the key-hole of the night he learns that there is much beyond—much to be learned—much to be solved. He alone, of all mankind, heterodynes with infinite Time and the Fourth Dimension!

This then—the great Romance of the Radio!

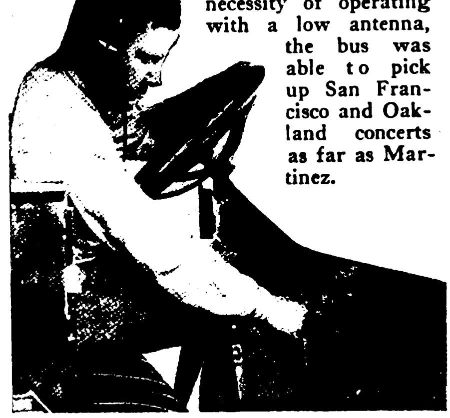
RADIO CONCERTS FOR BUS PASSENGERS

Bus lines in California will soon be serving you music with your rides.

Should tests which the California Transit Company, of Oakland, Cal., started recently prove successful, many of the eighty-five White busses operated by this line will be equipped with radio phones to pick up daily radio concerts in the bay region.

W. E. Travis, president of the California Transit Company, sent the first radio equipped bus out on its regular run to Sacramento and in spite of the obstacles which confronted the test enough information was obtained to warrant further experiments and to assure Mr. Travis that radio concerts would soon be a reality for his patrons.

With only a two step radio shortwave receiving outfit and handicapped by the necessity of operating with a low antenna, the bus was able to pick up San Francisco and Oakland concerts as far as Martinez.



At Sacramento a test was made by special arrangement with the Holbrecht broad-casting station. It was found that by a sacrifice of speed the concert was as audible when the bus was in motion as when it was standing at the curb.

According to officials of the bus company and radio men interested in the tests from a scientific angle, some refinements will be made, and experiments continued until desired results at varying speeds are obtained.

A Radio Primer

By H. A. Eveleth

Tuning Coils in Receiving Sets

THERE are several forms or arrangements of coils used in receiving circuits for tuning such circuits to the wave-length of the sending station. When two circuits are in tune the natural period of electrical vibration of the two are the same. The two circuits are tuned to resonance. The product of the inductance and capacity of the one circuit is equal to that of the second circuit. The tuning coil supplies inductance to the circuit, the amount depending on the number of turns of wire rather than on the length of wire in the coil.

The simplest form of tuning coil consists of a single layer of wire wound around a cylinder and a rod and sliding contact so arranged that any number of turns desired may be used. This is called a single slide tuning coil. It may be connected between the aerial and ground to tune the aerial-ground circuit to that of the sending station.

If two sliding contacts are used it is a double slide tuning coil. This second sliding contact permits the detector circuit to be turned more accurately to the aerial-ground circuit. The detector circuit is called the closed circuit and the aerial-ground circuit is called the open circuit. It will be seen that one winding or coil serves for both circuits.

If two separate coils are used, one for each circuit, so mounted that the distance between the two can be varied, tuning can be accomplished more accurately and there will be less interference; in other words the system will have greater selectivity. The loose-coupler consists of two windings, a primary and a secondary, one of which will slide within the other. There is no electrical connection between the two and energy is set up in the secondary winding (closed circuit) by induction from the primary winding (open circuit). The two windings are said to be coupled electro-magnetically. The coupling is close when the windings are near together and loose when the windings are drawn apart. The number of turns or inductance in each circuit can be varied either by a sliding contact or by taps brought out to switch points.

The coupling between two coils can be varied by rotating one coil within the other. The vario-coupler is of this form of construction. It can be mounted easily on the back of a panel and a knob and dial in front will permit easy and accurate adjustment of the degree of coupling.

The vario-meter is constructed similar to the vario-coupler except that the two windings are connected together. When one winding is rotated the mutual inductance between the two windings is changed and the effective inductance of the unit as a whole is changed. It has no sliding contacts nor switch points wherein there are opportunities for small energy losses due to poor contacts and it is therefore a very efficient tuning unit to employ in a receiving circuit.

When it is desired to tune the open circuit to a wave-length above that which can be secured with one tuning coil a second coil may be connected in series with the first. The second coil, which serves to add the required amount of inductance, is then called a loading coil.

There are also tuning coils known as bank-wound, honeycomb and duo-lateral wound. These coils are usually of fixed inductance and their wave-length can be varied by using variable condensers connected to them in shunt.

These coils have a number of advantages over the loose-coupler. They are much more compact and there are no losses due to poor contacts. So-called "dead-end" losses are eliminated, these being such as occur in portions of inductances not switched in circuit where sliding contacts or switch points are used. Due to the form of winding the high-frequency currents can pass through the windings with less resistance, and therefore more energy reaches the detector. Coils of different inductance values can quickly be inserted in the coil mountings and the effective wave range of the receiving set can be made to reach any practical values.

Regeneration

A REGENERATIVE circuit is one so connected that the plate or output circuit of the detector tube is coupled, that is connected electrically, to the grid or input circuit of the same tube. In the non-regenerative circuit the plate is connected to the filament through the phones and "B" battery, while the grid is connected to the filament through the grid condenser and the secondary winding of the loose-coupler, vario-coupler or other tuning device. These two connections are called the plate and grid circuits respectively. In the regenerative circuit an additional coil or coils are so connected that energy from the plate circuit is "fed back" to the grid circuit. One way to accomplish this is to use a "tickler" coil connected in the plate circuit and so placed that there is induction between it and the secondary winding of the tuner in the grid circuit. Regeneration may also be brought about by tuning both grid and plate circuits with variometers connected in these two circuits.

When the grid voltage is varied by incoming signals a change in current flow in the plate circuit takes place, but the energy flow in the plate circuit is much greater than in the grid circuit, due to the available energy in the "B" battery, which is released by the valve action of the tube as explained previously. In the non-regenerative circuit the tube therefore both detects signals and amplifies them. In the regenerative circuit some of the energy of the amplified signal is returned to the grid circuit so that it too acts on the grid, together with incoming energy from the aerial with the result that the voltage variations on the grid are greater than ever and hence the plate current variations are greatly intensified. The tube therefore not only detects but amplifies signals to an extent which greatly exceeds the amplification which could be had without regeneration.

The Armstrong regenerative circuit is probably the most efficient and manufacturers of apparatus who use it must pay a royalty.

Damped and Undamped Wave Reception

A SERIES of pebbles dropped into water at intervals create a series of water waves which spread out over the surface. Each group of waves represents the disturbance caused by one pebble. The largest wave of the group is at the front and the following waves of the group gradually die down in height or amplitude, and finally no further disturbance is visible until the next group of waves approaches. Each group is called a wave train. These wave trains are damped because they are generated by a source of energy which is not sustained.

In radio telegraphy damped waves are generated by the discharges of a condenser connected inductively to the aerial and ground of the sending station. The energy stored in the condenser by the high tension transformer discharges across the spark gap first in one direction and then in the opposite, each discharge decreasing in intensity until the condenser may be said to be discharged. This action sets up a corresponding train of oscillations or flow of alternating current in the aerial-ground circuit and a damped wave train is radiated.

At the receiving station the wave trains are rectified by the crystal or vacuum tube detector and made audible. The frequency of the condenser discharge is above the limits of audibility, in other words they are at radio frequency, but the detector rectifies the al-

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High Versus Low Antenna

By Dr. A. E. Banks—6ZB

IT is with some reluctance that the subject of antenna constants is tackled by the writer, who makes no claim to engineering expertness. Owing however, to the conviction that much has been left unsaid on one side of this issue, and that certain fallacies have been foisted on the minds of many amateurs, a non-technical attack on the problem follows, which it is hoped will bring forth arguments pro and con, to the end that we may finally know the truth of the matter.

First, let us note that the average amateur (owing to the physical limitations of his terrain) would prefer a low antenna with its limited expense, ease of erection and immunity from accidents, and that whenever he has erected a high antenna it has been for the purpose of obtaining a greater so-called "radiation resistance" with the reputed greater range. If he had found results could have been obtained equally as well on the low antenna, the high one probably would not have been erected.

The largest station in the world, where expense of installation meant little, has just finished a relatively low long antenna. The Eiffel Tower is one of the world's highest antennae, and it is known that great difficulties have been encountered at certain wave lengths on account of this height. Ships practically all have low antennae. Bucher gives a table on page 121 of his "Practical Wireless Telegraphy" in which the masts range from 55 ft. to 150 ft. and yet all these use the 600 meter wave and put more energy on it than on the 300. The longest natural period noted is 426 meters with a height of 150 ft., the flat top being 250 ft.

Again and again in amateur literature we read that "the higher the antenna the better." Bucher (Page 127 Wireless Telegraphy) says, "We want the radiation resistance of an aerial to be as high as possible, etc." A search of successful amateur station records has proven that antennae of an average height of 50 ft. have done more uniform long distance work that the few 100 ft. cases reported. Further, the 100 ft. masts are most frequently utilized for wave lengths over 200 meters, especially 375 meters, and it is on these latter wave lengths that their records are frequently noted. My hearers are invited to tabulate the station constants as reported in the four leading amateur magazines of this country for the past few years and the information gleaned will be startling. Prominent stations are the following:

Name		*Height*	*Distance*
2PL		75 ft.	1000 miles
2QR		50	....
2XX		55	1000
2RK		75	3600
8XK		50	?
5GJ		65	1500
3GE	Canada	40	1000
5ZX		62	1600
6JD	T	60	1800
5ZA		55	N. Y.
5ZP	T	40	1000
8ZI	T	60	1300
1AK		50	1100

Let us now proceed to deduce what our needs really are in the matter of antennae for spark stations. Everyone knows that a relatively low antenna with counterpoise is the thing for C. W. but we are willing to admit as before stated that the dictum "as high as you can and just short of brushing" still holds sway in spark literature. First let us go to the bottom of things and start with the premises that *we want maximum current in the antenna.* This current squared multiplied by the resistance of our antenna will then indicate the watts we are radiating. Now there are two ways of getting this current on the wire. One is to force it against its will and the other is to invite it in and make its entry easy. It is a well known fact that the higher the antenna the greater its total resistance. It is remarkable that some of the most successful radiators among the huge antennae of the world are using a total resistance which is in fractions of an ohm when from the learned discourses in the amateur columns engineers might perhaps to their advantage (?) have learned that they should have tried to get the whole 36 ohms radiation resistance possible back of their watts.

Given the choice between a high and low antenna of the same physical dimensions otherwise it goes without saying that with the same source of power more current will be put into the low than the high antenna. Please note the kick in the following quotation from Bucher: "The student will note that if the average value of current in the antenna circuit remains constant, the amount of energy radiated from a given aerial system depends directly upon the effective height and inversely upon the length of the radiated wave." It is believed that this statement is true but it is also believed that with the same transmitter as the source of energy the average value of current will be less in the high than in the low antenna.

Everyone acknowledges that a high antenna has a high natural decrement. Loading this antenna will reduce it but it can only be loaded so much for a given height or its natural period will be too great. Some of the barndoor variety of wave tops have been known to emanate from antennae whose decrement cannot be further doctored without lowering the mast, which indignity the station owners would not brook. In passing, the facetious remarks of a fellow amateur are recalled relative to this subject when we were discussing advisability of the low antenna. He said, "why not make it one foot high and really get some current into it?" Of course there is a limit to everything and one might roughly state that when the total resistance of the antenna system and ground has been reduced to 3 or 4 ohms it will do. A properly constructed antenna of 50 ft. height with a flat top either L or T, where every allowance is made in favor of reducing ohmic resistance in series with a ground system which is something else than a multiplicity of high resistance leaks from the metallic conductor, should prove superior to a high antenna where in addition to the ohmic and dialectric losses we have several ohms thrown in of so-called "radiation resistance." I say *should* prove—it would be more proper to state that experience has shown such form of antenna and ground to be superior.

In conclusion it is the writer's contention subject to correction by "those who know and have the proof" that if amateurs desirous of getting the most range out of their transmitters would eliminate ohms from their closed and open circuits, no matter where those ohms appeared, and limit themselves to an antenna system whose average height would be approximately 50 ft. that they would excel stations ignoring the ohms and substituting "high-voltage-amp drivers" to force energy way up a mast through a series of resistances of no utility, at the base of which an intricate system of buried substances are disposed, none of which constitute a perfect ground and in lieu of said ground form multiple high resistance leaks. In proof thereof we offer in evidence the ship's antennae and the ocean ground, and the innumerable instances of the successful long distance work done by amateur stations using a combination of moderate height and real ground or counterpoise.

There is no use advancing the C. W. argument because everyone to whom this has been mentioned always says, "Why that is different, that is C. W." Just the same, C.W. holds forth the ideal as to decrement and unless strenuous efforts are made in the near future to cut the decrement at innumerable spark stations it is believed that the spark will be taken away from the amateur.

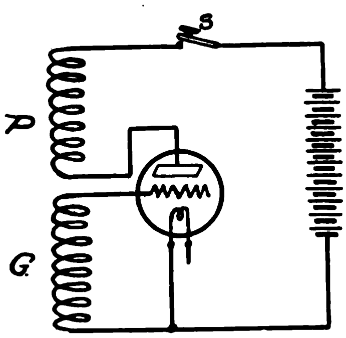
The Vacuum Tube As An Oscillator

By B. F. McNamee

THE steam engine offers a good analogy to the vacuum tube when the latter is used as an oscillator. Steam from the boiler enters the cylinder and moves the piston to the end of its stroke. The movement of the piston operates the valve which in turn controls the flow of steam and starts the piston moving in the opposite direction.

The reciprocating motion of the piston corresponds to the alternating current obtained from the vacuum tube. The steam coming from the boiler corresponds to the flow of current from the "B" battery, and the valve on the engine performs a function analogous to that performed by the grid of the tube.

To see more clearly the action of an oscillating tube the action of the circuit shown in the accompanying diagram will be followed out.



The potential of the grid, or in other words, its charge, is at present zero, because it is connected through coil *G* to the negative end of the filament, which is considered the point of zero potential is vacuum tube work.

Coils *P* and *G* are closely coupled, so that they act like the primary and secondary of a transformer, but as long as there is either no current or a steady current in coil *P*, there can be no induced potential in coil *G*. Only arising or falling current in the plate circuit can induce a potential on coil *G* and thereby affect the grid.

When the switch *S* is closed, current starts to flow in coil *P*. This rising current induces a voltage in coil *G*, making the grid either positive or negative, depending on which way the coils are wound with respect to each other. If the induced potential on the grid is negative, one of the coils should have its connections reversed; this will make the charge induced on the grid positive for a rising plate current.

But the result of a positive charge on the grid is a further increase of plate current, and this in turn induces a further positive charge on the grid. So the increasing of the plate current continues until it reaches its maximum—that is, when all the electrons given off by the filament are reaching the plate as fast as they are emitted. This is known as the "saturation current," and a further positive charge on the grid cannot cause any further increase in plate current when this point is reached.

For a brief instant the plate current remains at this steady maximum value. But since a steady current in coil *P* causes no induced voltage on the grid, the latter will immediately loose its positive charge and drop back to zero potential. This causes a drop in plate current.

Now a falling current in coil *P* must act on coil *G* in the opposite manner to a rising current; it will induce a negative charge on the grid. This will cause a still further decrease, and the action continues until the plate current is practically nothing. This results in no further action on the grid, which now looses its negative charge, becoming zero again, and allowing the plate current to rise to its normal value.

This rise in plate current starts a repetition of the same actions as described above, and they will continue indefinitely. The grid potential will swing back and forth between a positive and a negative value, and the plate current will rise and fall in strength. A coil coupled to coil *P* and connected to a tuned circuit would have an alternating current induced in it.

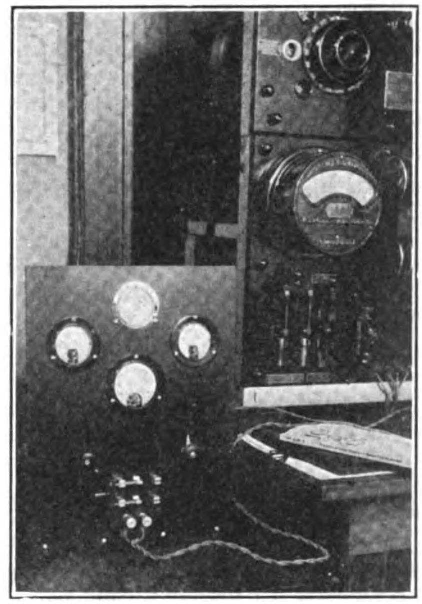
The frequency of the oscillations depends on the inductance and capacity of the circuits containing *P* and *G*. If *P* and *G* represent the primary and secondary of an audio-frequency amplifying transformer with iron core, the inductance has a very high value and the oscillations will take place about 200 to 2000 times per second, depending on the exact dimensions of the transformer. If a pair of telephones were connected in the plate circuit in series with coil *P*, a continuous howl would be heard.

In the case of the oscillator tube of a radiophone, these coils consist of a few turns each with air core, and the oscillations occur sometimes more than a million times in one second.

Other types of oscillating circuit are frequently used, but they depend on the same principle—a change in current in the plate circuit causes a change in grid potential, and this, in turn acts on the plate current.

RADIO STATION OF THE Y. M. C. A., DAYTON, OHIO

With the use of the 25 watt C. W. and radio telephone transmitter shown in the accompanying half-tone, the Y. M. C. A. Radio School at Dayton, Ohio, has succeeded in communicating with numerous stations in the bordering states. Stations at Troy, Ohio, report that the voice can be heard for two blocks when received



on an ordinary two step Magnavox amplifier and loud speaker.

It will be noted from the illustration that no switch points or dials are used for controls. An ordinary D. P. D. T. switch allows for wave length changes from 200 to 375 meters.

In addition to the C. W. transmitter there is the 500 cycle spark equipment. Communication is carried on with stations in Arizona and Texas by means of this transmitter.

The instructor of the school is Mr. Paul R. Fenner, formerly editor of "Pacific Radio News."

PITTSBURGH TO HAVE RADIO DAY

"Radio Day" will be a yearly event in Pittsburgh, Pa., under the auspices of the Radio Engineering Society. Westview Park will be the center of radio activity on August 24th.

There will be numerous radio contests, exhibitions and demonstrations. A number of the radio dealers in Pittsburgh will close their stores for the day.

RADIO RENDEZVOUS

The Radio Rendezvous is in process of organization. It will occupy an entire floor in the Grand Central Palace in the very heart of New York. The first radio theater and the first radio dance hall ever established will be the outstanding features of the Rendezvous. The theater will seat over a thousand people and the dance hall will accommodate over a thousand couples.

Helps for the Radio Builder

By H. Spencer Lewis
(Amorc Laboratories, San Francisco, Calif.)

THE following laboratory and shop notes will be of help to those who build their own or modify any of the standard sets. Theory and practice do not always agree in radio experimentation, and this is often responsible for the strange workings of a set after assembling, or for the failures experienced when certain results are strived for. The notes are disconnected and no attempt is made to make them constitute a logical system.

All hookups work better when assembled on an experimental table with even very loose association of parts, than when closed within a cabinet. Remember this when deciding to imprison a good working set.

An experimental table with handy aerial, ground and battery taps, plenty of room to arrange instruments far apart, is one of the best assets an experimenter can have.

Some of the finest working sets are located on such tables with the most unsystematic wiring you can imagine, but so perfectly are the parts balanced in their relation to each other that the owner would not permit a single wire or part to be moved a fraction of an inch.

Remember that amplifying transformers should be far apart or at right angles to each other.

In such tuning coils as employ a primary and secondary only, as a loose-coupler, vario-coupler, etc., bear in mind that the section of the secondary which is receiving the efficient induction from the primary, is that section which is outside the primary windings containing the aerial-ground stress. In other words a primary and secondary winding on the same coil, along side of each other, one-eighth of an inch apart, is the most efficient relation; not with secondary inside of the primary.

It is not true that in winding a rotor of a variometer the winding of the wire must be in the same direction as on the stator. Very efficient results are obtained sometimes (and only sometimes) by having the rotor wound in an opposite direction from the stator. In fact an excellent way is wind the first half of the rotor the same as the stator and the last half in the opposite direction.

After you have assembled your parts in a cabinet, try a temporary wiring hook-up before you solder connections. You may find many changes are necessary.

Place your grid leak where it will be easy to rub out any pencil marks and alter the leak. Experiment as much with the functioning of your grid leak as you do with your condensers and tubes and you will learn its importance.

No two detector tubes are alike in any sense and no two require the same grid leak values. When you change tubes, become acquainted with your set all over again. You have changed the most important link in the chain.

Every detector tube (even of the same make) requires slightly different plate voltage from the B battery, especially at critical points. You cannot change detector tubes on the same plate voltage as you do with amplifying tubes.

When all functionings of your parts in a set are balanced, your amplifying tubes should cause oscillations when the rheostat is moved, as with the detector tube.

Keep in mind when tuning, especially for distant signals or weak broadcasting, that the final adjustments and best tuning is done with your detector tube. The slightest movement of the detector rheostat will bring in or shut out a weak **signal.**

For the above reasons, the rheostat on the detector tube is a most important matter. Such rheostats as alter resistance gradually and not in steps, are the only rheostats to use.

Regarding detector rheostats keep this in mind also. If the rheostat is a resistance wire made into a coil about one-quarter of an inch in diameter, then every time you move the slider from one of the turns to another, you are adding or subtracting about three-quarters of an inch of resistance wire. How can fine tuning be done in such steps? Some rheostats have huge coils of wire, each turn representing over one and one-half inches of wire. They may be good for amplifying tubes but are not good for detectors.

A small bridging condenser, like a small fixed phone condenser, should be added by connecting one side to the lead that goes to the primary of the first amplifying transformer from the tickler, and connecting the other side to the lead

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"KFS" The World's Finest Coastal Radio Station

By Volney G. Mathison

Photography under supervision of the author by special permission of the Federal Telegraph Co.

"I DON'T know just what to put in here," remarked the editor, wrinkling his literate brow as he sat tapping thoughtfully with his pencil on a big white space in the "dummy," a hundred-page blank book pasted full of printed samples of articles and cuts and ads, for August RADIO. "I've got several really good things I might use, but I wish I could find something different—something with a regular snap to it, if you know what I mean."

"Stop right there," I cut in, "and I'll tell you what I'll do. I'll go and get you something I was planning to save for September—a feature on that big radio station out on the ocean beach, just south of Golden Gate Park."

The editor showed noticeable signs of interest.

"That station is a sort of mystery," he observed. "No one seems to know much about it——"

"That's because the folks that own it are too busy putting over real radio work to fool around with a lot of grandstand publicity guff," I explained. "The Federal Telegraph Company built the station in 1910, and installed the first arc transmitter that ever oscillated in America. The old twelve-kilowatt arc model that Valdemar Poulsen brought over from Denmark was set up in this station and experimented with for several years. You know, of course, that the Federal Telegraph Company bought Poulsen's patents and developed his invention from its crude state of those days to its present perfection; and it was the old Danish model in this Beach station here in San Francisco that showed our Navy chiefs what the arc could do and led to our national system of high-power CW stations which have brought Manila and Panama within hailing distance of Washington.

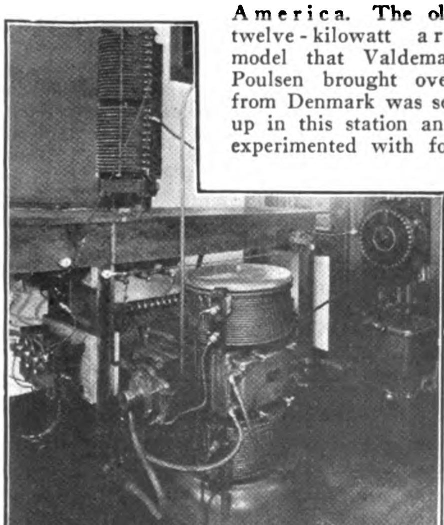
"Later on, when the company began building the Navy's 500-KW arc sets at their Palo Alto factory, they used this station as a unit in their duplex overland radio system, which they operated in competition with the land-wire companies."

"Didn't the Navy operate that Beach station for a while, also?" queried the editor. "I've heard they did."

"Yes—the Navy had it during the war; and after the war was over it was used by the government as the Pacific Coast terminal of the transcontinental chain of arc radio stations which are operated in connection with the air mail service.

"But at last the government turned the station back to the Federal Telegraph Company; and then the company set to work putting in brand-new up-to-the-minute apparatus and refitted the station for working exclusively with ships at sea. It is now a commercial coastal station, open for general public business; and it's setting some world's records for long-distance work."

Receiving-room. From left to right, arc-control panel, 1,700-3,000 meter CW receiver, and 600-meter spark receiver. The operator hears simultaneously 600-meter spark signals in one telephone receiver and 2,400-meter CW in the other.



A corner of transmitting room, showing arc converter and auxiliaries.

The editor seemed to have fully come to life now.

"There ought to be something good out there, if you can get it," he declared with enthusiasm. "Make some pictures 'n everything —and for the love of macaroni, work fast! The printing gang will raise particular Cain over delaying the work; so step on the gas——"

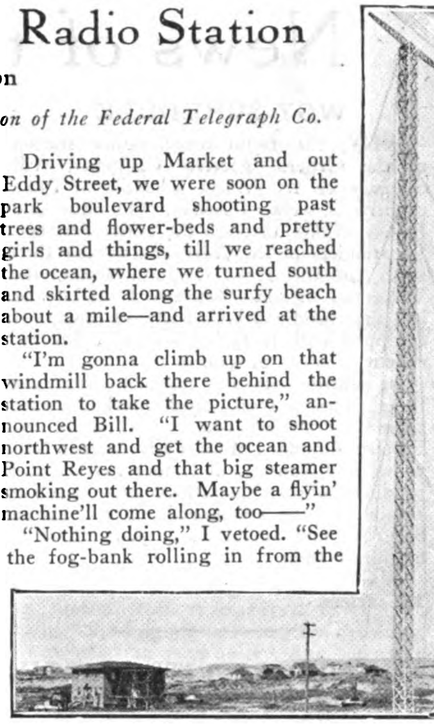
But I was already through the door, down Market Street, and into the Hobart Building, the headquarters of the Federal Telegraph Company. In his office on the eighth floor, I corralled the company's operating engineer, Mr. A. Y. Tuel, who has been in the radio game since 1899 and has seen the arc grow from the little Poulsen model to the thousand-kilowatt brute at Annapolis.

After a brief buzzing in his ear about permits and so forth, I dashed out again and down to Bill's studio. Bill, who is shaped like a camera tripod himself, has photographed everything from prize-winning billy-goats to fascinating young ladies in underwear for catalog cuts; so nothing can faize him.

Driving up Market and out Eddy Street, we were soon on the park boulevard shooting past trees and flower-beds and pretty girls and things, till we reached the ocean, where we turned south and skirted along the surfy beach about a mile—and arrived at the station.

"I'm gonna climb up on that windmill back there behind the station to take the picture," announced Bill. "I want to shoot northwest and get the ocean and Point Reyes and that big steamer smoking out there. Maybe a flyin' machine'll come along, too——"

"Nothing doing," I vetoed. "See the fog-bank rolling in from the westward, way out beyond that ship. Before you can get half-way up on the windmill that fog will be here; and then we'll get no picture at all. We'd better set up the camera down here on the beach and shoot against the sand hills back there. We'll come out and get a picture of the Pacific Ocean and a seagull some other day—no time now."



This San Francisco station, equipped with 10-KW spark and 20-KW arc transmitters and two mysterious receiving sets, is smashing all records for long-distance work with ships at sea.

"You ain't artistic a'tall," grumbled Bill. "There won't be a thing in th' picture but that darned wireless station!"

The picture taken, we picked up our photographic gear and approached the station.

"We'd better get those two loops mounted in that frame out there alongside the building," I suggested, as we came up the walk. "They look interesting."

"Not half so interestin' as that ocean view would be from the windmill," said Bill, disgruntled.

A 5,000 mile aerial! These loops are used for receiving. By means of gears and shafting the loops can be rotated by the operator at his desk (Kolster loop circuit).

As Bill was setting up the camera, I saw a man in his shirt-sleeves run out of the station; and as a precautionary measure, I climbed upon the loop frame.

"Hey—whadda-ya doing out here?" he demanded. "Come down from there."

"Still—lens open!" barked Bill; and then I climbed down.

"I've got an O. K. for photographing from

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News of the Broadcasting Stations

WGY SCHEDULE

WGY, the radio broadcasting station of the General Electric Company, will continue on its present schedule of three concerts a week, Tuesday, Thursday and Friday nights, through the entire summer. Vacationists in the Adirondacks, the Catskills, in the New England states, the Thousand Islands, Eastern Canada and in the middle west will be able, if equipped with receiving sets, to enjoy excellent musical programs.

In addition to the musical programs, three times a week, stock market quotations will be broadcast at 12:30 p. m., Eastern Standard time, daily, except Saturday and Sunday, and stock market and produce market quotations and baseball results will be announced nightly, except Saturday and Sunday, at 6 p. m., Eastern Standard time.

WGY broadcasts on a wavelength of 360 meters.

KDKA, EAST PITTSBURGH, PA., HEARD SOUTH OF THE EQUATOR

KDKA, the radiophone broadcasting station of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has established a new record. It has been heard south of the Equator, having been picked up by a ship operator while in the port of Iquique, Chile.

The news that KDKA had been heard so far south—Iquique is approximately 4,200 miles from East Pittsburgh, Pa.—was conveyed in a letter written the radio division of the Westinghouse Company by Mr. Frank F. Reb, chief operator of the *S. S. Santa Luisa*, who caught the signals.

It is quite possible that other call letters, which Mr. Reb states in his letter sounded like WFD, were WJZ, the call of the Westinghouse Radio Corporation station at Newark, N. J. In any event Mr. Reb heard two Westinghouse stations, KDKA and WJZ, the same night, both of which are located over 4,000 miles from Chile.

CLOSE ROCK RIDGE STATION

The Atlantic-Pacific Radio Supplies Company has closed the Rock Ridge broadcasting station at Oakland, California, and until plans have been completed for the opening of a station elsewhere the present Rock Ridge schedule will be maintained by various bay district stations. Programs will continue to be furnished by the Atlantic-Pacific Radio Supplies Co.

PROMOTING TRADE BY RADIO

Foreign trade news and dispatches by radiophone will be another means of informing the American business man of developments in foreign fields of industry and commerce if the innovation to be made by the United States Department of Commerce on July 11 and 12 is to be established as a permanent practice.

On those dates two large gatherings of business men will be held at Boston and Baltimore; the exposition of New England Shoe and Leather Association will take place at the former city, while an import and export exposition will be held in the latter. Arrangements have been made with the Navy Department to utilize the facilities of the Arlington radio station to send these meetings the latest cabled news of foreign markets and trade opportunities received from abroad by the Department of Commerce.

For the guidance of all receiving stations, the time of broadcasting will be 8 p. m. (Eastern standard time) on two days, July 11 and 12, the station Arlington (NAA), and the wavelength 2650 meters.

NEW BROADCASTING STATIONS LICENSED

W E A K—Julius B. Abercrombie, St. Joseph, Missouri.

D K Z R—Bellingham Publishing Co., Bellingham, Wash.

W E A I—Cornell University, Ithaca, N. Y.

K D Z I—Electric Supply Co., Wenatchee, Wash.

K D Z J—Excelsior Radio Co., Eugene, Ore.

K D Z M—E. A. Hollingworth, Centralia, Wash.

K D Z Q—William D. Pyle, Denver, Colo.

K D Z K—Nevada Machinery & Electric Co., Reno, Nevada.

K D Z P—Newbery Electric Corp., Los Angeles, Calif.

W E A G—Nichols-Hineline-Bassett, Edgewood, R. I.

W E A M—Borough of North Plainfield, New Jersey.

K D Z L—Rocky Mountain Radio Corp., Ogden, Utah.

K D Y X—Star Bulletin Publishing Co., Honolulu, T. H.

W E A H—Wichita Board of Trade & Landers Radio Co., Wichita, Kansas. (Also weather and markets).

Between May 20 and 27, the following limited commercial stations were licensed by the Radio Section of the Department of Commerce:

K D Z A—Arizona Daily Star, Tucson, Arizona.

W D A O—Automotive Electric Co., Dallas, Texas.

W D A L—Florida Times Union, Jacksonville, Florida.

W D A N—Glenwood Radio Corp., Shreveport, La.

W D A Q—Hartman-Riker Elec. and Mach. Co., Brownsville, Pa.

W D A R—Lit Bros., Philadelphia, Pa.

W D A P—Midwest Radio Central, Inc., Chicago, Illinois.

K D Z B—Frank E. Siefert, Bakersfield, Calif.

W D A M—Western Electric Co., New York, N. Y.

W D A T—Delta Electric Company, Worcester, Mass.

W D A W—Georgia Railway & Power Co., Atlanta, Ga.

W D A K—Hartford Courant, Hartford, Conn.

W D A U—Slocum & Kilburn, New Bedford, Mass.

W D A S—Samuel A. Waite, Worcester, Mass.

W D A X—First National Bank, Centerville, Iowa.

W D A Y—Kenneth M. Hance, Fargo, N. D.

K D Z D—W. R. Mitchell, Los Angeles, Calif.

W D A V—Muskogee Daily Phoenix, Muskogee, Okla.

K D Z E—The Rhodes Co., Seattle, Wash.

K D Z F—Automobile Club of Southern California, Los Angeles, Calif.

W E A C—Baines Electric Service Co., Terre Haute, Ind.

K D Z G—Cyrus Peirce & Co., San Francisco, Calif.

W E A A—Fallain & Lathrop, Flint, Mich.

K D Z H—Fresno Evening Herald, Fresno, Calif.

W E A D—Northwest Kansas Radio Supply Co., Atwood, Kansas.

W E A B—Standard Radio Equipment Co., Fort Dodge, Iowa.

SUPPLEMENTAL LIST OF COMMERCIAL BROADCASTING STATIONS LICENSED DURING WEEK ENDING JUNE 24.

W F A Y—Daniels Radio Supply Co., Independence, Kansas.

K F A C—Glendale Daily Press, Glendale, California.

W F A X—Arthur L. Kent, Binghampton, N. Y.

W F A U—Edwin C. Lewis, Inc., Boston, Mass.

W F A W—Miami Daily Metropolis, Miami, Florida.

W F A Z—South Carolina Radio Shop, Charleston, S. C.

W F A V—University of Nebraska, Lincoln, Nebraska.

W G A F—Goller Radio Service, Tulsa, Oklahoma.

W A A B—Valdemar Jensen, New Orleans, Lousiana.

K F A D—McArthur Bros. Mercantile Co., Phoenix, Arizona.

W G A C—Orpheum Radio Stores Co., Brooklyn, N Y.

W G A D—Spanish American School of Radio Telegraphy, Ensonada, P. R.

K F A E—State College of Washington, Pullman, Washington.

PORTO RICO AND SOUTH CAROLINA GET FIRST BROADCASTING STATIONS

The Department of Commerce issued 13 more broadcasting licenses during the week of June 21st to 26th, including one to a radio school in Porto Rico and one to a radio shop in Charleston, S. C., the first stations on the Island and in the State. This leaves but five states without one or more broadcasting stations.

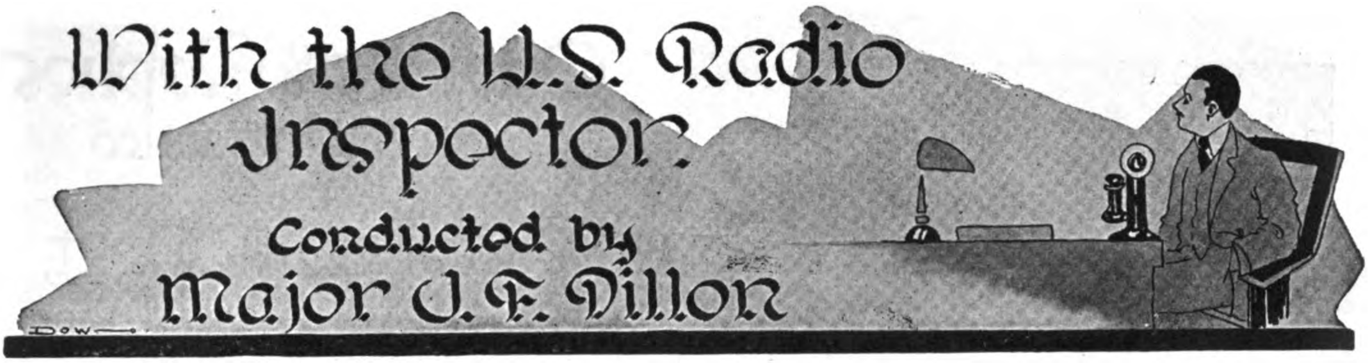
The thirteen new stations licensed, bring the total list of broadcasters in the United States and territories to 361.

WILL STUDY STATIC AND STORM CENTERS

Plans for the study of the well-known static, so troublesome to the radio fan, in connection with its possible relation to storm centers, have been announced by the Navy Department for the coming summer months. All radio compass stations, especially those along the southern and gulf coasts, will cooperate with the Weather Bureau in taking radio-compass bearings on all static disturbances three times daily, in an effort to determine whether or not there is any connection between the center of electrical disturbances and the centers of storms. If this is found to be the case, it is said that storms originating off the southeastern coast can be followed every foot of their progress up the gulf or coast and forecasts sent in advance of them to the sections of the country which they will touch. The new static schedule went into effect May 20th, at the Hampton Roads Air Station, reports on the quantity, intensity and bearing of atmospheric static being received by telegraph from Naval compass stations, at Hog Island, Virginia Beach, and Poyer's Hill daily at 8 a. m., noon and 4 p. m.

RADIO DEBATE

A radio debate staged by White and Boyer, of Washington, recently, is the latest thing reported in radio activities in their section. Messrs. C. J. Kephart and T. E. Rhodes of the National Law School took opposing sides on the popular subject of "Daylight Saving," and the fans were the judges. The result, WJH says, will be announced shortly.



EXAMINATION FOR RADIO INSPECTOR

The United States Civil Service Commission announces an open competitive examination for radio inspector on June 21 and July 19. Vacancies in the positions of radio inspector and assistant radio inspector in the Bureau of Navigation Department of Commerce, at $1,800 to $2,200 a year, and in positions requiring similar qualifications, at these or higher or lower salaries, will be filled from this examination. The duties of radio inspectors will be primarily to inspect the radio apparatus on steamships, to insure its compliance with the law, and to inspect shore stations. The inspectors may also be called upon to examine radio operators. The duties of radio inspectors require some office experience, therefore competitors should outline fully in their applications any office experience they may have had. The duties of assistant radio inspectors will be primarily the assisting of radio inspectors in the enforcement of the wireless communication laws. Assistant radio inspectors will be required to inspect the radio equipment on board vessels and in land stations, which involves the carrying of 30 or 40 pounds of testing and measuring instruments. The inspection work requires a knowledge of the installation and operation of the several types of radio installations, including the adjustment and tuning of transmitters and receivers.

Competitors will be examined in the following subjects, which will have the relative weights indicated:

1. Theoretical and practical questions in the construction, use, and adjustment of radio apparatus and auxiliaries, 50 lbs.
2. Education and experience in the line of the required duties, 50 lbs. Total, 100 lbs.

Applicants must have received a bachelor of science degree from a school of recognized standing, such educational training to have included a special course in radio or kindred science, or show that they are senior students in such institutions; or have had the equivalent of a high school education and at least two years' experience in special radio work, such as the manufacture, installation, or adjustment of commercial or governmental wireless apparatus. It is essential that applicants be wireless telegraph operators.

SPARK SETS FOR SALE

The Shipping Board is offering for sale 78 complete radio spark sets formerly used on its wooden war fleet, and estimated at a total valuation of $250,000. The sets are ½, 1 and 2 K.W. sets and include transmitters, batteries and generators. They are located at Norfolk, Virginia, where they may be examined by applying to B. N. Rock, 1025 Water Street, and purchased at private competitive sale.

BROADCAST INTERFERENCE

DEPARTMENT OF COMMERCE

NAVIGATION SERVICE

Office of Radio Inspector, Customhouse, San Francisco, Calif., June 15, 1922.

"RADIO" Editor, San Francisco, Calif.

Dear Sir:

It has repeatedly been brought to my attention that persons listening to the concerts, speeches and other matter broadcasted through the radio telephone stations complain of interference from amateur, commercial and government transmitting equipment, and a large proportion of those making the complaints appear to believe that broadcasting should be given the preference over all other classes of radio communication. However, there are several sides to this matter which the listeners either do not or cannot fully understand.

In the first place, general and restricted amateur stations are authorized to operate on 200 meters with a decrement of 0.2 or less. Commercial and government stations are authorized to operate on their respective wave lengths and their communication, being essential, cannot be interruped for the benefit of broadcast listeners or others of like character, which at best, must be regarded as non-essential communication.

Besides the essential character of the communication of these stations which is prescribed and protected by law, a great deal of reported interference by the broadcast listeners is due to their lack of skill in the adjustment of their apparatus and to the inability of their equipment to actually tune with any selectivity. It has come to my attention that a large number of the receivers now put on the market are designed with an idea to simplify them as much as possible and in many, though not all cases, these receivers are absolutely incapable of the sharp tuning necessary to reduce or eliminate the interference resulting from the operation of stations in the near vicinity. Broadcasting listeners in but very few cases are familiar with the Continental code and therefore are hardly capable of judging where the interference actually comes from and in many cases leaky power line insulators, noisy plate or filament batteries or other sources cause as much interference as a nearby transmitting station.

As stated above, the Government, commercial and amateur stations and their status defined by law and are just as much entitled to operate within the requirements of the law as any broadcasting stations and the listeners thereof are entitled to the use of the broadcast wave length.

(Signed) D. B. McGOWN,
Asst. Radio Inspector.

BUYERS ASK PERFORMANCE TESTS FOR RADIO RECEIVING SETS

Ever increasing public interest in radio has added to the troubles of department store buyers and others handling such equipment. Because of the rather technical problems involved, actual and prospective sellers of "ether wave" receiving devices say they are up against it in their efforts to satisfy the trade. Finding no information available to use in selecting good or rejecting bad apparatus and fearing the loss of established good will, appeals have been directed to the Bureau of Standards of the Department of Commerce to devise standard testing methods.

Performance test methods for immediate use by a commercial testing laboratory were recently agreed upon in an outline by representatives of the Bureau of Standards, the Electrical Testing laboratories of New York, and the National Retail Dry Goods Association. Suggestions regarding improvements on these methods, or new methods for testing the equipment submitted by the National Retail Dry Goods Association, will be subject to approval of the Bureau of Standards.

The tests outlined include examination as to the materials and workmanship of construction, the mechanical and electrical design, simplicity of adjustment, ruggedness, sensitivity, sharpness of tuning, wavelength range, and faithfulness of reproduction in radio telephone reception.

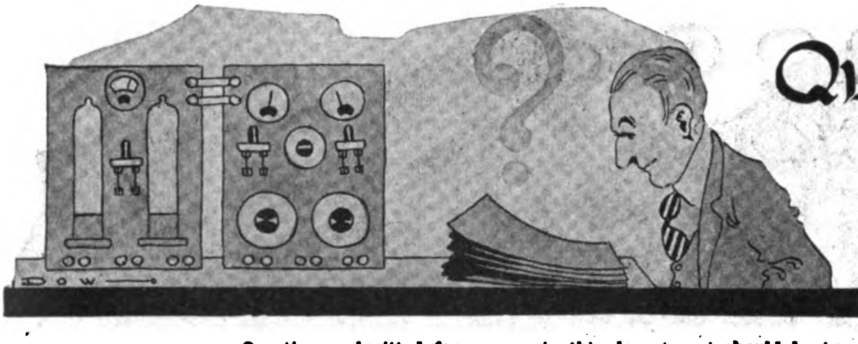
The Investigating Committee of the National Retail Dry Goods Association has suggested that from a commercial standpoint it would be of assistance to their members if responsible manufacturers would plainly mark their equipment, indicating the receiving radius of each instrument under every atmospheric condition. Owing to the large number of factors which enter into the determination of the range over which signals can be received with a given set, this is a very difficult problem, impossible to overcome at present by a brief statement or mark. Strength of signals required by a receiving operator, height and location of receiving antenna, power of transmitting station, its location with respect to other stations capable of causing interference as well as the sensitivity of the particular receiving set, must all be considered, according to Bureau of Standards experts.

Navy Asks for $3,828,460 for Radio

"I have estimated the cost of maintaining the Navy's 214 coastal stations for the fiscal year 1923 at $2,822,360, over $100,000, less than was appropriated last year," Admiral Robison stated, "and have asked Congress for that amount, as well as $1,006,100 for new radio and sound equipment and its maintenance on board ships." He continued, "it now looks as if the Congress would cut the total sum by about one million, necessitating great economies in our program."

"The operation of the shore stations pays a dividend into the Treasury more, by 100 per cent, than the amount of its expenses

Continued on page 80



Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

In the 10 watt self-rectifying set shown on page 15 of June RADIO, could I use an Acme 200 watt C. W. unit in place of the transformer shown? What changes would have to be made to use voice? What is the wavelength of an aerial 100 feet long, 75 feet high with 40 foot lead in? A. T. Chicago, Ill.

Yes, you could use the Acme transformer. This set was designed for telegraph only, and too many changes would have to be made to be practical in this particular case. Your antenna would have a fundamental wave length of approximately 210 meters.

Please publish the circuit of the U. S. Signal Corps amplifier "L-3."
J. E. C., New York City.

Information on this circuit is not available. Suggest that you write to Signal Officer, Fort Leavenworth, Kansas.

Can a Remler amplifier panel Type 333 be used in a radio frequency amplifier circuit? A. B. C., Spokane, Wash.

Change the present audio frequency transformer to one of the radio frequency variety and you can use it as a part of a radio frequency amplifier unit. Suggest that you use it as shown in Fig. 1.

Please publish a circuit for one stage of radio frequency amplification and detector, using the single circuit regenerative tuner described in March RADIO. What would be the correct number of turns for the primary and secondary of a radio frequency amplifying transformer.
A. L., Lodi, Calif.

The set shown in March RADIO was not designed for use with radio frequency amplification, where the regenerative feature is desired. You will have to use a two circuit tuner to get any kind of results with short wave radio frequency amplification. Would advise against your trying to construct a short wave radio frequency transformer, as good ones can be purchased for a small amount, and the results you might obtain from a home-made one would probably not warrant the expenditure of time or money. See the question page in July RADIO for a good two circuit tuner used in a radio frequency circuit.

Does shielding the back of a panel, in a receiver, cut down the signal strength? Will a long coil of iron wire with a copper wire running through it make a good aerial. If the aerial lead is made into a little pancake coil and two celluloid discs are put on both sides of it, will it cut out static?
R. L., Watsonville, Calif.

All three of your questions can be answered in one word; NO.

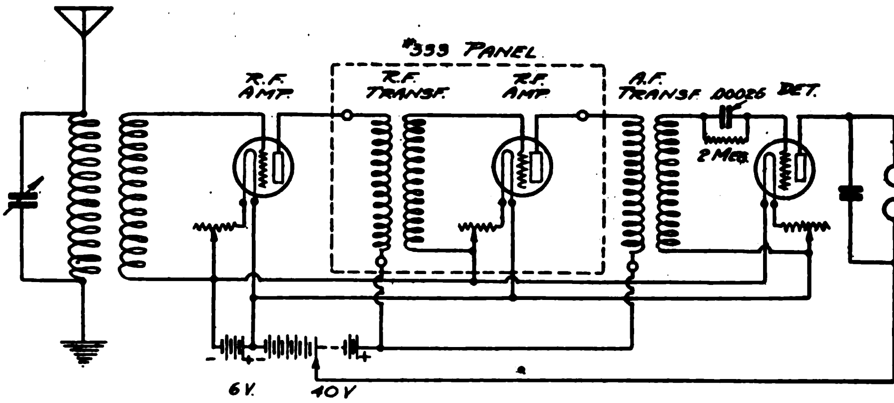


Fig. 1

Is it possible to charge an 80 volt storage battery from a 110 volt A. C. line? Could a chemical rectifier be used for this purpose, as well as for charging one as low as 40 volts?
C. W. P., Riverbank, Calif.

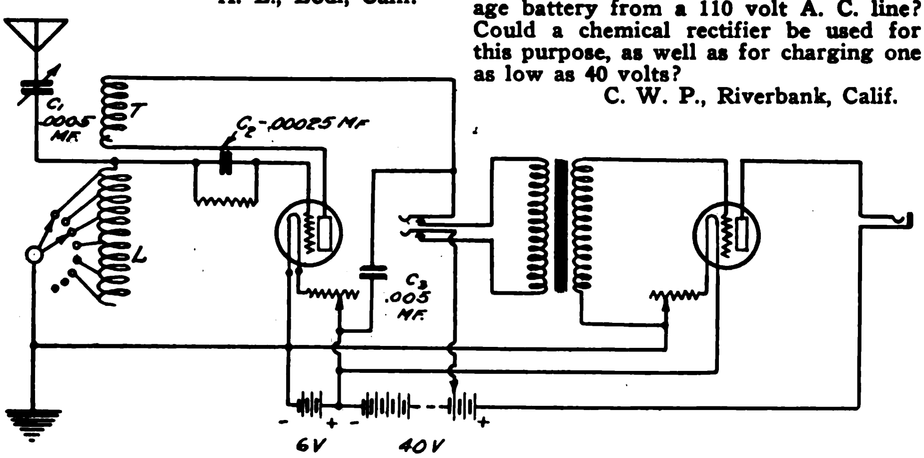


Fig. 2

Yes, a chemical or electrolytic rectifier, as it is called, could be used in either case. In order to prevent heating the jars of the rectifier, would suggest using four jars, two on each side of the wave. In the case of the 80 volt battery, place the battery in two units, of 40 volts each, in parallel across the charging voltage.

How can the necessary power in watts to supply a given number of 50 watt tubes be determined, when ordering a motor generator set for the plate supply?
W. R. T., Ottawa, Ill.

Fifty watt tubes have a normal plate current of 150 milliamperes at 1000 volts, so that two tubes, for example, would require a generator output of at least 300 milliamperes at 1000 volts, or in other words, an output of 300 watts. To provide for overload, the generator should be large enough to handle 400 to 500 milliamperes for a short time.

Kindly show how a one stage audio frequency amplifier may be added to the receiver described by D. B. McGown in March RADIO.
F. T. K., Springfield, Mass.

Fig. 2 shows the original receiver circuit, with one stage of amplification added.

What are the values of C-1, C-2, C-3 and L-1, in the circuit shown in Fig. 7 on Page 24 of June RADIO?
F. O., Cambridge, Mass.

While no accurate figures on this particular diagram are available, condensers of .001 M. F. capacity would appear to be the proper size. L-1 would have to be a coil of at least 100 turns 3 inches in diameter, in order to include the wavelength of 1,000 meters in its range, as mentioned in the article.

What is the wavelength of the Catalina Island public wireless telephone system, operated by the Pacific Telephone and Telegraph Company?
H. W. P., Santa Cruz, Calif.

The Long Beach station transmits on a wavelength of 450 meters, and the Avalon station operates on a wavelength of 320 meters.

Does the phrase "gas-content tube" refer merely to an incompletely evacuated tube, or does it indicate that an inert gas such as argon or nitrogen has been introduced into the bulb?
H. H. M., Oakland, Calif.

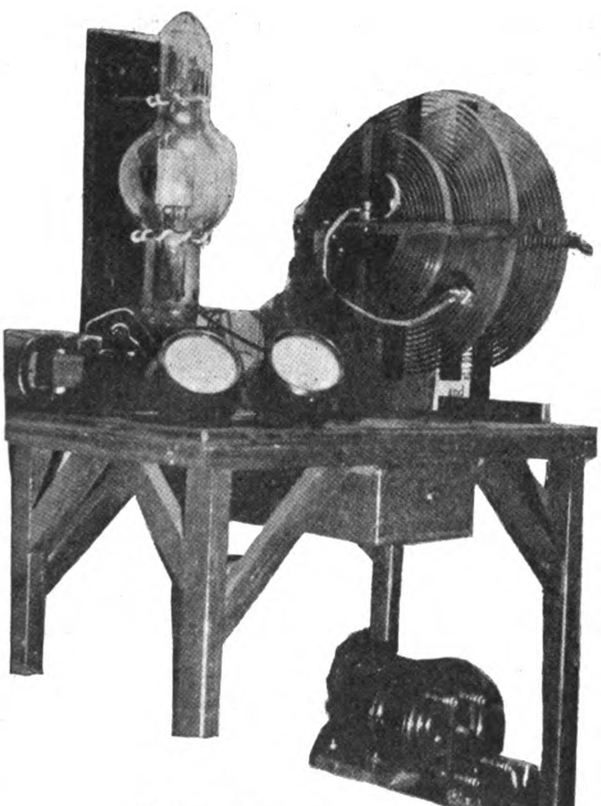
As a rule, a soft or "gas-content" detector tube is an incompletely evacuated tube, no inert gas being used.

Lawrence Mott, 6XAD, President. *G. G. Griffeth, 6AA, Secretary* *H. O. de la Montanya, 6AUL, Treasurer*

C. W. Station of 6EN, Los Angeles

One of the Most Efficient Tube Transmitters in the U. S.

MANY an ardent spark lover will relegate his equipment to the junk heap after reading what Mr. H. A. Duvall of Los Angeles expects to accomplish with his new ether wrecking, fifteen ampere radiation, tube transmitter. H. A. Duvall, better known on the air from East to West as 6EN, is constructing a powerful transmitter in an endeavor to outrival the famous 6KA.



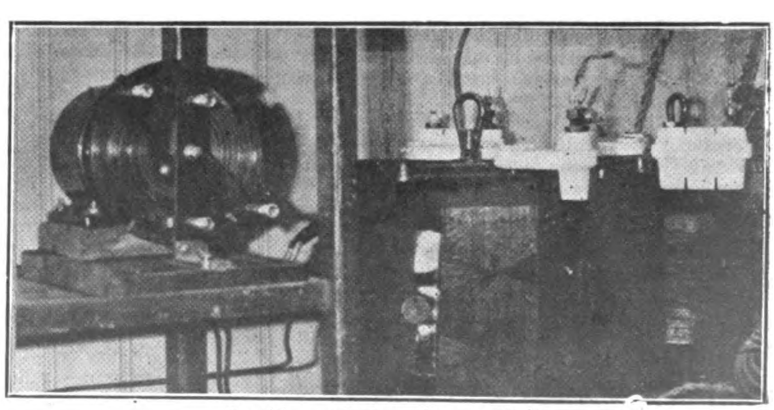
The Tube Transmitter

From the photo of his new transmitter you can see that it is of such proportions as to allow his radiated energy sufficient lee-way from one circuit to another without loss of efficiency. Note the size of the oscillation transformer, the heavy wiring and the monster tube. Power will be supplied from a synchronous rectifier. Two 2 K.W., 6,600 volt power transformers and a 6-inch bakelite disc, having two AC rings and two DC segments, driven by a two pole motor, constitute the rectifier. The Modified Hartley circuit, using inductive coupling, will be used. The by-pass condensers are of the Murdock moulded section type and another similar section is used for the grid condenser.

6EN states that it would be possible to filter the current of 2,700 volts for plate supply by using several sets of both R. F. and A. F. chokes and condensers of at least 3 mfd. capacity, but it is hard to get a condenser to hold up under the strain.

The antenna is by no means being overlooked. It consists of six wires, 56 feet long, suspended on 18-foot spreaders. A 10-inch cage lead-in is brought down to the operating room. The counterpoise ground is 48 feet long, 10 feet above the earth, and contains 20 wires. The mast is 90 feet high.

6EN operated one of the first CW stations in Southern California. His first transmitter was of the 5 watt size. 9XM of Madison, Wisconsin, reported hearing signals from this small set. Then came a 20 watt transmitter and also a 50 watter. Many records were made with the 50 watt equipment. Signals were reported from stations in every district. Communication was established with 4EZ one hour after "sun-up," a distance of nearly 3,000 miles. 2DN copies the signals on a detector and two stage audio frequency amplifier with his aerial disconnected from the set.



Rectifier and Transformer Unit

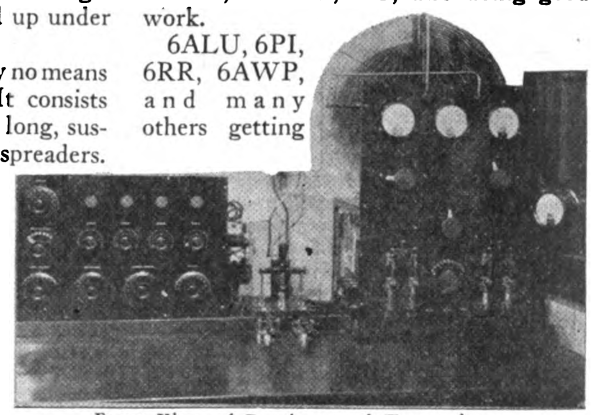
The following notes on CW development in Southern California have been supplied by Mr. Duvall:

6CU, 20 watt, AC, doing very good work.

6KY, 10 watt, DC, not on air at present but will have 100 watt CW set working soon.

6FT, 50 watt, AC, also doing good work.

6ALU, 6PI, 6RR, 6AWP, and many others getting out in fine shape. 6KA doing exceptionally good work with his big tube set and synchronous rectifier. 6ZG (6JD) has two 50 watters and a synchronous rectifier.



Front View of Receiver and Transmitter

Members of the C. W. Association and others interested in the Trans-Pacific Test are requested to forward suggestions and entries to the Secretary of the Association.

A New Radio Bill

Welcome, indeed, is the new radio bill from Washington. Numerous changes of importance for the regulation of radio communication are embodied in the accompanying bill which, after it is made a law by Congress, will benefit amateur and commercial radio development and operation.

In the Senate of the United States, April 20 (calender day, June 8), 1922.

Mr. Kellogg introduced the following bill; which was read twice and referred to the Committee on Interstate Commerce.

A BILL

To amend an Act to regulate radio communication, approved August 13, 1912, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of Congress entitled "An Act to regulate radio communication," approved August 13, 1912, is amended by striking out sections 1, 2 and 3 thereof and by inserting in lieu thereof the sections 1, 2 following:

"SECTION 1. A. That no person, company or corporation within the jurisdiction of the United States shall use or operate any apparatus for radio communication by telegraphy or telephony as a means of intercourse among the several States or with foreign nations, or upon any vessel of the United States engaged in interstate or foreign commerce, or for the transmission of radiograms or signals by telegraphy or telephony the effects of which extend beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby with the transmission or reception of messages or signals from beyond the jurisdiction of said State or Territory, except under and in accordance with a license in that behalf granted by the Secretary of Commerce and except as hereinafter authorized.

"B. That the Secretary of Commerce from time to time shall (a) classify licensed radio stations and the operators required therein; (b) prescribe the nature of the service to be rendered by each class of licensed station and assign bands of wave lengths thereto; (c) make, alter, and revoke regulations applicable to all licensed stations not inconsistent with this Act or any other Act of Congress or with the terms of any radio communication convention to which the United States is a party concerning the service to be rendered by each class of stations so established; the location of any station; the wave lengths to be used by any station; the kinds of instruments or apparatus in any station with respect to the external effect produced thereby; the power and the purity and sharpness of the waves of each station or the apparatus therein; the area to be served by any station and the times and methods of operating any station or the apparatus therein; (d) make such other regulations not inconsistent with law as he may deem necessary to prevent interference between all stations affected by this Act.

"C. That radio stations belonging to and operated by the United States and used exclusively for communications of official business, shall not be subject to the provisions of paragraphs A and B of this section. Every other station owned and operated by the United States shall be subject to the provisions of said paragraphs A and B of this section. All stations owned and operated by the United States and all other licensed stations on land or sea shall have special call letters designated by the Secretary of Commerce, and such stations and the designated call letters shall be included in the list of radio stations of the United States as published by the Department of Commerce. Radio stations owned and operated by the United States and used exclusively for the communication of official business shall use such wave lengths as shall be assigned to each by the President, and shall observe such regulations as the Secretary of Commerce may make to prevent undue interference with other radio stations and rights of others, except that upon proclamation by the President that there exists war or a threat of war or a state of public peril or disaster, or other emergency, the President may suspend for such time as he may see fit all such regulations of the Secretary of Commerce applicable to such stations owned and operated by the United States.

"D. That every such license shall provide that the President of the United States in time of war or public peril or disaster, may cause the closing of any station for radio communication and the removal therefrom of all radio apparatus, or may authorize the use or control of any such station or apparatus by any department of the Government upon just compensation to the owners.

"SEC. 2. A. That paragraph A of Section 1 of this Act shall not apply to persons sending radio messages or signals through a radio station belonging to and operated by the United States for the transmission exclusively of official business nor to persons sending such messages on a foreign ship while the same is within the jurisdiction of the United States.

"B. That the station license required hereby shall not be granted to, or after the granting thereof such license shall not in any manner, either voluntarily or involuntarily, be transferred to (a) any alien or the representative of any alien; (b) nor to any foreign government or the representative thereof; (c) nor to any company, corporation, or association organized under the laws of any foreign government; (d) nor to any company, corporation, or association of which any officer or director is an alien or of which more than one-fifth of the capital stock having voting power is owned or controlled by aliens or their representatives or by a foreign government or representative thereof, or by any company, corporation, or association organized under the laws of a foreign country.

"Such station license, the wave length or length authorized to be used by the licensee, and the rights therein granted shall not be transferred, assigned, or in any manner, either voluntarily or involuntarily, disposed of to any other person, company, or corporation without the consent in writing of the Secretary of Commerce.

"C. That the Secretary of Commerce, subject to the limitations of this Act, in his discretion, may grant to any applicant therefor a station license provided for in Sections 1 and 2 hereof, except that he may grant such license only to a station which is in the interest of the general public service.

"No license granted by the Secretary shall be for a longer term than 10 years, and any license granted may be revoked as hereinafter provided. Upon the expiration of any license the Secretary, in his discretion upon application therefor, may grant a renewal of such license for the same or for a lesser period of time.

"The Secretary of Commerce is hereby authorized to refuse a license to any person, company, or corporation, or any subsidiary thereof which, in the judgment of the Secretary, is monopolizing or seeking to monopolize radio communication, directly or indirectly, through the control of the manufacture or sale of radio apparatus or by any other means. The granting of a license shall not estop the United States from prosecuting such person, company, or corporation, for a violation of the law against monopolies or restraint of trade.

"D. That the Secretary of Commerce, may grant licenses only upon written application therefor addressed to him, which application shall set forth such facts as he by regulation may prescribe as to the citizenship, character, and financial, technical, and other ability of the applicant to operate the station; the ownership and location of the proposed station and of the stations with which it is proposed to communicate; the wave lengths and the power desired to be used; the hours of the day or other periods of time during which it is proposed to operate the station; the purposes for which the station is to be used, and such other information as he may require. Such application shall be signed by the applicant under oath or affirmation.

"E. That such station license as the Secretary of Commerce may grant shall be in general form as he may prescribe, but each license shall contain in addition to other provisions a statement of the following conditions to which such license shall be subject: (a) The ownership or management of the station or apparatus therein shall not be transferred in violation of this Act. There shall be no vested property right in the license issued for such station or in the bands of wave length authorized to be used therein, and neither the license nor any right granted thereunder shall be assigned or otherwise transferred in violation of the Act; (b) such licenses shall contain such other conditions not inconsistent with this Act, as the Secretary of Commerce may prescribe.

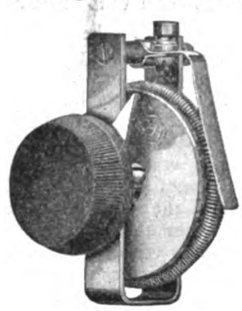
"F. That any station license granted by the Secretary of Commerce shall be revocable by him for failure to operate service substantially as proposed in the application and as set forth in the license, for violation of or failure to observe any of the restrictions and conditions of this Act or of any regulation of the Secretary of Commerce authorized by this Act or by the provisions of any international radio convention ratified or adhered to by the United States or any regulations thereunder, or whenever the Secretary of Commerce shall deem such revocation to be in the public interest; *Provided,* That no order of revocation shall take effect until thirty days' notice in writing thereof to the parties known by the Secretary to be interested in such license. Any person in interest, aggrieved by said order, may make written application to the Secretary at any time within said thirty days for a hearing upon such order and upon the filing of such written application said order of revocation shall stand suspended until the conclusion of the hearing herein directed. Notice in writing of said hearing shall be given by the Secretary to all the parties known to him to be interested in such license twenty days, prior to the time of said hearing. Said hearing shall be conducted under such rules and in such manner as the Secretary may prescribe. Upon the conclusion thereof the Secretary may affirm, modify, or revoke said orders of revocation.

Continued on page 72

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS

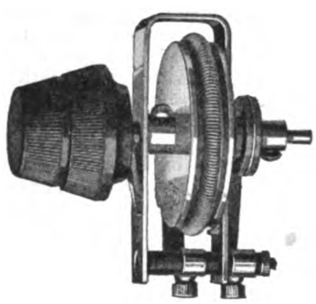
NEW RHEOSTATS

The Cutler-Hammer Company, well known in the electrical field, and more particularly as one of the largest manufacturers of rheo-



stats in the United States, has developed two new types of radio rheostats, illustrated herewith.

These rheostats differ from those now on the market insofar as contact-making device



and terminal connections are concerned. It will be noted from the illustrations that the entire resistance element revolves.

A stationary, flexible spring rests on the revolving element with sufficient pressure to insure proper contact at all times.

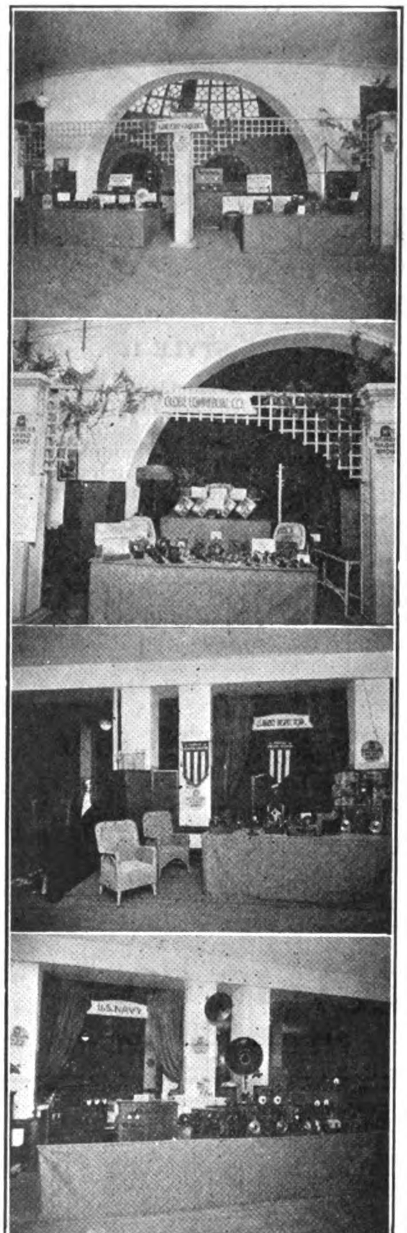
NEW L. A. CONCERN

The Superior Radio Company, managed by Mr. L. A. Kaplan, has established itself at 122 West Ann Street, Los Angeles, California.

The new company will manufacture various types of receiving equipment, including the new Type 101-A audion set, the smallest set of its kind on the market, the manufacturer claims.

The entire set is mounted in a cabinet, 10x8, arranged in such a manner as to accommodate the various instruments without loss of efficiency.

Mr. Kaplan, the designer and inventor of the new receiver, is a former A. E. F. Signal Corps man and has had extended experience as a commercial operator at the big Tuckerton and New Brunswick stations, as well as with the merchant marine.



San Francisco's third radio show was held in The Emporium during Shrine Week, June 12th to 17th. Credit for the success of the show is due to both Mr. Mauzy and Mr. Civilli, of The Emporium's radio department. Thirty-eight radio manufacturers, dealers and representatives displayed their wares. The major part of the third floor of this well known department store was devoted to booth space. Many thousands of visitors expressed their approval of the exhibits as well as the artistic arrangement of the booths, an idea of which can be had from the four accompanying views.

LARGE RADIO CONCERN EXPANDS

W. A. Layman, President of the Wagner Electric Manufacturing Company of St. Louis, Missouri, and C. B. Kennedy, President of the Colin B. Kennedy Company of San Francisco, announce that the two companies have joined in an arrangement to increase the facilities of the Kennedy Company in serving the radio field.

The Wagner Company has acquired a substantial interest in the Kennedy Company which in turn will take over the Wagner Company's St. Louis plant No. 2, a six-story building of about sixty thousand square feet of manufacturing space, the extensive equipment of which has been adapted to the manufacture of Kennedy radio apparatus.

The engineering personnel includes radio men of national reputation.

The engineering department is under the direction of Dr. Leonard F. Fuller, who is largely responsible for the development of the Poulsen arc transmitter as now used for world-wide communication in practically all the high power stations of the United States Navy. These stations have ratings up to one thousand kw. and include those located at Bordeaux, France, Annapolis, Md., San Diego, Cal., Pearl Harbor, Hawaii, Cavite, P. I., Sayville, N. Y., and El Cayey, Porto Rico.

The Kennedy Company will continue to operate at full capacity the manufacturing plant established at San Francisco, the output of which will be used to meet the requirements of the western trade and supplement production at St. Louis.

ST. LOUIS RADIO SHOW

The annual St. Louis Radio Show, given under the direction of the St. Louis Radio Association, in conjunction with the Missouri State Radio Association convention and the mid-west division A. R. R. L. convention, will be held during Fall Festival Week, October 4th to 7th, inclusive.

The Radio Corporation of America announces the opening of a district office of its sales department at 10 South La Salle street, as well as a warehouse at unit "B", Central Manufacturing building, Chicago, Ill. This new office is to provide a more central point for distributors and thus offer them convenient facilities for the handling of radio apparatus. The states to be served by this Chicago office are those west of Chicago.

NEW RADIO CATALOGS

Bulletin No. 312 of the Bristol Company, Waterbury, Connecticut, describes a new loud speaker, the "Audiophone," which operates without auxiliary magnetizing current.

The latest eight page Wilcox folder deals with new receiving sets and amplifiers.

THE RADIO SEARCHLIGHT

Continued from page 21

"As far back as 1895 and 1896 I had obtained some promising results with waves not more than a few inches long," said Marconi. He then proceeded to describe how he had returned to his original idea of using short waves.

Marconi stated that when very short waves are used, disturbances caused by static can be said to be almost non-existent and the only interference comes from the ignition apparatus of automobiles and motorboats. He predicted that "the day may come when we will have to screen our ignition systems or carry a government license for transmitting."

SENDING RADIO MESSAGES AROUND THE EARTH

"The question as to whether it would be possible to transmit radio signals right around the world is one which has always fascinated me," Marconi assured his hearers. He discovered that "there is something in the idea of the wireless waves traveling around the earth in various ways and reuniting at the Antipodes." Sometimes these radio waves traveling around the earth in different ways reinforce each other at the receiver and sometimes they interfere with each other. Tuning, however, overcomes the interference. The enormous station built by the Radio Corporation of America at Port Jefferson, Long Island, Marconi found, sent waves which "preferred to travel three-quarters of the way around the earth rather than come the shortest way round."

Static, a subject to which the research engineers of the Radio Corporation of America have devoted much study in this country, was also discussed by Marconi. He told his hearers that there are particularly violent types of static over Africa and South America, but that static did not interfere very seriously in transoceanic communication in temperate zones.

Senatore Marconi is visiting this country for the first time in a decade as guest of the Radio Corporation of America. He came in his yacht, the Elettra, a floating radio laboratory, to consult with American engineers on recent developments in this new science.

RADIO "MOVIES"

Radio Films Inc., is a California Corporation composed of the following individuals: John W. Boyle, President; Otto K. Oleson, Vice President; E. H. Kaufman, Treasurer.

The company is producing a series of two reel educational comedies based on the science of Radio, each picture will teach a direct lesson as to the construction and operation of various kinds of receiving and transmitting Radio apparatus. In the first three series the Hatton boys are featured in the main roles and the pictures in addition to portraying an interesting story with educational value, have on the end a question and answer department in which Radio Films show by actual operation and animation the answers to knotty problems that confront the embryo Radio fan. The Radio apparatus used in the pictures actually works.

Mr. Oleson, Vice President of the Company, is an electrical engineer and is manufacturing Radio apparatus and all instruments are constructed under his direct supervision.

In addition to two reel educational comedies, the company is producing five reel Radio dramatic features and "The Radio Supplement," a one reel straight educational on Radio, what to do and what not to do, the importance of lightning arresters, danger of erecting aerials near high voltage wires, etc., etc.

interest. The two sizes of Magnavox Radio (as here illustrated) meet every requirement of volume and range —from the home gathering to the largest public audience.

Any receiving set of good quality can be equipped with the Magnavox Radio, no alterations or adjustments being required. With either type of Magnavox Radio the hookup is as simple as connecting an ordinary head set.

Concert and dance music, speeches, songs, vaudeville and market reports, Magnavox Radio amplifies them all in tones of marvelous clarity and power.

The electrodynamic principle involved in its construction makes Magnavox Radio the most efficient converter of electrical energy into sound waves.

The Magnavox Radio and Magnavox Power Amplifier Model "C" may be had of good dealers everywhere.

THE MAGNAVOX CO.
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3-Stage

Radio

of every receiving set

R-3 Magnavox Radio

with 14-inch Horn

THIS instrument, constructed on the electro-dynamic principle, is ideal for use in homes, amateur stations, offices, etc. It is furnished with a special metal horn and requires one ampere field from your filament battery.

Price, $45.00

Model C Magnavox Power Amplifier

THE use of the Magnavox Power Amplifier insures getting the largest possible power input for the Magnavox Radio. Switching from stage to stage is made easy by master switches as illustrated. Can be used with any "B" battery voltage which the power tube may require for best amplification.

Best results are obtained with power tubes as these amplifiers are specially designed for their use.

With either type amplifier it is necessary to use an amplifying transformer between your receiving set and Magnavox Amplifier.

Handsomely finished in solid mahogany case.

2-Stage
AC-2-C, Price $80.00

3-Stage
AC-3-C, Price $110.00

CALLS HEARD

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY 6APO—R. G. ADAMS RADIO STATION, HUDSON & ESSEX AGENCY, FULLERTON, CALIF.

C. W.—5za, 6cu, 6en, 6jd, 6ka, 6xad, 6aif, 6alu, 6bes, 6aat, 6aau, 6awp, 6ec, 6aag, 6bjr.

Spark—6gt, 6iv, 6kc, 6km, 6lc, 6hy, 6od, 6om, 6ol, 6aak, 6aei, 6adl, 6afn, 6agf, 6ahq, 6aib, 6avr, 6atf, 6aqp, 6bik, 6alo, 6ark, and many others too numerous to mention.

BY RADIO 6ABU—OAKLAND, CALIF.

Spark—6eb, 6ef, (6cc), (6gr), (6gf), (6gt), (6gp), 6hf, 6hy, (6iv), 6kc, (6ke), (6mh), (6od). (6ol), (6ou), (6pr), (pj), (6uo). 6xad, (6aak), (6ala), (6ald), (6acy), (6atf), (6ajh), (6ajr), 6sa, (6ahp), (6avr), (6up), 6avd, 6aau, (6acr), (6bbv). 6bbc, (6bmp), (6za), (6zu), 6zr, 6zam, 6zz, (7tj), 7vo, 7vx, 7bk, (7xh), (7yj), (cl8), (9bd). C.W.—(6cu), 6ka, 6jd, 6ea, 6bak, 6bes, 6zf, 6zz. All those having 6abu please Q. S. L.

BY 6BQL—ARTHUR M. SNELL, 575 TWENTY-FIRST AVENUE, SAN FRANCISCO, CAL.

Spark—6cc, 6dd, 6ea, 6eb, 6gt, 6iv, 6kc, 6ke, 6lc, 6mh, od, 6ol, 6up, 6zj, 6aak, 6abw, 6acv, 6acy, 6ahf, 6ajh, 6ajr, 6akl, 6ald, 6amw, 6apy, 6aqx, 6ars, 6asc, 6atf, 6avr, 6baj, 6bbd, 7bh, 7ga, 7to, 7tj, 7ya, cl8, 9bd.

C. W.—6cu, 6ea, 6ec, 6ef, 6ek, 6en, 6fh, 6ft, 6gy, 6jd, 6ka, 6ku, 6pi, 6zb, 6zf, 6zac, 6aat, 6aeh, 6aiu, 6akl, 6alu, 6aqa, 6awp, 6bbc, 6bcd, 6bmd, 6bqc, 6bqq, 6bqt, 6xad, 7na, 7sc, 7xg, 9amb. 9zaf.

BY 9BD,—BARRON HOTEL, VANCOUVER, B. C.

Spark—(6acr), (6ala), (6ark), (6aqu), (6ajr), (6agx), 6avb, 6aen, 6arb, 6abh, 6gr, (6ib), (6hc), (6hp), (6tu), 6awh, 6ex, (6tu), 6vx, 6ic, 6cc, (7bk), 7ack, 7aax, (7ey), (7fr), (7ge), (7hi), 7iw, 7iy, 7jm, 7jw, 7fq, 7kj, 7mu, 7ot, (7oh), 7qu, 7tj, (7vz), 7ve, 7xa, (7zj), (cl8).

C.W.—(5bq), 6asj, 6ang, (6bhk), 6bir, 6aat, (6awt), 6cu, 6jd, 6en, 6ft, (6ka), 6gf, 6gr, 6nx, 6gx, 6ti, (6zi), (7bs), 7ey, (7aw), (7nw), (7na), (7qw), 7qu, (7sc), (7ex), 7ack, (bt3).

U. S. Eastern amateurs pse QSL to W. D. Wood, Barron Hotel, Vancouver, B. C., upon hearing my C.W. or SPK.

BY 6EB—"SPK" AND "C.W."

C.W.—5za, 6gf, 6gx, 6gy, 6ku, 6lv, 6ni, (6ti), (6zi), (6zx), (6arb), 6asj, (6awt), (6bcd), 6bhk, 6bmu, (6bsa), 6xaf, 7na, 7nf, 9wd, 9amb.

Spark—5xd, (6as), 6cc, (6ex), (6gr), (6gy), 6hc, (6hp), 6ib, (6ic), 6im, 6km, 6lk, 6ng, (6qr), 6qy, 6te, (6tu), 6vk, 6vx, 6wg, 6xh, 6zi, 6zq, 6aau, 6amk, 6ark, 6avb, (6bak), 6bgl, 6bip, 6bms, 7bh, 7mf, 7ot, 7ya.

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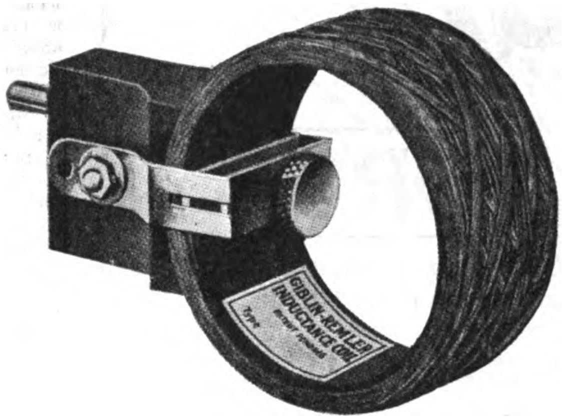
The Western Radio Electric Co. employ only men who are experienced in the radio field.

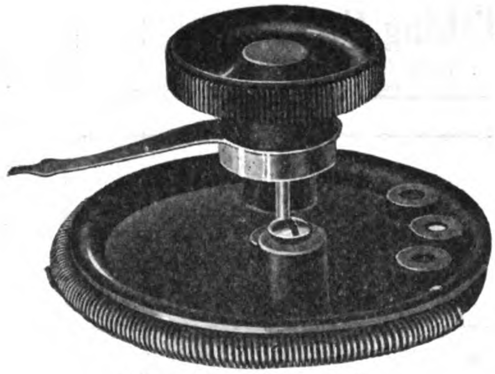
Write us for reliable engineering information.

Try us for real radio service.

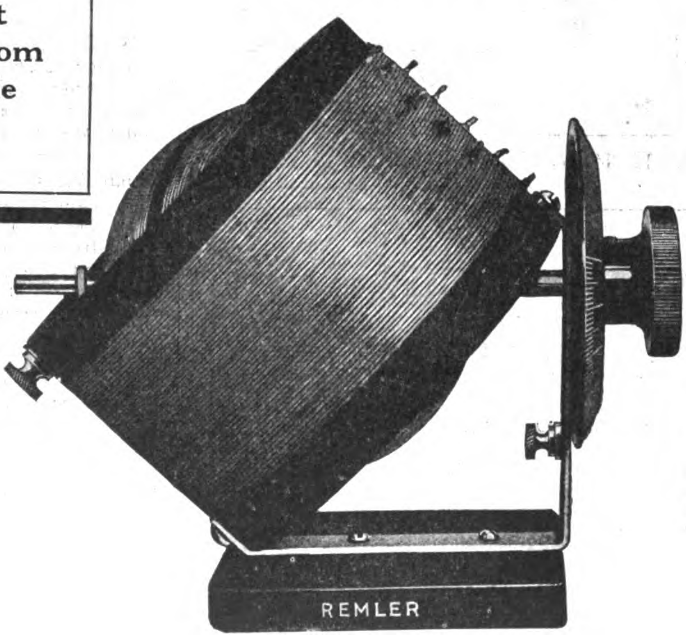
We solicit inquiries from responsible dealers.



Remler-Giblin Coil



Remler Rheostat



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1200 Franklin St., Oakland, Calif.

THE CLASSIFIED ADS ON PAGE 94 WILL INTEREST YOU!

Book Review

How to Make and Operate a Radiophone Receiver, by J. A. Dowie, I. R. E. This book, size 5x7, contains general information on various types of receiving equipment, and simplified radio formulæ. The purpose of the book, the author states, is to aid the young radio experimenter in building and operating an inexpensive radiophone receiver. There are fifteen illustrations, various formulæ and a dictionary of the common radio terms. Bound in heavy paper. Price, seventy-five cents.

Elements of Radio Telephony by William C. Ballard, Jr., M. E. 132 pages of popular radio data. The purpose of the book is to present in simplified form a brief discussion of what happens when messages are sent and received by radio—also a simplified description of the apparatus required to produce these effects.

The book is published by the McGraw-Hill Company. Beautifully bound. Printed on enameled paper. Price, $1.50.

"The Radio Library," volume 1, published by the Radio Electric Company of Pittsburgh, Pa., is a 24 page pamphlet on radio receiving methods and devices. The authors are J. W. H. Weir and Parker E. Wiggin. It will be of assistance to the new "American Radioist."

"The Complete Radio Book," by Raymond Francis Yates and Louis Gerard Pacent, is the work of two experts in the radio field who have taken much care in collecting, organizing and presenting useful material in a 330 page book.

The book is illustrated with diagrams, photographs and maps. It is heavily bound, size 5x7, price $2.00 per copy. Published by the Century Company, New York City, N. Y.

"Radio Installation Rules" is the title of a pamphlet issued by the Board of five Underwriters of the Pacific, 914 Merchants Exchange building, San Francisco. Copies will be mailed upon request.

Radio Enters the Home, a 128-page combined catalogue and instruction book, issued by the Radio Corporation of America. The book is divided into four parts. Part I deals with broadcasting, fundamentals of radio reception, classes of apparatus, and general information on receiving sets.

Part II deals with accessories, such as vacuum tubes, batteries, and charging equipment. Part III extensively covers transmitting equipment, numerous circuits, and much data on rectification. Part IV contains general information for the amateur, technical radio terms, National Electric Code radio rules, radio laws and regulations, international abbreviations, a log sheet for stations heard, and a half dozen open pages for various memoranda that the user of the book may "jot down."

This is perhaps one of the most valuable publications on the market. Size 8x11. Bound in heavy paper. Price 35 cents.

Radio for the Amateur, by A. H. Packer and R. R. Haugh. This book deals with the construction and operation of radio receiving sets. It contains 208 pages of non-technical, understandable material, and is well illustrated with 72 diagrams. Published by Goodheart-Willcox Company, Inc., 2009 So. Michigan Avenue, Chicago. Bound in board, size 5x7½. Price $1.50.

"It's a Super-Rheostat for Your Radio Set"

No *Wire* Rheostat can produce the amazing results of the Bradleystat

If you want the finest results from your radio set, install a Bradleystat in each vacuum tube circuit. Our customers have found that by using Bradleystats, instead of wire rheostats, they get

1. ***Clearest and Loudest Reproduction,*** because the Bradleystat stepless control locates the precise filament current for greatest amplification or detection.
2. ***Quickest and Easiest Tuning,*** because one knob, without vernier, does the work. There are no interfering noises, no loss of time, and no worry as with complex wire rheostats.
3. ***Greatest Receiving Range,*** because noiseless control detects weak radiophone waves and by locating exact filament current, amplifies the waves to fullest extent.

That is why the Bradleystat is known among radio experts as the Super-rheostat. Don't hamper your vacuum tubes with inadequate wire rheostats. Use the Bradleystat.

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PERFECT FILAMENT CONTROL

Two columns of graphite discs (not loose carbon grains) provide the delicate control so vital and essential for vacuum tubes in radio sets.

A single adjusting screw gradually applies or removes pressure from the discs, thereby changing the filament current in such a smooth and stepless manner that you quickly find the loudest and clearest reproducing point of your tube.

The Bradleystat is so simple and efficient that thousands of radio enthusiasts are using them to the exclusion of all wire rheostats. Twenty years of experience and research have made such perfection possible.

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Please send me latest bulletin on Bradleystat Perfect Filament Control, explaining how it will improve my radio set.

....

....

A SOFT GRAFT

Continued from page 25

graft on th' fence-wires over ter Sally Spilker's house; an' when old Ezekiel Gibbs come an' set up on th' fence ter gas with th' hands plowin', like he allus does, Margy put thet sputterin' juice-squirter onto th' wires, an' old Ezekiel keeled over into th' ditch, with a big hole burnt clean through his best pants. He allows he kin feel th' fire flyin' up an' down his back-bone yet—an' I had ter pay fer th' pants. We kept puttin' up with it, anyhow, hopin' fer th' best;—an' then whut do ye s'pose we found out?

" 'Search me,' I answers, puzzled.

" 'Why, ding bust it, sh'd read a fool yarn in them wireless magazines about a gal named Lizzie Pratt, or suthin' like that, who uster talk ter her feller by wireless—an' here Margy is doin' th' same durned thing with thet gosh-danged Eusebius! Seems like some good-fer-nothin' young upstart up ter Stonefield is lettin' Eusebius use his outfit—or I guess th' kid's runnin' it fer him, 'cause thet dum-headed fool couldn't wind up a kitchen clock 'thout bustin' it! But that Margy—

" 'That's just like 'em, ' sympathizes. 'Did you tear down her outfit?'

" 'Crickety, no!' Timothy exclaims. ' 'Twouldn't be safe ter handle a lively, high-strung young gal like Margy that way. She might go an' do suthin' desprit. But now, I was jist a'thinkin' if we could git a reg'lar wireless feller like you ter come an' stay awhile with us, 'thout lettin' on ter Margy who ye be, ye could likely cure her. Ye could slip around an' keep her wireless contraption bunged-up, so's she'd hev a peck o' trouble with it;—then mebbe after while she'd git sick o' th' durned thing an' give it up. Now, if ye'll come—

" 'No—I don't think I want that kind of a job,' I tells him, promptly. 'I'd be sure to land in all kinds of cussed complications—like I always do.'

" 'But we kin say ye're a friend o' my nephew Cornelius in Chicaggy,' replies Timothy, eager-like. 'There won't be no complicated bizness about it. Ye jist hev ter try t' cure up Margy's danged wireless fever—an' I'll give ye a hundred dollars, if ye kin do it or no. Ye kin cancel ye're ticket at Kansas City, an' I'll pay th' diffrunce on a new one from Pilcher's Corners to thet Indian camp whur ye're goin' ter.

" 'No, I don't want'a fool with it,' I tells him. 'Plenty trouble comes my way without me huntin' for it.'

" ''Tain't goin' ter be no trouble', insists old Timothy. 'It'll be jist like a vacation fer ye. Th' missis'll have reg'lar Sunday dinner fer ye every day, with fried chicken an' apple dumplin's an' rhubarb pie, an' ye kin hev a fine colt ter ride, an' there's a crik ter go fishin'

Continued on page 48

Ask to See This New Radio "B" Battery

Ask also to see the Willard All - Rubber Radio "A" Battery—a 6-volt battery built especially for Radio reception.

Ask your dealer or your nearest Willard Service Station to show you this specially designed 24-volt rechargeable Radio "B" Battery. Note the leak-proof glass jars—hard rubber screw-on covers—special Radio "B" plates—Threaded Rubber Insulation.

These features considered, it is not surprising that the Willard Radio "B" Battery has such a *remarkable ability to hold its voltage,* or that it is so noise-free and trouble-proof.

WILLARD STORAGE BATTERY COMPANY, CLEVELAND, OHIO
Made in Canada by the Willard Storage Battery Company of Canada, Limited, Toronto, Ontario

Willard THREADED RUBBER BATTERY

Continued from page 46

in—an', by gum, ye kin use th' fambly Ford any time ye want ter!

"'Well, I don't know,' I says. 'I had a vacation once—

"'I'll give ye a hundred an' fifty dollars—pay ye right now!' breaks in Timothy, hopeful-like. I hev ter do suthin' ter cure up Margy.

"I was kind'a weakenin'; but then I feels my old reliable hunch comin' on, an' my mind is made up. 'No,' I tells him. 'Absolutely no. Nothin' doin'.'

"'By gum, that's too darned bad!' says Timothy, real disappointed-like. 'But hev a little nip, anyhow,'—an' he produces his flask.

"I takes the nip, an' another one, an' the flask is dry; but Timothy breaks out a second;—an' then I gets to feelin' hard-boiled an' foolish, an' th' next thing I clearly knows, I've got off my train at Kansas City an' am sittin' in a dusty day-coach on a bangety-clatter old milk-can railroad, with Timothy's hundred an' fifty in my pocket, an' chuck full'a determination to bust up Margy's wireless fever, if I have to break my neck.

"LATE in the afternoon, th' train stops out in a field, alongside a post with th' name *'Pilcher's Corners'* painted on it, an' we disembarks. A hired man is waitin' fer us with th' lizzie; in which we jounces up th' dusty road a couple miles to Timothy's farm. It was a fine-lookin' farm, too, though I mostly observed the small aerial which was strung between the house and the nearest barn, with th' lead-in runnin' down into a wood-shed about half-way between.

"As we turn into the drive-way, I notices a big white-an'-yellow cat sittin' up on the top of a telephone-pole alongside the road.

"'By jingo, that looks like our tomcat, Perseus,' says Timothy, puzzled-like. 'Wonder what—he stops talkin' all of a sudden, an' I see he's starin' at a big bay horse who is gallopin' round an' round in a circle out behind th' barn, snortin' an' kickin' up his heels like a young colt.

"'What in tarnation's got into old Independence ter make him go gallivantin' round like that!' mutters Timothy. 'Crickety — what's happened 'round here, anyhow!'

"The lizzie stops alongside the house; an' a motherly-lookin' old missis, with good ample beam, breezes out to meet us.

"'My land, it's about time you was gittin' home!' she says, mighty relieved, after she'd smacked old Timothy, an' I'd been introduced as a city-weary side-kicker of Cousin Cornelius; 'that girl Margy an' her wireless is jist got me worried clear to death. Three days ago somebody took that awful ground-

Continued on page 50

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wire of hern off the pump again, an' Perseus got hisself tangled up in it, an' it burnt most all his fur off! He runned up the telegraft pole out on the road, an' he's bin up there ever since. Then this mornin' one of her antenner wires broke an' fell down on old Independence,—an' now he thinks he's a merry-go-round or a jumpin'-jack, heaven knows which. 'Nother part of the wire hit poor Jerry Mooly, who was sleepin' out in the sun, bein' it was Sunday, an' he skedaddled under the cow-barn, an' won't come out no more. I even offered him a lemon-custard pie; but he won't budge. He says he's kilt.'

" 'Bout time ter do suthin', by gum!' Timothy mutters under his breath, lookin' at me.

" 'Just then I hears a laugh an' a patter, an about five foot four inches of smiles an' curls comes skippin' up an' throws her pretty arms around old Timothy's neck.

" 'Oh, I'm so glad you're back, Pa—did you bring my new audions?" she gurgles, smackin' him first on one cheek an' then on the other. She was a mixture of sweetness an' mischief all through; she showed it in her black eyes an' her thick heavy curls;—a little sweety, an' a little devil. No wonder old Timothy didn't smash up her wireless—how could he with a girl like that?

" 'When she gets through huggin' him, he introduces me; an' before I know what's comin' off, she puts her arms round my neck an' goes through the same performance as she had with Timothy. I begins to think maybe I havn't landed such a bad job after all —an' I feels sure I haven't when we have supper—roast duck an' jellies an' layer-cake, an' all the rest. It made me feel sad to think of all th' raw fish an' burnt cow-hide I'd eat in my time on ship-board, when there was grub like this in the world.

"AFTER supper Margy drags me off to the wood-shed to see her wireless outfit. She had the gear for a first-class one-kilowatt set, but it was all lashed together in a tangle of wires like a pile of boulders overgrown with ivy. The shed was littered up with pieces of telephones, an' clocks, an' phonographs, an' tools scattered all over —a regular dump.

"Of course I'm s'posed to know nothin' about wireless; so Margy hands me a spiel that for humbug an' hot-air would make the worst stuff I ever slipped to green steamer-passengers sound about as original an' clever as the jokes a ten-cent variety-show actor hands out to the crowd on a rainy Monday night.

" 'I've been reading some stories about a wireless operator by the name

Continued on page 52

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of Samuel Jones,' she tells me, pickin' up a familiar-lookin' magazine. 'He's just the awfullest boob, and he does the craziest things. You ought to read about him.

"I politely declines.

" 'Pa says my poor Eusebius boy is a dunderhead,' she remarks, with a sigh; 'but he's smart as a whip compared to this silly Samuel Jones that puts his stories in the magazine.'

"Durin' the next few days Margy keeps me pretty busy. First she takes me around to be exhibited to all th' neighbors; then she drags me off in the lizzie to a Sunday-school picnic; next I have to go out an' pick blackberries with her—an' while I got all scratched up on briars an' bit up by ants, I stood for it just the same, because I figured that she had to have some one to take her mind off that donkey of a Eusebius, an' I might as well be the goat as anybody.

" 'For the first week, I didn't try to tamper with her wireless set; but one night when she is monkeyin' around in the wood-shed, I reads on the spark-gap a kind of a half-coded spoony message, which I figures must be for that confounded clodhopper, Eusebius; an' right then I resolves it's time for action. Of course I wasn't jealous or anything—an' you don't need to smile that way neither,—I had to do what old Timothy had hired me for.

" 'Pretty well after midnight, that same night, when everybody was asleep, I puts on my clothes; then slips downstairs, an' out into the yard. It was a queer night, even for Kansas. A strong dry wind was sweepin' in from the south, swishin' through the sycamore trees around the house; an' the low barns an' the fields were splotched with flyin' streaks of pale moonlight, for the sky was full of rollin' clouds, through which the moon was scootin' like she was scared somethin' was after her. It was one of them nights like you read about in a story-book, when there's goin' to be a murder.

"In th' wood-shed, it was pitchy dark. Th' first thing inside the door, I steps on Perseus, the family cat, who lets out a yowl that makes me jump half out of my shirt. Somehow I have a hunch that somethin' is wrong. Fumblin' around in th' dark, I can't see nothin'; but I feel as if there is some darned thing slinkin' around in th' wood-shed that doesn't belong there. Every time the wind moans outside, it makes me shiver, an' I get so nervous an' jumpy that I begin to wonder if all th' fine grub I've been stuffin' myself on has give me a sleep-walkin' nightmare, my system not bein' used to anything richer than moldy sea-bread an' soggy spuds; so I pinches myself hard to make sure I'm awake, which I am.

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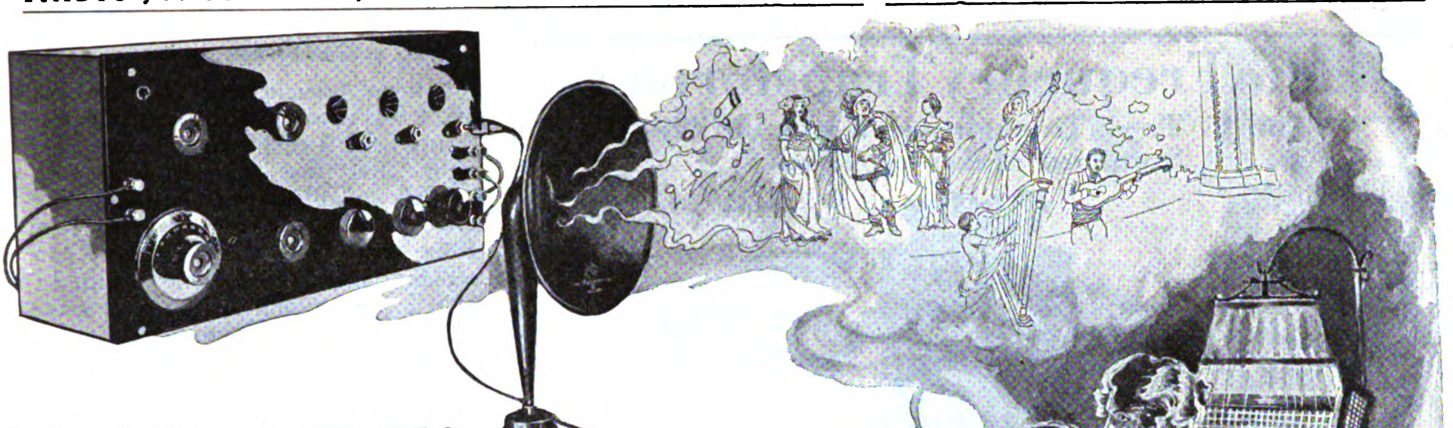

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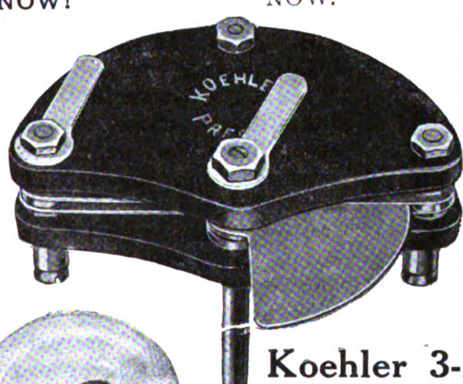
This Fall and Christmas

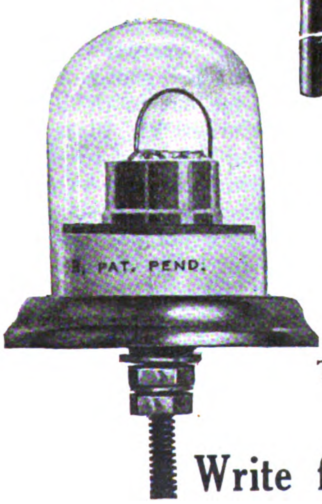
Radio business is going to be larger and more profitable this fall than ever before. New developments will open up a vast potential market and sharpen the interests of all radio fans. The Christmas trade will be tremendous.

How much of this business you will get depends a good deal upon how **farsighted** you are. Remember the hectic months of the first wave of radio popularity and be ready this time with complete stocks. Don't wait till the last minute. Map out your policy, plan your operations and **place your order NOW!**

The services of the Wholesale Radio Equipment Co. will help you do the best possible business. Whatever your need, we have plenty always in stock—products of 16 or more of the most important nationally known manufacturers. Deliveries to meet every situation. Let's get together NOW.

Everything Comes to the Dealer Who Looks Ahead and Prepares—Profit by the Past and Order Now!





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Heavy aluminum plates, thick Bakelite ends, other parts of brass, nickle-plated. .000075 Mfd. capacity. Other sizes. Accurately manufactured and carefully tested. Koehler Condensers have made good.

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Write for Attractive Discounts on Our Complete Line

Wholesale Radio Equipment Co.

24 WILLIAM STREET, NEWARK, N. J.

Continued from page 52

"Havin' brought some matches with me, I was about to strike one; but just then I hears a clicky, rasping noise, and right after that a groan—a gaspin', horrible groan like somebody stabbed an' bleedin' to death—right at my feet! Froze stiff as a' icicle an' my hair standin' on end, I holds my breath an' hugs myself, wishin' to heaven I could remember where th' blasted door was—which I couldn't.

"Finally I manage to get up against the wall, where I stand tense as a steel spring, and listen. Everything is still as death now, except for the whining of the wind outside, and a low, gurglin' sound, like the gushin' of blood. Just as I am makin' up my mind to start creepin' along the wall and try to find th' door, all of a sudden there begins right in the same place beside me a terrible, blood-curdlin' scream, '*Yar-r-r-r-oo-oo-oo-o-o-o!*—half howl an' half shriek—that sends me flyin' straight across th' wood-shed, leavin' behind my suspenders an' half of my pants, which got caught on a nail in th' wall. Makin' a whizzin' spurt to where I hoped th' door was, I trips up on a blasted grocery box full of scrap-iron an' junk, and sprawls flat on my face, digging my nose half way through th' floor. I bounces to my feet an' makes another dash, but I comes so fast that I rams my head against th' wall with a *k-r-r-rumpt!* that sends a million stars shootin' in front of my eyes. Findin' myself at the door, I yanked it open so hard I tears th' door-knob off, an' suckin' in my breath like a gas engine, I catapults out into th' yard.

Gettin' half-way to th' house in two jumps, I puts th' breaks on again an' comes to a skiddin' stop as old Timothy comes dashin' out onto th' back porch in his night-gown, carryin' a lantern an' a double-barreled shot-gun. The instant he sees me out in th' dark, he levels his blunderbuss an' blazes away in my direction with a fire-belchin' *bang!* like a bustin' cannon. A piece of burnin' wad stings me on th' cheek, but th' charge of buck-shot goes by. This was too much for me. My knees cave clear in, an' I sags down on th' grass.

" 'I got him! hot durn his onery hide—I got him!" yells old Timothy; an' he comes gallopin' at me with his night-gown flappin' in th' wind like a main-sail gone adrift, an' his second shot-gun barrel ready for business;—but when he recognizes me, he stops, astonished-like.

" 'Goshamighty tunkets!' he ejaculates, 'I thought ye wuz thet gol-durned skunk agin!'

" 'Sk-sk-skunk!' I mumbles, staggerin' weakly onto my feet. 'Couldn't ya tell me from a sk-skunk?'

" 'No—thur's some low-down thievin' amachoor bin gittin' away with Margy's aujons an' things—I thought sure I'd got him, by gum!' Timothy pants, kind'a disappointed-like.

" 'Well—well, wh-what's that cursed thing in th' wood-shed?' I gasps.

" 'Thet's Margy's bug'lar-scarer,' answers Timothy. 'She's got a 'lectric bizness rigged up so's if anybody opens th' door at night, it starts off a' old phonygraft hid down under th' floor with a home-made record on it whut sounds like somebody was bein' burnt t' death by Californier Indians. We made it by gittin' Jerry Mooly, th' hired hand, ter try t' sing "Rocked in th' Cradle of th' Deep," when he was full a' Jim Hogan's moonshine.'

"I GOT back to bed without Margy findin' out who'd been shot at. Next day she has me help her rig up another contraption in th' wood-shed, so that if anybody tries again to sneak in there, three flat-irons an' a topmaul will come crashin' down on his neck. So far as I was concerned, there was no need of riggin' anything. I was through with night-hawkin' around that place.

"One afternoon, though, I manages to slip into the shed with a handful of carpet-tacks, which I dumps into the cells of Margy's filament-current storage-battery. I sees next day that they're puttin' th' battery on th' blink, all right; so a while afterward I hunts up old Timothy to tell him the good news. I finds him standin' out in th' yard alongside his Ford, in his town clothes, lookin' peeved as blazes.

'Margy's storage-battery's gone up the spout, somehow 'r 'nother,' he tells me. 'I had to give her th' battery out o' th' ottymobile, an' take th' bunged-up one. Zachary Bilgiks sez as how th' price o' butter hez riz two cents down ter Rapsville, an' I got ten pounds I hev ter take down, right away. I wish ye'd try an' see if ye kin doctor up this durned bat'try a little.'

"I fixes th' battery—an' if I didn't say nothin', I thought plenty.

"I leaves th' wood-shed alone for a while, after that; but a few evenings later I overhears Margy sendin' another of those confounded half-coded notes to somebody; an' feelin' sure it must be for that homely worm of a Eusebius, I gets pretty wrathful.

"As I said before, I wasn't jealous; I'd been hired to stop this foolishness an' I was determined I was goin' to do it, if I had to burn down th' whole darned ranch.

"The next morning, I manage to get away from Margy while she is busy washin' th' breakfast dishes; an' hikin' out into the wood-shed, I hunts up a spool of fine magnet-wire—about number thirty. Taking this, I goes out an' twists the end onto the ground wire of the wireless set, an' runs it up th'

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wall of th' shed, pushin' it under a batten where it couldn't be seen; then I climbs up onto th' roof, figuring to bring the wire up onto the aerial lead-in.

"After spendin' quite a lot of time workin' the wire into small cracks an' crannies, at last I have the upper end ready to twist onto the lead-in. To do this I have to hang way out over th' end of th' roof an' reach down;—an' just while I am hangin' in this neck-breakin' position, tryin' to make the connection, I hear the confounded rotary-gap down in th' shack beginnin' to hum. Before I can let go of that blasted tangly lead-in, th' spark crashes out with a terrific *whr-oo-oo-o-o!*—and' th' next thing I know, I'm lyin' flat on my back down on th' ground, tryin' to get my breath.

"A few minutes later, Margy comes out, and sees me lyin' in the grass.

"'Takin' a sun-bath, aren't you?' she chirps, trippin' up alongside.

"'Yes, it's right pleasant lyin' here,' I answers, tryin' to look drowsy an' contented; but swearin' to myself that I'd never try that stunt again.

"THAT was the last time I ever fooled around that wood-shed. There didn't seem to be any need of it, anyway; because Margy an' I were gettin' to be better pals every day. We were goin' skylarkin' in the lizzie pretty frequent now; we sit together in the hammock on the front porch every evening; and we even begin to hold hands under th' post-card album when old Timothy butts into th' parlor after supper to read th' *'Corn Planters' Journal'*

"Margy keeps gettin' more sweet an' cuddly every day, and sometimes I would find her gazin' at me with a kind of starlight dancing in her black eyes that—well, after sittin' down one day an' thinkin' it all over for a long time, I finally comes to the conclusion that the only thing left for me to do is to marry her. I hadn't fell for her or anything —you want to understand that—but she was too sweet an' pretty a girl for that codfish of a Eusebius to get away with, and it was up to me to save her, even if I had to dig up th' price of a weddin'-ring. Course old Timothy hadn't hired me to go quite so far as that, but th' ranch cookin' seemed to agree with me, and it was up to me to save her, I believe in always doin' a little more than just what I'm paid to do; I never was a work-pincher or a clock-watcher.

"So one evening out on the lawn, it comes to a show-down. I hands Margy th' old spiel, orates the only-girl-in-the-world mush with all th' trimmin's, an' waits for th' answer.

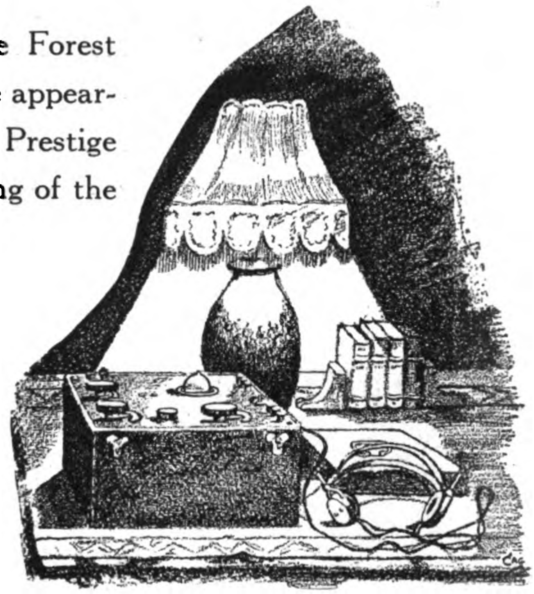
"'Ask pa!' she says, looking up shyly from under her dark lashes; an' then she runs away.

"I breezes up to old Timothy while my courage is up, an' asks him.

Continued on page 58

DE FOREST Dependability is an inbuilt quality that only years of experience in the building of radio apparatus and a thorough knowledge of radio science can give. It is not a tangible element that one can grasp or point out yet its presence is essential to satisfactory performance.

To those who are looking for satisfactory performance, De Forest Radiophones also present technically correct design, handsome appearance and unequalled efficiency. De Forest Reputation and Prestige insure the quality of the workmanship and materials used being of the highest.



The Everyman Receiver is for 30 mile reception; the Radiohome Receiver is a vacuum tube set efficient up to 100 miles; for use with either of these sets there is the "DT-800" Two-Stage Amplifier. MR-6 Receiver includes an unsurpassed tuner, tube detector and two-stages of amplification. Ask your friends who use them.

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Light In Weight—
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ABSOLUTELY THE BEST ON THE MARKET
REGARDLESS OF PRICE

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DEMAND
From Your Dealer GENUINE FEDERAL APPARATUS
Accept No Substitute

Federal Telephone and Telegraph Company
BUFFALO, N. Y.

Continued from page 56

"He looks kind'a surprised, an' strokes his goatee awhile.

" 'Wull, I reckon it's all right,' he says, at last. 'I'd let her marry a Chinaman, 'fore I'll see her spliced up ter thet durned Eusebius!'

"THE weddin' is set for Margy's eighteenth birthday, which is due in two weeks;—an' then there begins th' greatest stewin' an' preparations you ever saw. Th' whole darned farm was turned upside down with dress-makin'; cake-bakin'; red an' green paper bells; and invitations to all th' farmers in th' state of Kansas. I was a happy imbecile until two days before th' big day, when trouble lands on me with both feet.

"As I was sittin' out in the shade on the front porch dreamin' about the girl an' the home-cookin' I was goin' to have all th' rest of my life, Margy comes cryin' an' all upset and tells me that it's all off. At first she wouldn't say what was th' matter; but after a lot of honey-fussin' around, she takes me out to the wood-shed an' shows me a bunch of old bills for wireless instruments.

" 'I'd forgot!' she sobs, like she was clean heart-broke. 'It was about three months ago—I sent for a lot of apparatus collect on delivery—and pa was so mad that time because he'd found out I was using my wireless to talk with Eusebius, I was afraid to ask him to pay for it. I—I told Eusebius I'd wait for him to work all his time for old Ebenezer Pitts if he'd pay for it—and he did.'

"That was a stunner; but after thinkin' it over awhile, I sees a way out.

" 'How much was it? I asks her.

" 'A hundred and forty-nine dollars and fifty-three cents, altogether,' she says, wipin' her pretty eyes, an' lookin' at me, hopeful-like.

"I was determined I wasn't goin' to let a little thing like that get between me and strawberry short-cake for life. Next mornin' I takes possession of Timothy's lizzie, tellin' him I'm goin' down to Rapsville to buy some new togs. I rambles all the way up to Stonefield, and after doin' some inquirin', I finally locates Eusebius—a fat-faced idiotic-lookin' cross between a donkey an' a clod of dirt.

" 'I'm tyin' up with Margy Tuggle,' I informs him, right square off the bat. 'Here's your blasted hundred an' forty-nine bucks an' fifty-three cents for that wireless gear of Margy's you paid for, an' a note from Margy—and now we're clear of you! If I ever catch you hangin' around Pilcher's Corners, I'll rip you inside an' throw you to th' buzzards!'

"I departs, leavin' th' rube standin' there with his mouth gapin' wide enough for a' elephant to have shoved his foot in it.

Continued on page 60

Would You Make A Violin out of Tin?

What kind of a **noise** would you expect to get out of a **piano** made from brass, aluminum or sheet iron?

And, do you remember the discordant "jar" of the old table-top **talking machines** before the wood cabinet was perfected?

Seasoned **wood** has acoustic properties belonging to no other material. The right kind of wood for radio horns cannot be found in commercial quantities, so we **make** it. We break down selected wood to its original fibre and **cast** it, in steel dies, under 12 tons' pressure and 800 degrees of heat, producing a material several times denser than violin wood—uniform in texture—with **wonderful** acoustic properties.

Back of this product is our 20 years' experience as acoustic engineers and manufacturers of papier-mache domes, and sound reflectors for opera houses, churches and other public places.

MADERA-WARE

Clearspeakers are offered in your choice of old gold, verde green or ivory finishes, as follows:

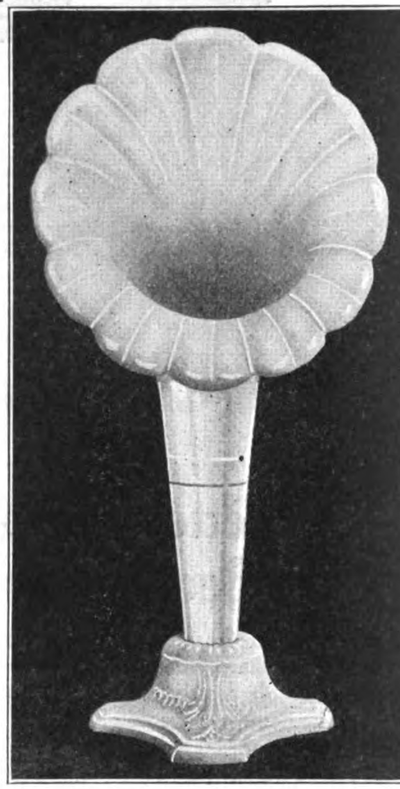
No. 801 Horn, height 20½"; width 10"; depth 7⅜"....**$15.00**

No. 802 Horn, height 23¾"; width 13⅝"; depth 11¼" **18.00**

No. 800 Horn and Cabinet, height 22" over all. Horn 18" high; opening 10" dia. **25.00**

They can be used with the loudest amplification for public places or with ordinary head-phones for household sets.

Send for descriptive circulars



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No. 550 Murdock	$1.00
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No. 14 Bare Copper, 100 ft.	$0.50
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Please include sufficient postage with all C. O. D. orders.

"We give all we can for what we get——Instead of——Getting all we can for what we give"

MISSOURI RADIO SUPPLY COMPANY

4623 Maryland Ave. SAINT LOUIS MISSOURI

Continued from page 58

"THE old lizzie had run all right comin' up to Stonefield; but she bucks all th' way back like a' ornery broncho. Tires blow out; the gas-tank springs a leak; the radiator goes dry; th' timer falls to pieces; an' every other blasted thing breaks down.

"As I crawl up alongside th' house; where the engine gives a last wheezin' gasp an' dies a long-deserved death, I can smell calamity in th' very air. Timothy meets me on the runnin' board, his goatee standin' out stiff, like a typhoon-warnin'. He shoves a note into my hand.

" 'Read it!' he jerks out. I reads it. *'Don't you think I saw what you were doing the day you fell off the wood-shed? You are the awfullest boob. Margy.*

" 'Huh!' I gasps, clean dazed. 'What—where—

" 'She's gone!' raves Timothy. 'Some gul-darned skunk guve thet dum Eusebius a lot o' money, an' he paid off his debt t' Ebenezer Pitts—an' early this mornin' he comes with a weddin'-license an' sneaked off with Margy! Margy was eighteen at half-past six—an' thet cussed ol' Zoroaster Sims married 'em three minnits after! Said he hated ter do it, but Eusebius had ten dollars, an' butter's riz agin. If I kin ever find out who guve Eusebius thet money, I'll bust his rotten head—hot durn 'im!'

" 'Well,' I sighs, jugglin' some forty-seven cents in my left-hand pants pocket: 'You sure ought to.' "

MON-YOUGH RADIO ASSOCIATION ELECTS OFFICERS

At a semi-monthly meeting of the Mon-Yough Radio Association, held Thursday evening, June 1st, in the club rooms, 326 Fourth Avenue, McKeesport, Pa., the following officers were elected:

Vice President, John Hunter; Assistant Secretary-Treasurer, Emil Klob; Technical Committee, H. F. Kelso, Donald Willard; Chairman, Albert G. Moore; Membership Committee, Walter Estep, Chairman; Albert G. Moore, Harry W. Wallis.

The new officers will assume their duties July 1st, for a term of one year.

The Mon-Yough Radio Association is an affiliated society of the American Radio Relay League, and has a membership of 72. Four of the members are licensed operators, two of whom hold a limited broadcasting license identified by call WIK.

Two classes of membership are available, junior and senior. The membership fee and dues are very nominal. Radio fans are urged to investigate and consider the advantages of affiliating with this association, which meets regularly the first and third Thursday of each month, at 8 o'clock p. m. Information may be obtained by addressing a post card to the association at the above address.

SUNSET RADIO CLUB

The last meeting of Sunset Radio Club was thrown open to all interested in amateur radio and broadcasting and was largely attended, the Chamber of Commerce Directors' room being well filled. The papers of the evening were by Lieut. Col. Robert Loghry of the Presidio, San Francisco, on "Military Radio," and Mr. Cattell of the Mare Island Laboratory, whose paper was on the "Vacuum Tube." Mr. Davis presented a complete Reinartz tuner for demonstration. Dr. A. E. Banks presented a home made wavemeter, calibrated from 150 to 600 meters.

Sunset Radio Club in an effort to further the interest of broadcasting receiving stations has prepared a series of lessons in radio telegraphy which will be broadcasted nightly from KDPT, the Southern Electrical Co. station of San Diego. It is felt that the ranks of amateur radio will be added to considerably, following the completion of this course.

Major Lawrence Mott is expected to read a paper before the Club at the next regular meeting.

Owing to QRN, local relay stations are suffering with the rest of the District, but a fair degree of service is being maintained at certain hours.

The members of Sunset Radio Club were delighted to greet Mr. F. H. Schnell, Traffic Manager, A. R. R. L., at a special meeting called at the Federal Building on June 19th. The speaker was introduced by Major John F. Dillon, Radio Inspector 6th District. Both Major Dillon and Mr. Schnell thoroughly covered the subject of amateur co-operation and were enthusiastically received. An unfortunate incident whereby a certain rowdy element endeavored to break up the meeting was promptly squelched by Major Dillon and the four individuals in question left the room, much to the delight of all remaining, when the speaker, Mr. F. H. Schnell, proceeded with his talk.

C. W. has now invaded San Diego in earnest and most of the old sparks are disappearing. Station 6ZB, which has operated a C. W. for over two years, is still going strong. 6TW, the best in the locality, is getting ready for next winter's traffic. 6BJY has recently installed a keen set. 6AJH is reported to be in favor of installing one. Rumor has it that the following stations are about to install C. W.'s: 6JI, 6IZ, 6MZ and 6AHF.

Tell them that you saw it in RADIO

A RADIO PRIMER

Continued from page 27

ternating current and there is a deflection of the diaphragm of the telephone receiver for each wave train and the sound or note produced in the receiver depends on the number of wave trains arriving per second.

Referring to the water analogy, if the water is struck rapidly by the blades of a revolving paddle wheel a series of waves of equal amplitude will be generated. There will be no damping because the source of energy is constant and an undamped or continuous wave train is set up.

Undamped waves may be generated electrically by using an electric arc with special equipment or by using the three-electrode vacuum tube, which when properly connected, will generate undamped oscillations. The advantages of C. W. (continuous wave) over damped wave are the greater efficiency of reception and sharpness of tuning which results.

It is obvious that the crystal detector will not "detect" C. W. because the wave train is not broken up into groups.

The heterodyne method of detecting C. W. signals consists of generating high frequency oscillations at the receiving station with special apparatus and then superimposing the high frequency oscillations on the C. W. oscillations in the detector circuit. If the oscillations generated locally are made a little more or less than the antenna oscillations "beats" will be produced, which will be audible in the telephone receivers.

The autodyne method of reception utilizes one vacuum tube both as a detector and generator, for with certain connections the tube will both generate continuous wave alternating current and detect C. W., thus giving a self-heterodyne effect.

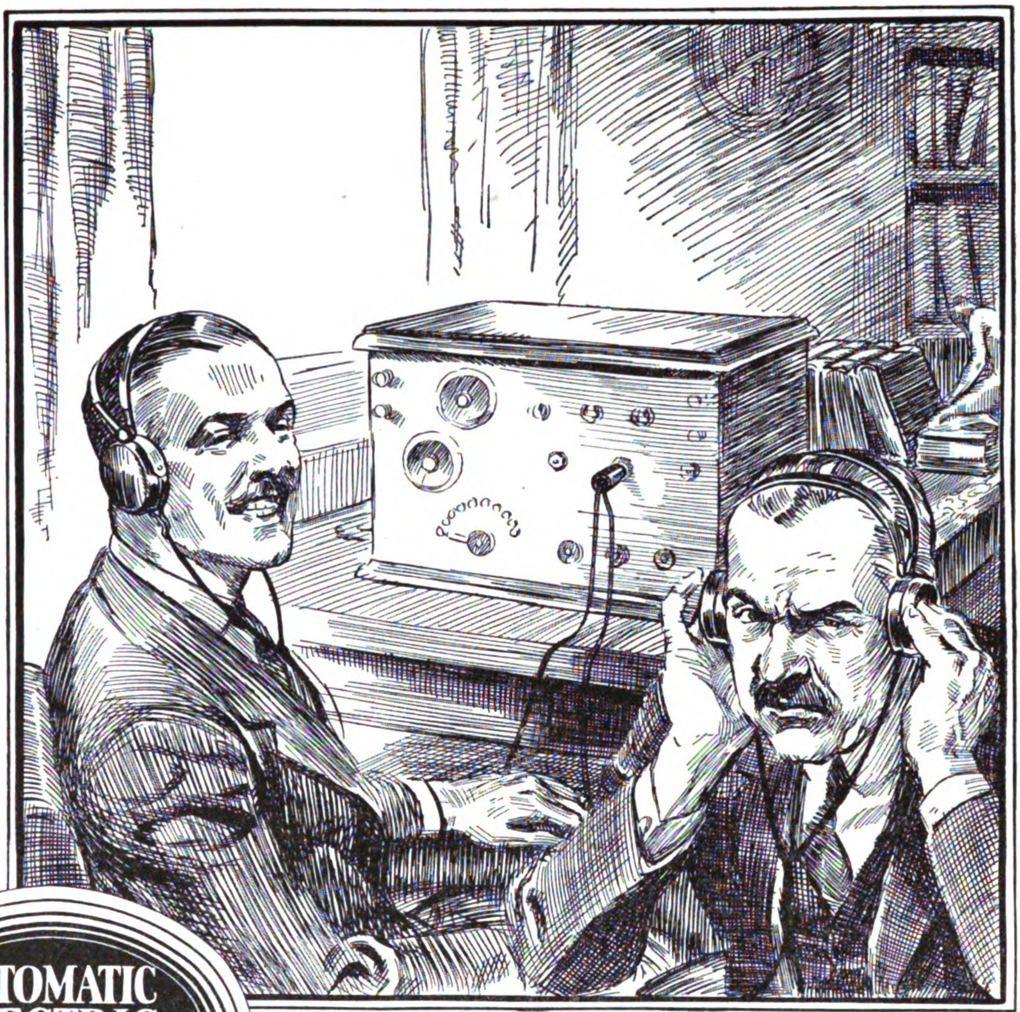
The regenerative receiver makes use of detecting, amplifying and generating actions of a vacuum tube. It will detect spark or damped waves, it will regenerate or greatly amplify damped and undamped waves and it will cause the tube to oscillate and generate radio frequency currents, which when superimposed on the incoming antenna currents will render audible C. W. signals.

The regenerative receiver under certain conditions (when the tube is oscillating) may actually radiate energy back into the ether, that is the set may receive and send out energy at the same time, this action taking place when the tube is made to generate C. W. and secondary circuit is tuned to antenna-ground circuit.

Method of Operating Regenerative Receiver

TO properly operate a regenerative receiver one should have a knowledge of the function of each unit com-

Continued on page 64



AUTOMATIC ELECTRIC
LONG RANGE
RADIO
HEAD SETS

Ask your dealer. If he cannot supply you, we will send you at once an Automatic Electric Head Set for

$10.00 Postpaid

With plug attached, $11.50

One Smiles; Another Frowns — Why?

THE man with the smile is enjoying a radio musical program through an Automatic Electric Head Set. Scientific design and careful manufacture assures him loud and distinct reproduction without distortion or foreign noises. These are qualities that are seldom found in receivers that are carelessly designed, or in which high resistance is given first importance.

The Automatic Electric Head Set was designed and perfected **by a staff of engineers who have had more than thirty years of experience in the development of telephone talking apparatus. It is made in only one style and resistance,—the one proven by careful experiment to be the most efficient under all conditions.**

The Automatic Electric receiver is designed with a single powerful electro-magnet which takes effect at the exact center of the diaphragm. This produces concentric vibrations, avoiding all distortion and false overtones. The coil is wound on a cylindrical core. The absence of sharp corners gives practical immunity from short-circuited turns—even **after long continued use.**

Whether used with crystal or vacuum tube detectors, multistage amplifiers or loud speakers, all signals are reproduced with maximum loudness and clearness.

This is the high grade plug that comes attached, when desired, to *Automatic Electric Head Sets*. It will take care of any kind of cord terminals, will fit any kind of jack and will accommodate two head sets. With this plug attached to our head set you can be sure the head set is properly "poled."

Automatic Electric Company

ENGINEERS, DESIGNERS & MANUFACTURERS OF THE AUTOMATIC TELEPHONE IN USE THE WORLD OVER

HOME OFFICE AND FACTORY: CHICAGO, U. S. A.

Continued from page 62

prising the receiver so that the most satisfactory results may be secured.

The first operation is to bring the filament of the tube to approximately the right temperature so that it will function as a detector. When the temperature becomes too high a slight hiss will be heard in the telephones and the rheostat should be turned back until the hiss stops.

The antenna or primary circuit should now be adjusted to the approximate wave-length of the station to be received. The amount of inductance in the primary circuit may be adjusted by the variable contact switch, each point of which gives a definite wave setting and any intermediate wave setting between contact points can be secured by operating the primary variable condenser. A series-parallel switch is often included in the primary circuit whereby the variable condenser may be switched either in series or in parallel with the primary inductance, the former connection enabling the primary circuit to be tuned to a lower range of wave-lengths than can be secured with the parallel connection alone.

The secondary circuit should be tuned to approximately the same wave-length as the primary circuit by manipulating the secondary inductance switch and the secondary variable condenser. The coupling between primary and secondary circuits controls the amount of energy transferred between these two circuits. It regulates the mutual induction between the primary and secondary inductances, the transfer of energy being maximum when the coupling is close and minimum when the coupling is loose. It is usually best to set the coupling part way between these two points in which position great selectivity can be obtained and interference from stations not desired may be almost entirely eliminated. The adjustment of the secondary condenser will usually be quite sharp, especially when long distance stations are being received, and a vernier attachment is often included to permit accurate adjustment of this unit.

A very close adjustment of the "B" battery potential may be secured by using the plate potentiometer, but this is of value only with certain tubes.

When the station is being received with maximum loudness the strength of the signals may be increased considerably by adjusting the regeneration. For each adjustment of the secondary circuit there is a point in the regeneration setting at which the vacuum tube will oscillate, that is, generate currents of radio frequency which will "feed back" to the grid circuit. If speech or music is being received the oscillating of the tube will cause distortion and the amount of regeneration should be reduced a little to

Continued on page 66

Like Postage Stamps Used Everywhere

FROST RADIO

154 W. LAKE ST.
CHICAGO. ILL.

Herbert H. Frost

**NATIONAL FACTORY DISTRIBUTORS
TO THE ELECTRICAL-RADIO JOBBER**

FOR THE FOLLOWING

RADIO APPARATUS

Unequalled results identify this Apparatus as highest grade workmanship and abundant value.
Dealers: Inquire of your local Jobber.

CUNNINGHAM VACUUM TUBES — for HOME RADIO Equipment

Nationally recognized as the ideal Detector or Amplifier Tubes for use with Radio Receiving Sets, Cunningham Tubes today are the choice of those who want the finest results from their equipment.

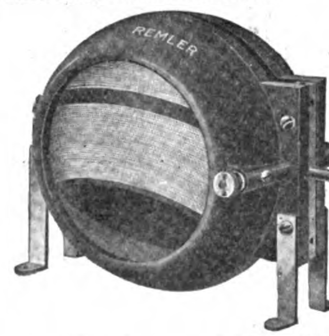
FROST FONES

Ideal Receivers for use with Home Radio Sets. Combine maximum efficiency with permanent sensitiveness.

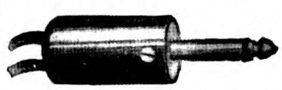
REMLER RADIO APPARATUS

Radiates Quality

Every Remler item is first studied and tested for its practical Radio utility before being marketed.



FROST IMPROVED PLUG AND JACKS

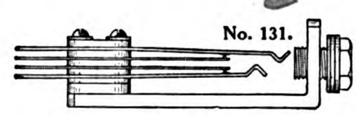


No. 137. Cord Tip Plug.
Each................$1.25

Specially designed for Radio Panel Work.

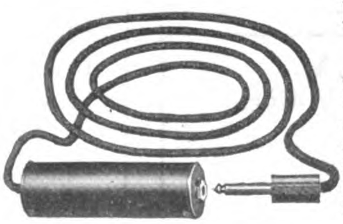
No. 132. Plug only...**$1.00**

Both plugs are interchangeable with other standard makes.



No. 131.

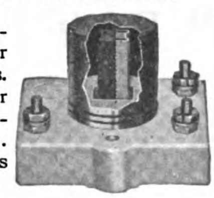
Frost Extension Cord and Plug



Comes in lengths from 10 to 100 feet. Loud speaker can be placed anywhere and connected with Radio set with Frost Radio Extension Cord.

FROST RADIO PROTECTOR

Listed by Underwriters' Laboratories under April, 1922, regulations. No interference. Never Grounds. Mounts indoors. Price $1.50. Good deliveries on this approved device.



Prices on the above Radio Apparatus will remain at a standard level long after inferior goods have been purchased at cut prices and found to be unsatisfactory. Your trade knows and asks for Frost Radio Apparatus by name. Are you supplying them?

Write, wire or phone your nearest Dealer or Jobber

HERBERT H. FROST

**154 West Lake Street
CHICAGO, ILLINOIS**

National Factory Distributors to the Electrical-Radio Jobber

Continued from page 64

eliminate such distortion. The tube must be in an oscillating state when receiving C. W. telegraph signals.

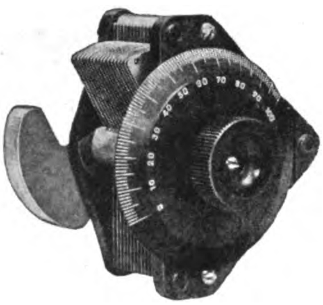
Final adjustments of primary and secondary condensers, filament temperature and regeneration should now be made to secure maximum signal strength with minimum distortion.

One or more stages of amplification may be used in addition to get signal strength sufficient to operate a loud speaker, but if too much amplification is used there will be distortion and when receiving speech or music it is generally preferable to sacrifice loudness for quality.

It should be remembered that the life of a tube depends to a great extent on the temperature at which its filament is burned and hence no more current should be passed through the filament of a tube than is necessary to give satisfactory results.

When through operating the set the rheostat should be turned back to zero or "off" position, and this will automatically open the "B" battery or plate circuit, as no current can flow between plate and filament when the latter is cool.

CHELSEA



No. 3, Price $4.75

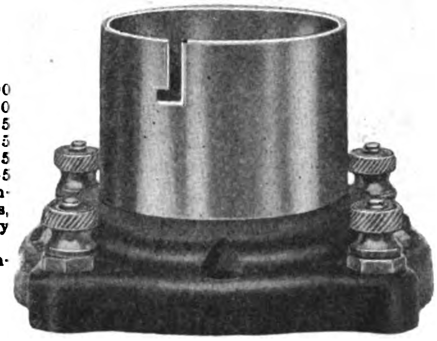
VARIABLE CONDENSERS (Die-Cast Type)

No. 1—.0011 m.f. mounted $5.00
No. 2—.0006 m.f. mounted 4.50
No. 3—.0011 m.f. unmounted 4.75
No. 3—.0011 m.f. unmounted, without dial 4.35
No. 4—.0006 m.f. unmounted 4.25
No. 4—.0006 m.f unmounted, without dial 3.85

Top, bottom and knob are genuine bakelite, shaft of steel running in bronze bearings, adjustable tension on movable plates, large bakelite dial reading in hundredths, high capacity, amply separated and accurately spaced plates.

Unmounted types will fit any panel and are equipped with counterweight.

Guaranteed for circuits up to 1,000 volts.



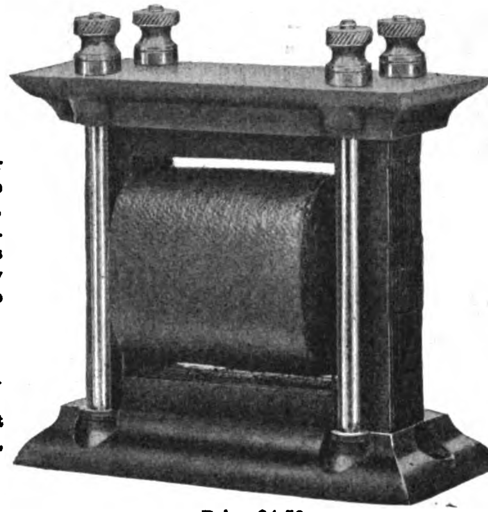
Price $1.00

Amplifying Transformer No. 50

The Chelsea Amplifying Transformer gives the highest amplification possible and at the same time will not squeal, howl, or in any way cause noisy circuits. It is beautiful in design and embodies electrical characteristics unequalled by any. Guaranteed for all circuits up to 500 volts with a high safety factor.

It will not fail in service.

Purchase Chelsea Radio Equipment from your dealer. If he does not carry it, send to us.



Price $4.50

Bakelite Socket No. 60

This socket includes a bakelite base supporting four external readily accessible binding posts. The tube receptacle is highly polished nickel and will take any standard detector or amplifying tube as well as the smaller size power tubes. Although primarily intended for receiving circuits it will operate satisfactorily on any circuit up to 1,000 volts. It may be mounted either on table or panel. Positive contact springs.

An added beauty to any radio station.

Write for our new No. 6 catalog.

CHELSEA RADIO COMPANY

150 FIFTH STREET, CHELSEA, MASS. Manufacturers of RADIO APPARATUS AND MOULDERS OF BAKELITE AND CONDENSITE

Quality Radio Apparatus

The sign of quality Radio Apparatus

Standing for the best in all manufactured lines of Radio Apparatus the name "Meyberg" has become synonymous with Quality Radio Apparatus. The stores of the Leo J. Meyberg Company are rendering a service to Radio Purchasers that maintains the acknowledged leadership in supplying the best the market affords in Radio Equipment.

Circulars on request.

LEO J. MEYBERG CO.

Operating the Fairmont Hotel Radio Station KDN, San Francisco
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—14 YEARS OF KNOWING HOW

IT IS gratifying that Murdock Apparatus has attained an even higher prestige in radio than we dared expect.

Fourteen years of good designing and good manufacture has convinced most users of radio apparatus that solid integrity on the part of the manufacturer is better than an oversupply of questionable apparatus.

Prices: No. 55—2000 Ohm....$5.00
No. 56—3000 Ohm.... 6.00
No. 57—3000 Ohm.... 7.50

MURDOCK PHONES

WM. J. MURDOCK COMPANY
342 Carter Street, Chelsea, Mass.

200 WATT A. C. RADIOPHONE

Continued from page 17

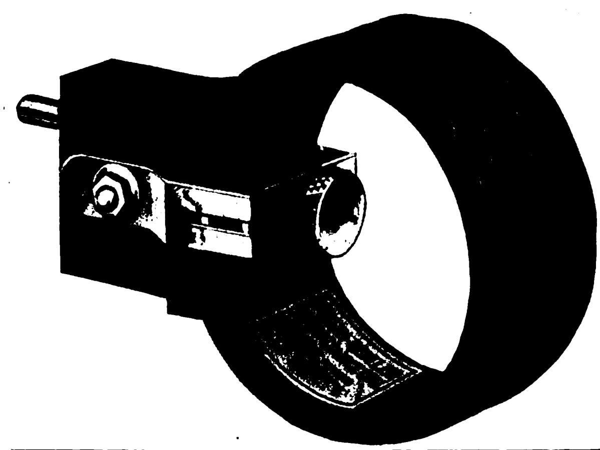
system and really the most important is the condensers shunted across the coils. This was discovered by the writer and is very effective. This is a tuned circuit, apparently to a harmonic of sixty cycles. In the case of the filter coils used, a 1 m. f. d. shunt was found to be the proper value. Higher or lower values had the effect of throwing the a. c. out of phase. While experimenting with this, having set radiating and listening to a. c. in wavemeter, one side of line was built up in steps by multiple condensers. As condensers were added the peak voltage of the loaded side, as applied to the radio tubes, was apparently shifted from a direct right angle until a peculiar off-phase hum or "beat" was observed. When this circuit is tuned properly the filtering will be very effective. It is found that this method cuts down the necessity of having high condenser capacity across the line as ordinarily used. The voltage across the coils is much lower than that across the line, thereby reducing the number of condensers used by "series-paralleling." (c) It is important when two iron core filters are used and clamped together as a unit, that they must be poled properly. (d) The a. c. is given further filtration in the modulator tubes by inserting individual resistance rods, 1000 ohms, in each grid circuit. By reference to the schematic it will be seen that these are in series with grids. (e) The plate and grid reactors and also resistances of modulator and amplifier tubes also aid in the filtering. (f) It was noted that when the proper filtering was accomplished the complete transformer circuit became very quiet. This condition was chiefly brought about by the tuned filter system mentioned in "b" and proper capacities in "a."

It is hoped that this article will help those using a. c. radiophones. An a. c. phone if properly filtered is highly desirable, because of its flexibility and ease of control and also by the fact that it has just as sharp a wave as generator sets and is not a "O. R. M. hound." It is admitted that there are many a. c. sets not accomplishing good results that are creating enemies every time they open up. Instead of enemies our set has made many friends, while operating on test at 2BB. After further tests are completed the set will be used regularly by Station 2BQH, located at Mamaroneck, N. Y.

Giblin-Remler

INDUCTANCE COILS

INTERCHANGEABLE WITH ALL COIL MOUNTINGS



The new Giblin-Remler Coil has achieved a remarkable success. Placed on the market thirty days ago, it has already achieved enthusiastic response from all sections of the country.

Thomas P. Giblin, in designing the Giblin-Remler Coil has built an inductance coil that is infinitely superior in every respect to both the Honeycomb and Duo-Lateral Coils of which he is also the originator.

The Giblin-Remler Coil is equally effective on all wave lengths—the self capacity is far less than any previous compact inductance—this gives selectivity and sharp tuning for a given coil which is of special advantage to the amateur who usually has an antenna of low capacity. The high frequency resistance is also lower than any previous type.

Type and Number of Turns, Mounted	Price, Mounted	Type and Number of Turns, Unmounted	Price, Unmounted	Inductance in Milli-henrys at 1000 cycles Accuracy ½%.	Natural Wave Length in Meters, Accuracy ½%.	Distributed Capacity, in micro-micro-farads, Accuracy 1%	Wave Length Range in Meters using Condenser of .001 max. and .00004 mfd. min.		High Frequency Resistance in Ohms at Wave Length Shown			
							Minimum	Maximum	200	500	1000	2000
RG 20M	1.50	RG 20U	.70	.030	39	14.3	63	334	......	1.1	......	......
RG 25M	1.50	RG 25U	.70	.041	47	15.2	75	389	......	1.5	......	......
RG 35M	1.50	RG 35U	.70	.083	87	25.4	128	550	......	3.5	......	......
RG 50M	1:60	RG 50U	.80	.169	114	21.6	185	785	......	8.8	4.4	......
RG 75M	1.65	RG 75U	.85	.377	163	19.8	266	1170	......	28.3	12.1	6.2
RG 100M	1.70	RG 100U	.90	.666	217	19.9	358	1550	......	80.3	26.8	12.6
									1000	2000	5000	10000
RG 150M	1.75	RG 150U	.95	1.503	281	14.8	512	2320	69.8	23.8	7.1	......
RG 200M	1.80	RG 200U	1.00	2.68	374	14.7	690	3110	......	50.6	12.5	......
RG 250M	1.90	RG 250U	1.10	4.20	424	12.1	860	3880	......	87.5	19.9	......
RG 300M	2.00	RG 300U	1.20	6.11	494	11.2	1030	4680	......	141	29.3	13.8
RG 400M	2.10	RG 400U	1.30	11.04	618	9.7	1380	6300	......	......	54.6	22.3
RG 500M	2.30	RG 500U	1.50	17.50	747	9.0	1730	7900	......	......	93.1	34.9
									2000	5000	10000	20000
RG 600M	2.40	RG 600U	1.60	29.2	1024	10.1	2260	10250	......	111	43.8	......
RG 750M	2.65	RG 750U	1.85	39.0	1249	11.3	2660	11850	......	......	64	......
RG1000M	3.40	RG1000U	2.50	71.6	1620	10.3	3570	16000	......	......	123	......
RG1250M	3.80	RG1250U	2.90	108.0	1930	9.7	4380	19700	......	......	......	......
RG1500M	4.40	RG1500U	3.50	159.8	2300	9.3	5300	23800	......	......	......	......

These tests have been made by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.

Giblin-Remler Inductance Coils are patentable—they are manufactured by patented machinery. This protects you and insures your receiving the genuine Giblin-Remler Coils.

If you cannot secure Giblin-Remler Inductance Coils from your dealer send to us direct. Order now as these coils will help you get truly wonderful results from your set.

REMLER RADIO MFG. CO.

E. T. CUNNINGHAM
General Manager

248 First Street
San Francisco, Calif.

154 W. Lake Street
Chicago, Ill.

HELPS FOR THE RADIO BUILDER

Continued from page 3

from the secondary that connects with the filament of the detector tube. On 360 meter work this condenser will strengthen the signals and make the regeneration more sensitive and efficient. If a small variable condenser can be used instead of a fixed condenser, greater efficiency in tuning for loudness (especially with a loud speaker) will result.

Very often the fixed condenser across the phones will have to be removed if one or more loud-speakers or a Magnavox is attached in addition to the phones. It is well, therefore, to have the phone condenser connected with a switch.

Flexible wire connections, even though unsightly at times, are far better, hanging loose or running in various directions, than bus-bar wiring, which is so often in parallel. Flexible wiring, loose and uneven, prevents induction, hissing and howling. That is why so many sets on experimental tables work so well. The bus-bar wiring is only a fad and does not make for short connections in many cases.

Don't think that because your tubes are lighted that you have perfect contact with the four prongs of each tube. It takes only two of the prongs to light the lamps. I have seen cranky sets where neither the plate or grid prong were make poor contact, touching at times and then not touching. Bend the lips of each socket up to be sure of four perfect contacts.

Unless the outside lead from the secondary of an amplifying transformer is connected with the grid, there will be no efficient operation of the tube—of any tube.

If perfect regeneration is not secure with the tickler, reverse the connections from the tickler, that is change the connections from the tickler where they unite with plate and transformer or at the coil.

A larger condenser will often increase the sound volume and broaden the tuning, especially on the 360 meter waves. More small sets are hampered in efficiency by a small primary condenser (in either the ground or aerial) than by any other factor.

When you are planning to arrange your primary condenser so that it can be in the ground circuit or in parallel with the primary coil, also arrange to have it in the aerial circuit. There are some signals and especially some broadcasting stations which, come in better with the primary condenser in the antenna circuit, some with it in the ground circuit. It seems strange that such is the case, but try it.

NEW BIDS ON NAVY TUBES

Jacob Loving of 610 Broadway, New York, was high bidder for the 30,000 surplus vacuum transmitting tubes offered for sale by the Navy Department. He bid $4.0069 each for all or none. The lowest bid was ten cents each, made by L. M. Alexander of Cincinnati.

STANDARD TESTS FOR RECEIVING SETS O. K.'D

The Bureau of Standards and the Electric Testing Laboratories of New York have approved in outline a standard method of testing complete radio telephone receiving sets. The method is said to be for immediate use in testing sets manufactured for receiving Radio Telephone Broadcasting, but details have not yet been made public.

Improvements on the method or new methods used in testing the equipment submitted by the National Retail Drygoods Association will be subject to the approval of the Bureau of Standards, the Bureau co-operating with the Electric Testing Laboratories in establishing these methods as standard procedure.

VARIABLE CONDENSERS

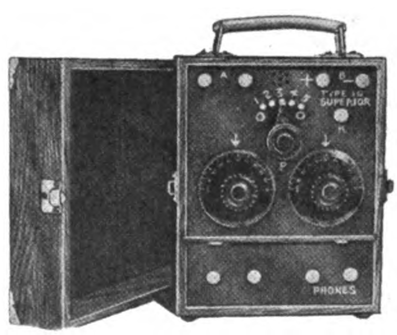
PLATES 1/32" thick ALUMINUM

If in your opinion this condenser is not equal to the best on the market in workmanship, appearance and efficiency we will refund your money. Strongly built—Beautiful design—High efficiency.

Type as illustrated
43 plate .001, $8.75
23 plate .0005, $3.25
11 plate .00025, $3
3 plate Vernier, $1.25

MONTROSE Mfg. Co.

Bedford. Dept. P., Brooklyn, N. Y.



A Portable Vacuum Tube Receiver

MOUNTED IN HANDY CARRYING CASE

Smallest, most compact portable receiver

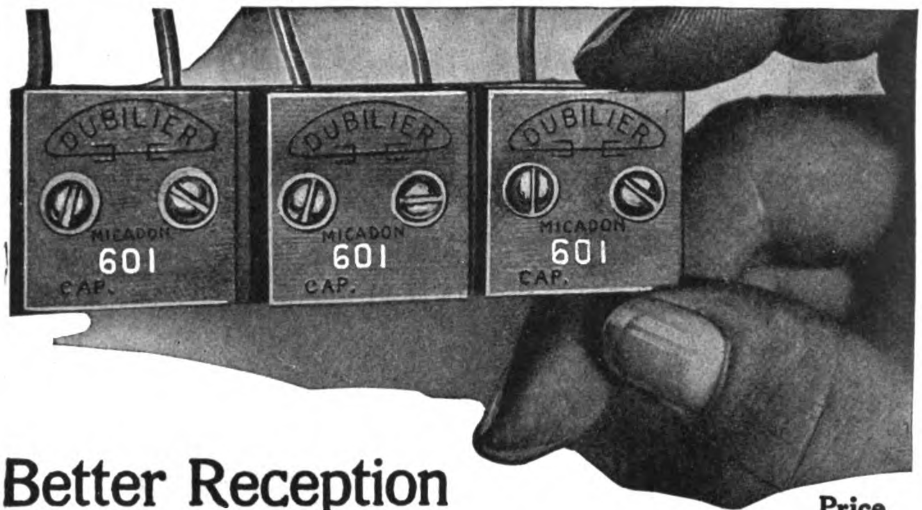
HIGHLY EFFICIENT

We also manufacture various types of RECEIVING SETS

Write today for prices and particulars

Superior Radio Co.

120-122 West Ann St., Los Angeles, Cal.



Better Reception With Micadons 601

Price **35c** each

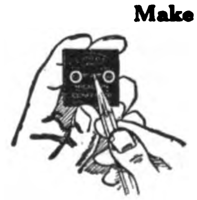
Dubilier Micadon Type 601, here shown full size, has the same perfect mica insulation, the permanent capacity that has always characterized the famous larger, Dubilier mica condenser, which is the standard equipment of 95% of the governments and radio companies of the world.

Dubilier Micadon Type 601 is a little larger than a postage stamp. Use Micadons Type 601 to build up any capacity by connecting them in series or parallel. Buy Micadons by the dozen and keep them on hand.

Dubilier Micadon Type 601 insures perfect broadcasting reception. Because the condenser layers are *pressed* together they cannot dilate and contract with the oscillations of current in the antenna. Hence the capacity cannot vary, and there can be no tube "howls" and noises due to fluctuations of capacity.

Price 35 cents each for capacities .0001 to .0005 mfd.; by the dozen $4.00. Price 40 cents each for capacities .001, .002, and .0025 mfd.; by the dozen $4.50.

Make Your Own Grid-Leak With a Lead Pencil



Sandpaper the surface of Dubilier Micadon Type 601 between the terminals. Next rub the point of a black lead pencil over the roughened surface as here shown. To adjust the grid-leak thus made rub away as much of the graphite that has been deposited as may be necessary. Every tube should have an *adjusted* grid-leak, and this is the way to make one simply and cheaply.

Order from your dealer

DUBILIER CONDENSER AND RADIO CORP.

Department 217-219 Centre St., New York

BRANCH OFFICE: Munsey Building, Washington, D. C.

LICENSEES:
- CANADA: Canadian General Electric Co., Toronto
- ENGLAND: Dubilier Condenser Co., Ltd., London
- GERMANY and SOUTH AMERICA: Telefunken Co., Berlin
- FRANCE: C. Capart, Paris.

PRMCO GRID CONDENSER

Bakelite Strip . . . . **40c.**

All Kinds of Apparatus in Stock

Get Price List—Postage-Paid

QST RADIO SHOP

3305 BELMONT AVE. FRESNO, CALIF.

FRESNO'S PIONEER RADIO STORE

A NEW RADIO BILL

Continued from page 36

"Sec 3. A. That the actual operation of apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued thereunder. No person shall operate any apparatus in such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

"B. That the Secretary of Commerce, in his discretion, may grant special temporary operators' licenses to operators of radio apparatus under such regulations, in such form, and upon such conditions as he may prescribe whenever an emergency arises requiring prompt employment of such an operator.

"C. That an operator's license shall be issued by the Secretary of Commerce in response to a written application therefor, addressed to him, which shall set forth (a) the name, age, and address of the applicant; (b) the date and place of birth; (c) the country of which he is a citizen; and if a naturalized citizen of the United States, the date and place of naturalization; (d) the previous experience of the applicant in operating radio apparatus; and (e) such other facts or information as may be required by the Secretary of Commerce. Every application shall be signed by the applicant under oath or affirmation.

"D. That an operator's license shall be issued only to a person who, in the judgment of the Secretary of Commerce, is proficient in the use and operation of radio apparatus and in the transmission and reception of radiograms by telegraphy and telephony. Except in an emergency found by the Secretary of Commerce to exist, an operator's license shall not be granted to any alien, nor shall such a license be granted to a representative of a foreign government.

"E. That an operator's license shall be in such form as the Secretary of Commerce shall prescribe, and may be suspended by him for a period not exceeding two years upon proof sufficient to satisfy him that the licensee: (a) has violated any provision of any act or treaty which the Secretary of Commerce is authorized by this Act to administer, or of any regulation made by the Secretary under any such Act or treaty; or (b) has failed to compel compliance therewith by any unlicensed person under his supervision; or (c) has failed to carry out the lawful orders of the master of the vessel on which he is employed; or (d) has wilfully damaged or permitted apparatus to be damaged; or (e) has transmitted superfluous signals, or signals containing profane or obscene words or language.

"F. That a license may be revoked by the Secretary of Commerce upon proof sufficient to satisfy him that the licensee was at the date his license was granted to him, or is at the time of revocation, ineligible for a license.

"Sec. 4. A. That after the approval of this Act the construction of a station for which a license is required by this Act shall not be begun, nor shall the construction of a station already begun be continued, until after a permit for its construction has been granted by the Secretary of Commerce upon written application therefor. This application shall set forth such facts as the Secretary of Commerce by regulation may prescribe as to the citizenship, character, and the financial, technical, and other ability of the applicant to construct and operate the station, the ownership and location of the proposed station and of the station or stations with which it is proposed to communicate, the wave or wave lengths desired to be used, the hours of the day or other periods of time during which it is proposed to operate the station, the purpose for which the station is to be used, the type of transmitting apparatus to be used, the power to be used, the date upon which the station is expected to be completed and in operation and such other information as the Secretary of Commerce may require. Such application shall be signed by the applicant under oath or affirmation.

"B. That such permit for construction shall show specifically the earliest and latest dates between which the actual operation of such station is expected to begin and shall provide that said permit will be automatically forfeited if the station is not ready for operation within the time specified. The rights granted under any such permit shall not be assigned or otherwise transferred to any other person, persons, company, or corporation, without the approval of the Secretary of Commerce: *Provided*, That a permit for construction shall not be required for Government stations to be used exclusively for communication of official business or for private stations as provided for in Section 4, fifteenth regulation, of the Act of August 13, 1912. The granting of this permit to construct a station as herein required shall not be construed to impose any duty or obligation upon the Secretary to issue a license for the operation of such station.

"SEC. 5. That an advisory committee is hereby established to whom the Secretary of Commerce shall refer for examination and report such matters as he may deem proper relating to: (a) the administration or changes in the laws, regulations, and treaties of the United States relating to radio communication; (b) the study of the scientific problems involved in radio communication with the view of furthering its development; (c) the scientific progress in radio communication and use of radio communication.

"The advisory committee shall consist of twelve members, of whom one shall be designated by the Secretary of State, one by the Secretary of War, one by the Secretary of the Navy, one by the Secretary of Agriculture, one by the Postmaster General, and one by the Secretary of Commerce, to represent these departments, respectively, and six members of recognized attainment in radio communication not otherwise employed in the Government service to be designated by the Secretary of Commerce.

"The necessary expenses of the members of the committee in going to, returning from, and while attending meetings of the committee, including clerical expenses and supplies, together with a per diem of $25 to each of the six members not otherwise employed in the Government service for attendance at the meetings, shall be paid from the appropriation made to the Department of Commerce for this purpose.

"SEC. 6. That radio telephone stations, the signals of which can interfere with ship communication, are required to keep a licensed radio operator, of a class to be determined by the Secretary of Commerce, listening in on the wave length designated for distress signals during the entire period the transmitter of such station is in operation.

"SEC. 7. That regulation first of Section 4 of said Act of Congress approved August 13, 1912, is amended by striking out the words 'this wave length shall not exceed six hundred meters.

"Regulations third and fourth of Section 4 Act of Congress approved August 13, 1912, is amended by striking out the words 'provided that they do not exceed six hundred meters or that they do exceed one thousand six hundred meters.'

"Regulations third and fourth of Section 4 of said Act of Congress approved August 13, 1912, are amended by striking out the words 'exceeding two hundred meters' and substituting in lieu thereof the words 'of not less than one hundred and fifty meters nor more than two hundred and seventy-five meters.'

"SEC. 8. That any person, company, or corporation who shall erect, use, or operate any apparatus for radio communication in violation of this Act, or knowingly aid or abet another person, company, or corporation, in so doing, or knowingly make false oath or affirmation for the purpose of securing a permit or a license, shall incur a penalty not to exceed $1,000, which may be mitigated or remitted by the Secretary of Commerce, and the permit or license of any person, company, or corporation, who shall violate any of the provisions of this Act, or of any of the regulations of the Secretary of Commerce issued hereunder, or knowingly make any false oath or affirmation for the purpose of securing a permit or license, may be suspended or revoked by the Secretary of Commerce.

"SEC. 9. That the Secretary of Commerce is hereby authorized and directed to charge, and through the imposition of stamp taxes on applications, licenses, or other documents, or in other appropriate manner, to collect, the fees specified in the schedule following. The Secretary shall collect said fees through the collectors of customs or other officers designated by him, and he may make such regulations as may be necessary to carry out the provisions of this section."

"SCHEDULE OF FEES TO BE COLLECTED"

"For trans-oceanic radio station license, $300 per annum; for commercial land station license, other than trans-oceanic, one kilowatt transmitter input or less, $50 per annum; and for each additional kilowatt or fraction thereof, $5 per annum; for ship station license, 25 per annum; for experiment station license, $25 per annum; for technical and training school station license, $15 per annum; for special amateur station license, $10 per annum; for general and restricted amateur station license, $2.50 per annum; for commercial extra first-class operator's license, $2.50 per annum; for commercial first-class operator's license, $1.50 per annum; for commercial second-class operator's license, $1 per annum; for commercial cargo grade operator's license, 50 cents per annum; for experiment and instruction grade operator's license, $1 per annum; for amateur first-grade operator's license, 50 cents per annum; for amateur second-grade operator's license, 50 cents per annum; for commercial extra first-class radio operator's examination for license, $2.50 for each examination; for commercial first-class radio operator's examination for license, $2 for each examination; for commercial second-class radio operator's examination for license, $1.50 for each examination; for commercial cargo grade radio operator's examination for license, $1 for each examination; for experiment and instruction grade radio operator's examination for license, $1 for each examination; for amateur first-grade radio operator's examination for license, $1 for each examination; for amateur second-grade operator's examination for license, 50 cents for each examination.

"In the event that other classes of station and operator's licenses or other examinations shall hereafter be prescribed in any lawful manner, the Secretary of Commerce is hereby authorized and directed to charge and collect in the same manner as herein provided fees for such new classes of licenses and of examinations, which fees shall be substantially of the amount herein specified for the license and examination nearest in character and purpose to the new license or examination so prescribed.

"For failure to pay at the time and in the manner specified by the Secretary of Commerce any of the above fees the Secretary of Commerce is authorized to refuse to issue such licenses; or if issued, to suspend or revoke the same, as he may deem proper.

"SEC. 10. That wherever the words 'naval and military' stations appear in the Act to regulate radio communication, approved August 13, 1912, said words 'naval and military' shall be stricken out and the word 'Government' substituted in place thereof.

"SEC. 11. That all Acts or parts of Acts in conflict with this Act are hereby repealed."

IS RADIO HERE TO STAY?

By E. P. EDWARDS

For years, and until 1920, the typical drummer's story held sway in the smoking compartments of our trains. Then, with the enactment of the 18th Amendment, it was "how to make it" and "where to get it." Now, the talk is all radio.

Has the country gone mad over a fad?

To many it would seem so and, in many respects, the present furore is unfortunate, creating an unprecedented demand which nobody was prepared to meet.

In consequence the population of the country is divided into two classes, those who are clamoring for radio equipment and those who are trying to manufacture it—the latter class being almost as strong numerically as the former.

As a result, the market will shortly be flooded with good, bad and indifferent devices and the public, together with the legitimate manufacturers, will suffer from the activities of the radio "bootleggers" whose number is legion.

Radio will not supplant the wire telephone on land; it will not take the place of the phonograph or the daily newspaper; it will occupy a field of its own creation, and supplement rather than supersede. Radio is destined to play one of the most important roles in the world's history.

It will do more than any other one thing to stimulate the "back to the land" movement, by bringing news, crop, market and weather reports to the farmer and his family, thus giving him that element of human contact, the lack of which has driven so many of our people from the farm to the cities.

Has radio come to stay, or is it a passing craze?

That is a question which many of us are asking.

A little psychological reasoning seems to satisfactorily answer the question.

The favorite indoor and outdoor sport of the American people is centered around the pleasure they derive from "kicking." This national trait of being dissatisfied with things as they are, coupled with the ability to criticize constructively, is what has put us in the forefront of progress and invention.

Do you ever get tired of your phonograph? If so, isn't it because you get what you want when you want it with a minimum of trouble, and with unvarying results?

Do you get tired of golf? You would if you could steadily improve your game to a point where you could play every hole in par with certainty. True, you burn, break, sell or give away your clubs at irregular intervals, but you do not stop playing. Why not? Isn't it because of the element of uncertainty in the game?

This same element of uncertainty attaches to billiards, fishing, matrimony and many other well known sports.

In radio we have a deadly parallel introducing all kinds of uncertainties, such as static, interference, fading and "birdies."

Do you not think that from the very "nature of the beast" that our people will find the keenest enjoyment in that competition for better results, which will lead to the perfection of an art that is now only in its infancy?

Don't forget to read the classified Ads on page 94

BIG SUPPLY LATEST APPARATUS **ON HAND** READY FOR PROMPT DELIVERY

4 HOUR MAIL ORDER SERVICE

WE ASSURE YOU OF THE MOST PROMPT SERVICE

Our Radio Mail Order Service is gaining much popularity on account of the FAST SERVICE. We ship your order within four hours of its receipt. After you tire of waiting days—or maybe weeks—for your supplies, try Warner Brothers' Radio Mail Order Service and you will use no other. Following are a few items that we have in stock:

VARIABLE CONDENSERS

.0003 17 Plates K & C Type	$3.00
.0005 23 Plates K & C Type	3.50
.001 43 Plates K & C Type	5.00
.0015 63 Plates	7.20
.001 43 Plate Warner	4.00
.0005 23 Plate Warner	3.50

LOUD SPEAKERS

R3 Magnavox Radio Type	$45.00
R2 Magnavox (36 inches long)	85.00

EVEREADY "B" BATTERIES

No. 765, 22½ Volts	$2.00
No. 766, 22½ Volts, tapped	3.00
No. 774, 43 Volts, tapped	5.00

REMLER APPARATUS

810 Jr. Rheostats	$1.00
811 Rheostats	1.75
813 3 Amp. Rheostats	1.75
330 Audion Detector Panel	8.00
331 Amp. Panel	6.00
333 Amp. Panel	9.00
400 3 Coil Mounting	6.50
96 Variable Grid Leak	.60
97 Grid Condenser	.35

SOCKETS

158 GENERAL RADIO	1.50
550 MURDOCK	1.00
DEFOREST Moulded Bakelite	1.10
CROSLEY Porcelain	.60
KELLOGG	1.00
PARKIN	1.50

AMPLIFYING TRANSFORMERS

UV-712 Radio Corporation	$7.00
231A GENERAL RADIO	5.00
226W FEDERAL	7.00
A2 ACME, semi-mounted	5.00
Thordarson	4.00
BRYANT	5.00

VARIOMETERS

REMLER 505 Moulded Bakelite	$6.50
OUR OWN TYPE	4.50
ATWATER KENT	8.00

JACKS AND PLUGS

FEDERAL 1421 Open Circuit Jack	$ .70
FEDERAL 1422 Single Circuit Jack	.85
FEDERAL 1423 Double Circuit Jack	1.00
FEDERAL 1435 Automatic Filament Control Jack	1.20
FEDERAL 1438 Automatic Filament Control Jack	1.30
WESTERN ELECTRIC Plugs	1.30
FEDERAL Plugs	2.00
PACENT UNIVERSAL	1.25
NEW FEDERAL Universal Plug	1.75
FEDERAL PLEIPHONES	14.00

RHEOSTATS

REMLER Jr.	$1.00
FADA—with new Knob	1.00
GENERAL RADIO No. 214 7 ohm or 2½ Amp. 2 ohm	2.50
DEFOREST, new type	1.25
PARAGON	1.50
MURDOCK 560	$1.00
KLOSNER	1.50
JENKINS	2.00
FRAMINGHAM	1.00
HOWARD	1.25
CUTLER HAMMER	1.00

RADIO FREQUENCY TRANSFORMERS

MURAD T-11, 160 to 500 meters	$6.00
MURAD T-11A	6.50
MURAD T-11B	7.00
RADIO ENGR. CO.	6.00
UV1714	6.50
Radio Service Co.	6.00
Radio Instrument Co.	8.00

STORAGE BATTERIES

6 Volt 70 A. H.	$16.00
Philadelphia 6 V. 60 A. H.	16.00

VARIO-COUPLERS

REMLER 503 Vario-Coupler	$5.40
REMLER 505 Coupler on Unit Panel	12.75
OUR OWN TYPE	3.50
ATWATER KENT	8.00

PHONES

Federal, 2200 Ohms	$8.00
Federal, 3200 Ohms	10.50
Cory	8.00
Western Electric, 2200 Ohms	12.00
Dictograph, 3000 Ohms	12.00
Manhattan, 2000 Ohms	6.00
Manhattan, 3000 Ohms	7.00
Brandes, Superior	8.00
Lincoln, 3000 Ohms	8.00
Frost, 2000 Ohms	5.00
Frost, 3000 Ohms	6.00

Now that you have read the list, get that order into the mails without delay. If there is something that you want and don't see it listed here, write us anyway and we will get it for you. Our two stores save still more time in getting your apparatus in a hurry. Enjoy the pleasure of real service for a change. Send us your orders.

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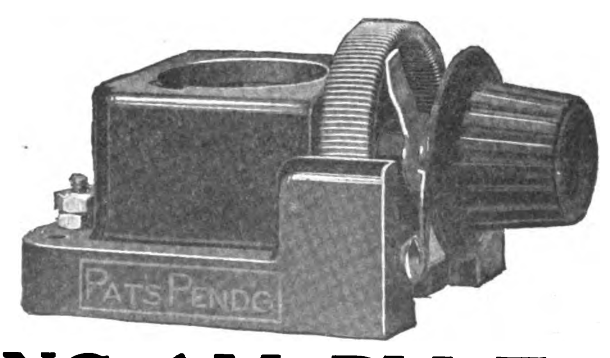
KING Rheo-Socket

Another RADIO SURPRISE

Price $3, f. o. b. New York City

Compact, increased efficiency, shorter connections, less wiring—brings in stations you never heard before. Make this a part of your up-to-date set.



A high grade article in Red Bakelite with Phosphor-Bronze Contacts and Alloy Resistance Wire.

For Base or Table Mounting

KING AM-PLI-TONE

82 CHURCH STREET NEW YORK

Mfrs. of the Famous KING AM-PLI-TONE

Jobbers, wire or write for proposition

WILL TRY OUT AUTOMATIC RELAY

The Radio Section of the Signal Corps plans very soon to try out the operation of an automatic relay at Chicago, controlled from Washington, thus enabling the Capital station to control traffic through Chicago west, probably at least as far as Omaha. If the circuit works well, it is also planned to install a similar relay at Omaha and to operate to the far west from Washington by means of the 20 K. W. set at Arlington. Omaha will be advised when the messages are to be relayed through their station and will stand by letting Washington work through the relay to Salt Lake City or even farther west.

Last month the Radio Section of the Signal Corps handled 5,232 official messages numbering 175,672 words, and equalling a saving of approximately $2,718 over what the cost would have been via commercial lines. Except for the interference of static in the west, these figures would have been doubled, it is said.

NAVY ASKS APPROPRIATION

Continued from page 33

every year," he stated. Going further into details, the head of the Navy's radio research and maintenance department explained that the shore stations did not interfere with other government or commercial services, and that they were necessary to the safety of merchant and war ships, both in times of peace and war.

Today the Navy has 214 shore communication stations, including 90 on the coasts, 46 on light vessels, 54 radio compass stations, three radio laboratories, 10 carrier pigeon stations, and 11 super power trans-Atlantic stations, all of which practically pay for themselves besides being essential in the interests of the country.

Earns $23,000 Per Month

For the first six months of the current fiscal year, Naval radio stations earned the sum of $144,659, an average of $23,000 per month. In 1921 the number of words carried decreased by 24,946,657, due to the discontinuing of many war-time activities, the reduction of Shipping Board operations, and the elimination of much telegraph and radio traffic in the interests of economy. Therefore, the earnings or "savings" decreased in 1921 some two million dollars over what they were the year previous, being only $3,509,386, a sizable saving, nevertheless, it was pointed out.

"It is worthy of note," the Admiral interjected, "that the interests of the U. S. Navy in radio communication has resulted in the United States commercial interests becoming predominant in world radio communication."

The Navy's net is almost world wide, and connects all the Government's outlying possessions with the United States, furnishing as well a medium of rapid communication with our fleets of war and merchant marine.

Some Radio Developments

Replying to a question as to what the Navy had done specifically to develop the art of radio telegraphy and telephony, Admiral Robison stated that a few of them included improvements in facilities for secret communication; increased the range of aircraft radio sets from 50 to 500 miles, and reduced the weight materially, making long-range spotting possible; developed a pilot cable for harbors and aircraft landing fields, increasing the safety of both water and aerial navigation; made possible the sending and receipt of five simultaneous messages; increased long-distance speed from 10 to 60 words per minute, and made possible automatic transmission and reception. Other work includes the development of the kite aerial for transmitting from a seaplane on the water; radio compass improvements making radio applicable as a direction indicator and position finder; the elimination of static and "mush;" an advance in the radio controlled torpedo and vessels, and the introduction of the arc transmitter and uniwave system of signalling.

MARCONI VISITS BIG RADIO PLANTS

WELCOMED by scientists and engineers of international note who joined in high praise of his great accomplishments in the field of radio, Senator Guglielmo Marconi spent a busy day at the plant of the General Electric Company, Schenectady, N. Y., on June 26, inspecting the big electric works and conferring with the wireless experts of the G-E Company and the Radio Corporation of America.

Senator Marconi made a special trip as far as Albany in his yacht *Electra* and was brought over to Schenectady by automobile, accompanied by a large party of officials of the Radio Corporation, officers of the Italian Navy, the United States Army and Navy and others.

During his visit he delivered a speech on wireless from the General Electric Broadcasting Station WGY, held an informal reception for several thousand Italian residents of the city, attended an informal dinner tendered to him by E. W. Rice, Jr., honorary chairman of the board of directors of the General Electric Company, and a large luncheon in his honor given by the company. He returned to New York the following day.

The greater part of the distinguished inventor's visit was filled with inspection of the radio manufacturing division of the General Electric Company, its broadcasting station and an examination of the famous Research Laboratory.

At the luncheon held at the Mohawk Golf Club, the toastmaster was Mr. Rice and the speakers included Owen D. Young, chairman of the board of directors of the General Electric Company and of the Radio Corporation, Dr. W. R. Whitney, director of the Research Laboratory, Dr. Irving Langmuir, assistant director, Mayor George R. Lunn of Schenectady and G. P. Baccelli, Italian Consul in New York, a member of Senator Marconi's party. Among other officials present were Edward J. Nally, president of the Radio Corporation, J. W. Elwood, secretary, and David Sarnoff, general manager. About 125 persons, including officials of the G-E Company, attended the luncheon.

The spontaneity of the greeting accorded Marconi pervaded the whole city and came not only from the scientific workers who are engaged in engineering problems, but from the lowliest citizen, all turning out to do him honor.

O. D. Young, in a keynote address at the luncheon, classed Marconi with Edison as "the leading inventor of the world." Dr. Whitney and Dr. Langmuir pointed out some of the high spots of his epoch-making investigations and predicted new and greater fields for the extension of radio communication. The freedom of the city was tendered by Mayor Lunn and a brief address of welcome was given by Consul Baccelli.

In responding to the toast Marconi spoke of the influence which radio is having and is destined to have on world human relations by facilitating communication between nations and between peoples of the world, and the infinite future possibilities of the art of wireless as new knowledge of this strange and little understood phenomenon begins to be known.

Marconi's experiments in short and long wave radio transmission were touched on with the prediction that the feat of encircling the globe by wireless was a possibility in the not distant future.

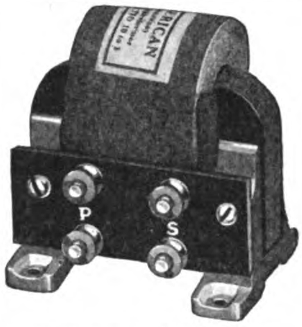
RADIO THIEVES MAKE BIG HAUL

People are bound to have radio sets, even if they have to steal their instruments.

What is believed by detectives to be the work of boys was the robbery of between $900 and $1,200 worth of apparatus from the Radio Concert Equipment Company's store at 734 West Sixth Street, on the evening of July 4, the biggest haul of radio equipment ever made by robbers in Los Angeles.

Among the apparatus taken were five audion sets, twelve Thordarson transformers, twenty-five Kilbourne & Clarke telephones, six pairs of Manhattan telephones, three home chargers, fifteen crystal detector sets, soldering irons and many odds and ends, such as switch points and switches.

The thieves entered by the rear door, breaking the glass with a piece of gas pipe and unlocking the door from the inside, according to Will Brenniman, manager of the concern.



TYPE R-2 $4.25
TYPE R-3 $4.50

Is Your Receiving Set Complete?

You are not getting the most out of your Receiving Set unless you are using Radio and Audio Frequency

TYPE R-10
$4.50

THE Audio Frequency Transformer is made in two ratios—R-3, 10 to 1; R-2, 3 to 1. The R-3 for use on one stage and the R-2 for subsequent stages. The coils of these transformers are carefully insulated and the iron core has been designed from practical tests made by our engineers.

The whole is mounted with a bakelite-delecto panel in a polished aluminum stand, easy to install. It is provided with four binding posts, nickel plated.

The All-American Radio Frequency Transformer, Type R-10 (150-550 meters), has given a new impetus to this latest discovery of radio receiving. Heretofore, Radio frequency was hard to control—but this transformer has now made Radio frequency accessible to all.

Weak signals are amplified before detected. Simple to tune, yet sharp enough for the most discriminating. Fits into tube socket, making connections simple, and permits of short connections which are so desirable. Efficient on 150 to 550 meter wave lengths.

Ask Your Dealer

If he cannot supply, write us

RAULAND MFG. CO.
35 So. Dearborn St., Chicago, Ill.

Send for folder of All-American complete line of radio supplies, including variable condensers, fixed condensers, 50-watt tube sockets, etc.

Radio Panels and Parts

Start *your* set right. Pay particular attention to "insulation." Get a good panel and dependable parts. To make sure that you *do* get them look for the dealer displaying this sign:

CONDENSITE CELORON
Radio Panel Service

Condensite Celoron panels and parts are right. You can bank on them, for this strong, handsome, waterproof material (approved by the Navy Department, Department of Engineering) is extremely high in surface and volume resistivity and dielectric strength. It machines readily, engraves without "feathering," and takes a beautiful natural finish—polished or dull. That is why it is so widely used for panels, tube bases, mountings, variable condenser endplates, tubes, dials, knobs, handles, bushings, etc. We can machine all of these parts to your specifications.

Send today for our Radio Panel Guide

Are you an enthusiast? This Guide describes our panels in detail—tells how they are made and what they cost. Are you a radio dealer? Learn about Celoron Radio Panel Service and how easily and profitably it enables you to supply your customers with panels and parts fully machined and engraved to their specifications. Write for our Special Dealer's Proposition today.

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NATIONAL RADIO CLUB ORGANIZING

PITTSBURGH, Pa., is the scene of the organization of a club that seems destined to play a big part in the future of radio. The work of enrolling members is already well under way and articles of incorporation have been filed along with application for a charter.

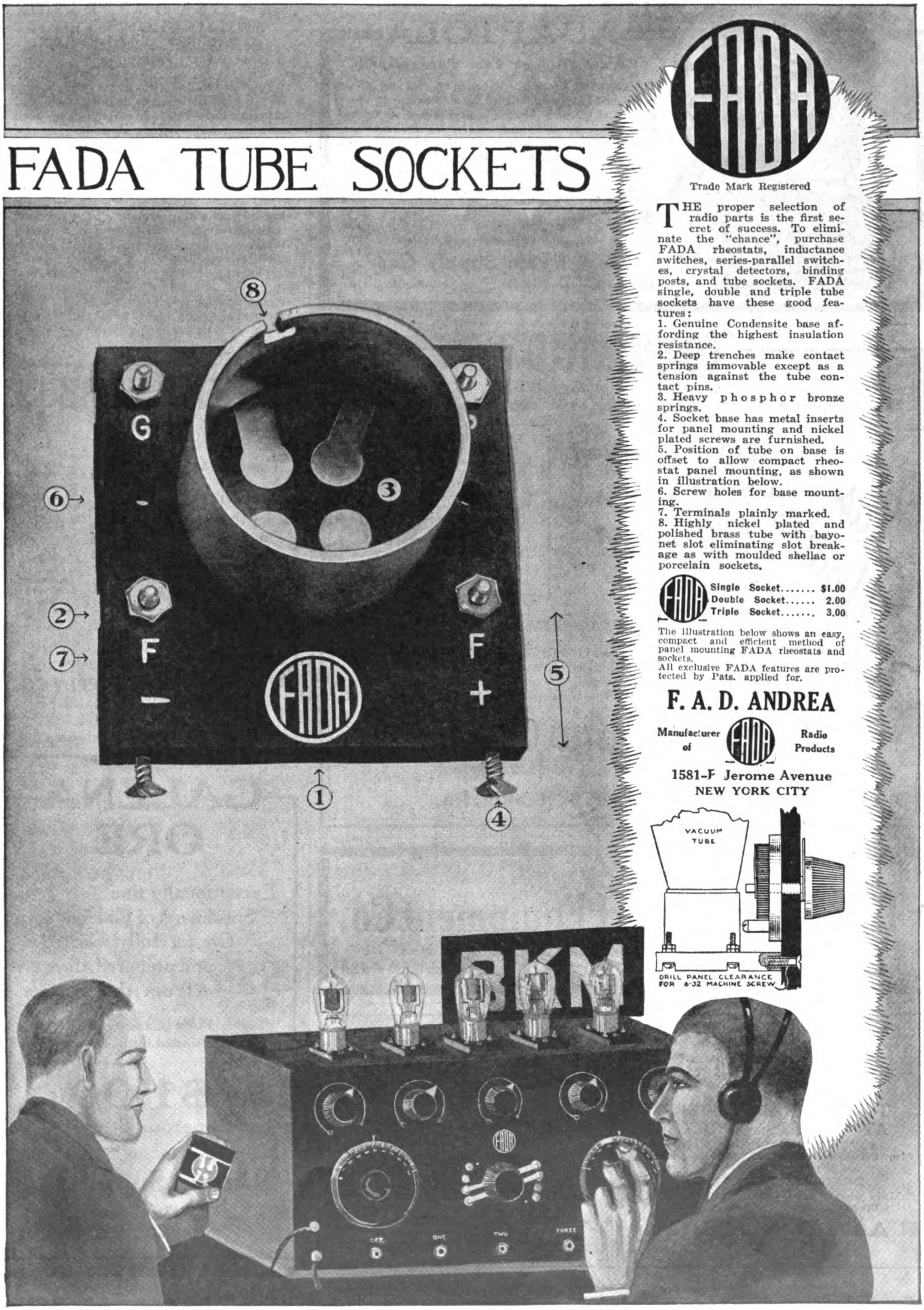
While one of this club's fundamental purposes is to promote and finance the installation of radio equipment in hospitals, it will also use its influence to keep the broadcasting art on its present high plane; enlarge musical and educational radio programs; keep all members informed regarding developments, improvements and news of interest regarding radio; answer, without charge, all technical questions asked by members; receive and file articles written by members for reference; lend the moral support and influence of the club to those agencies endeavoring to eliminate the confusion of signals; promote fraternity and good fellowship among members with the aid of a distinctive official button and card of membership.

The organization committee includes Harold B. Coe of New York City, Charles W. Payne of Philadelphia, F. R. McCray of Los Angeles, Otto J. Palm of Cincinnati, R. Gordon Craig, Ray Mansmann and Francis G. Albertson of Pittsburgh, all radio enthusiasts who are sparing no effort to promote the interests of radio transmission.

Although the National Radio Club has been assured the hearty co-operation of the large manufacturers it will maintain a strictly neutral attitude in all matters of equipment and its officers and directors will be selected from radio enthusiasts not engaged in making or selling radio apparatus.

A nominal membership fee of two dollars will be paid by applicants who will have issued to them a membership card and club button.

Interested persons can get in touch with the club by writing to Francis G. Albertson, Secretary, 419 Fulton Building, Pittsburgh, Pa.


FADA TUBE SOCKETS
FADA
Trade Mark Registered
THE proper selection of radio parts is the first secret of success. To eliminate the "chance", purchase FADA rheostats, inductance switches, series-parallel switches, crystal detectors, binding posts, and tube sockets. FADA single, double and triple tube sockets have these good features:
1. Genuine Condensite base affording the highest insulation resistance.
2. Deep trenches make contact springs immovable except as a tension against the tube contact pins.
3. Heavy phosphor bronze springs.
4. Socket base has metal inserts for panel mounting and nickel plated screws are furnished.
5. Position of tube on base is offset to allow compact rheostat panel mounting, as shown in illustration below.
6. Screw holes for base mounting.
7. Terminals plainly marked.
8. Highly nickel plated and polished brass tube with bayonet slot eliminating slot breakage as with moulded shellac or porcelain sockets.
Single Socket....... $1.00
Double Socket...... 2.00
Triple Socket....... 3.00
The illustration below shows an easy, compact and efficient method of panel mounting FADA rheostats and sockets.
All exclusive FADA features are protected by Pats. applied for.
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Manufacturer of FADA Radio Products
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VACUUM TUBE
DRILL PANEL CLEARANCE FOR 6-32 MACHINE SCREW
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FADA
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3
6
2
7
5
1
4
BKM
DET.
ONE
TWO
THREE

NEW DEMONSTRATION STUDIO SHOWS PROGRESS OF RADIO DEVELOPMENT

A new studio with over 3,600 square feet of space devoted to demonstration and experimental research work has been opened at 1215 Leland Avenue, Chicago, by the Ray-Di-Co. organization. Every evening in this auditorium as many as 300 people can congregate and be entertained free of charge with the best of concerts, operas, bedtime stories, etc., from the local broadcasting station. In connection with this demonstration room is a special studio, size 15x16 feet, with special soundproof walls. This studio is equipped with a pick-up microphone. A particular feature in the Ray-Di-Co. demonstration rooms are the special booths built around the room where radio apparatus can be tested out before being purchased by a radio enthusiast.

It Is Time to Think of Service

It is time to look further than the mere equipment when you buy radio supplies, whether you're in Radio for profit or pleasure.

When you see this name "SIGNAL" on wireless and radio equipment, you may confidently expect real radio service on your problems.

SIGNAL Radio Apparatus is built entirely in SIGNAL factories, from improved designs, by our own radio engineers, working in our own laboratories.

Bear in mind that SIGNAL Equipment is not, nor will it ever be **"side-line" material.**

Back of every SIGNAL Product is a reputable company, with a record of years of successful development in Radio.

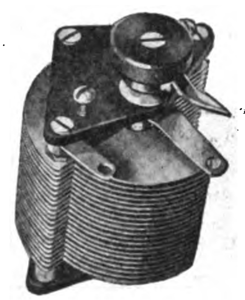
As a part of the Service offered beginners, advanced amateurs and serious experimenters on Radio, we maintain a complete engineering service department, upon which our friends are at liberty to call, at any time, regarding their Radio problems, and to aid them in getting the best results at all times from their apparatus.

When you specify "SIGNAL" you specify "SERVICE"

SIGNAL ELECTRIC MANUFACTURING COMPANY

Menominee, Michigan

SIGNAL BACK MOUNTED VARIABLE CONDENSER



One of the SIGNAL line, produced to meet the demand for a condenser for panel mounting. Comes in three models, so built as to permit mounting on panels from 1/8 to 3/8" in thickness. Machine screws are furnished for fastening the instrument to the panel; it is only necessary to drill three holes. Each instrument furnished with metal scale calibrated to 180 deg. Knob and pointer are removable. Construction is very rigid, the material in the aluminum plates being .026". The bearing plates are 3/16" black Formica.

This request-coupon makes it easy to secure all "SIGNAL" latest Wireless Bulletins, without any obligation. Simply fill out and mail now.

CUT OUT AND MAIL COUPON NOW

COUPON

Send me the new Signal Wireless Bulletin W.

Name ....

Company ....

City ....

State ....

"K F S"

Continued from page 31

the operating engineer," I began to explain.

"Oh, that's all right then," answered Mr. H. E. Coyle, the chief of the big station. "Come right in and blaze away."

Our next picture was of the twenty kilowatt arc in the transmitter room.

"This arc set is tuned to 2,400 meters and is operated on the highest aerial," said the chief. "The ten-kilowatt spark set over there, which is tuned, of course, to 600 meters, has its own separate aerial suspended about sixty feet below the arc-transmitter aerial. The 360-foot masts carry both aerials."

"Whoof!" flared the magnesium powder as Bill shot the picture of the arc transmitter.

"I see th' fog's not rolled in yet," remarked Bill eagerly, as he looked out of the window. "While we're waitin' for the smoke to clear out, I might get up on th' windmill——"

"We're not taking anything more here in the transmitter room," I replied. "There's a fine set of generators and a splendid spark set over there, but nearly everybody knows what dynamos and spark transmitters look like. We're going into the receiving room now."

Muttering something under his breath, Bill followed us into the receiving room.

"We have two complete receiving sets here," said the chief. "One built especially for 600-meter spark signals, and the other for 2,000 to 3,000-meter CW. Each receiving set has its own loop-aerial. The loops are exactly eight feet square, and the 600-meter loop has five turns of wire and the longer-wave loop, fifteen turns. This is a Kolster hook-up."

"How are the loops connected to the receiving sets?" I inquired.

"The two ends of the loop coil are simply connected to the two ends of the receiving transformer primary, and a variable condenser is shunted across for tuning," answered the chief. "There is no ground connection whatever. The two loops are mounted on rotating shafts and are connected by means of bevel gears and other shafts to these two hand-wheels here at the operating desk——"

"I can just get half of one of them wheels in the picture," said Bill from under his focussing cloth. "I've got all the arc-control panel on the other side."

"We rotate the loops according to the direction we wish to receive from," resumed the chief. "If we want to work a ship out on the Japan coast, we have to set the loop in a different position from that with which we work southeast toward Panama, for instance. Of course, we can hear signals from either direction, no matter how the loops are set; but for the best signals, we have to adjust them."

"You must have some remarkable receiving apparatus behind those panels," I hinted.

"Yes, it's pretty good," admitted the chief, with evident pride. "I'd like to tell you about it and give you the hookup, but the chief engineer says that the circuits must be kept secret for a while yet. I'll tell you what I'll do, though. If you'll promise not to describe what you see, I'll let you look inside one of the receiving sets."

"That's understood," I replied.

The chief turned a few thumb-nuts and swung down the hinged panels.

For a few moments, I stood petrified.

"Whew!" I gasped. "I hope I'll be able to write about that some time. A description and hookup of that on paper would be worth five thousand dollars."

"We may be able to make it public later on," said the chief.

"It looks as if some of the designers of amateur apparatus could get some pointers

Continued on page 90

RHAMSTINE*

MODEL B

AMPLIFYING TRANSFORMER

$4.00
Postage and Packing 10c

Ever since its introduction sixteen months ago, the Rhamstine* Amplifying Transformer has steadily gained in favor until today it holds an enviable position with manufacturers and builders of radio sets.

Now comes a new model—the same good quality in the Transformer but with a shielded coil—a metal casing plated and highly polished; a distinctive improvement which will satisfy the most exacting demands.

The Model B is a guaranteed product. The list price is $4.00. You may pay more, but it is difficult to get a Transformer that is better. Immediate deliveries.

THE RHAMSTINE* MODEL A TRANSFORMER

The original Rhamstine* Transformer, now called the Model A, is of course still produced. Substantiating our belief that it is the equal of any Transformer on the market, many letters have been received paying tribute to its excellent amplifying powers. The price is $3.50, postage and packing, 10c.

Complete circulars upon request

Manufactured by

J. THOS. RHAMSTINE*

2152 E. Larned Street **Detroit, Michigan**

*** Maker of Radio Products**

"K F S"

Continued from page 88

on simplicity from your engineers. You have hardly more than half-a-dozen control knobs on each receiving set."

"Yes. You see, we simplify the tuning by having separate complete receiving sets for the two waves we do our work on. One of the receivers of the head telephone set is connected to the 600-meter spark receiving set and the other telephone receiver is hooked to the 2,400-meter CW receiver. There is no electrical connection of any kind between the two receivers. While we are working on 2,100 or 2,400 meters CW, we can at the same time hear everything on 600 meters spark, or *vice versa*. Then we have a master-switch, whereby we can put both receivers on either the 600-meter or the 2,400-meter set. We stand by, however, with one receiver on each set, as we are after all the ship business we can get hold of, arc or spark.

"One interesting thing we've discovered is that the receiving sets work better when the large transmitter aerial is open. That's why we have that big switch up above the arc set, in the transmitter room."

"The ship operators report working you four or five thousand miles right along," I said. "Do you receive those small shipboard sets over such distances with these loop aerials?"

"We certainly do," replied the chief. "We have cleared ships 5,200 miles from San Francisco; and during the winter months we handle business with the Pacific Mail passenger steamers all the way down to Panama, in the Gulf of Mexico, and up the Atlantic until they berth at Baltimore. They have two-kilowatt arc sets."

"Five thousand two hundred miles with a shipboard set," I cogitated. "Just think how few years it is since we were satisfied to cover two hundred miles on our old straight-gap spark outfits."

As I shook hands with the chief, I suddenly discovered that Bill had disappeared. Outside, where the sun blazed in July glory, I overtook him plowing through the sand on the way to the windmill.

"Th' sun's still shinin' and there's another ship out there," he pleaded. "It'd be a pretty picture——"

"Nothing doing," I said firmly, turning him around. "We're making a dash back to our dark-room and typewriter to get this ready for August RADIO."

BUILD YOUR RADIO SET NOW

WITH OUR HIGH QUALITY GOODS

NOTICE OUR ATTRACTIVE PRICES

We Pay Transportation Charges in the U. S. East of the Rockies

THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR

FAST SERVICE—TRY US AND BE CONVINCED

THIS GUARANTEE PROTECTS YOU—**Examine the goods we ship you. They must suit you in every respect. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.**

PLATE CIRCUIT "B" BATTERIES

Look what you can save on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

E180 Signal Corps type small size, 15 cells, 22½ volts. Each $1.10.

E182 Navy size, 6½x4x3, 15 cells, 22½ volts. Each, $1.80.

E184 Variable Navy size, 5 taps giving range from 16½ to 22½ volts in 1½ volt steps. Each, $2.25.

E186 Double Navy size 6½x4x6, 30 cells, 45 volts. Suitable for amplifier circuits and power tube use. Two or more of these units in series may be used in C. W. and radiophone circuits. Each $3.40.

E188—Combination Tapped 45 volts, 30 cell, 6½x4x6 battery. Tapped to give voltage regulation for detector tube. Handles both detector and amplifier tubes. Each, $3.90.

VACUUM TUBES

Standard Brands—Cunningham Radiotron. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.
E105 Detector, each.....$5.00
E110 Amplifier, each..... 6.50
E115 5 Watt Transmitter......... 8.00

FILAMENT CONTROL RHEOSTATS

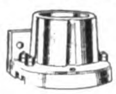
Crosley—Wound on vulcanized fiber. Adjustable to any panel. Complete with knob. E130 Each............ 54c

Best made. High heat resisting base. Diam. 2½ in. 1½ amp. Resist, 6 ohms. 1¼ in. Knob with pointer. E132, each.................. 78c

E133 Potentiometer.............$1.38
E135 Vernier Rheostat............ 1.18

VACUUM TUBE SOCKETS

Our Special Socket. A wonderful value. Moulded entirely of Bakelite. Four binding post connection. E140, each......... 58c



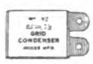
Porcelain Base and Tube E144 **Crosley** for either panel or table mounting, 45c.

Bakelite Base combination type for panel or table mounting. E146, each.... 69c

VARIABLE GRID LEAK

Pencil mark type. Resistance may be varied exactly as needed. E160, each 24c.

GRID CONDENSER

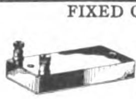


E162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF...... 19c
E163 Same as 162 but higher grade. Enclosed in metal case............ 39c

BAKELITE DIAL AND KNOB

Neat clean cut design. Clear plain engraved scale, with enameled white letters contrasting with polished black finish of dial. Fluted knob. E902 For 3/16 inch shaft. Each 79c; Dozen $7.20.
E903 For ¼ inch shaft. Each 69c; Dozen $7.20.

FIXED CONDENSERS



Moulded cases, nickeled binding posts.
E802 .005 Mfd. Each 59c.
E804 .01 Mfd. Each 79c.

RADIO FREQUENCY AMPLIFYING TRANSFORMER

This transformer will get the long distance stations loud and clear. Permits of easy sharp tuning. Helps cut out static and interference. Makes your set sensitive enough to use a loup aerial. Enclosed in metal case affording perfect shielding. Suitable for panel or base mounting. Because of its special design can be mounted in any V. T. socket. Works with any make of tube. Wave ranges 150 to 550 meters. Wiring diagrams included.
E995 Each.....................$4.50

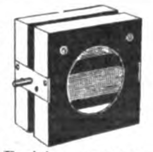
OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

We believe these transformers to be the best on the market. We offer them with two winding ratios—the 10 to 1 for Radiotrons and Cunninghams—the 3 to 1 for A. P. Moorehead. These two types of tubes have entirely different characteristics and therefore require transformers of different winding ratios. As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.
E234 10 to 1 Mounted, each.....$3.95
E235 10 to 1 Unmounted, each.. 3.20
E236 3 to 1 Mounted, each..... 3.90
E237 3 to 1 Unmounted, each.. 3.10

VARIO-COUPLER

E415 Price completely assembled, $3.60
E416 Not Assembled but all parts complete, $1.40.
With this loose coupler and two variometers together with the necessary other parts a highly efficient tuning set can be made. Easily mounted on panel. Windings on formica tubes. Inductively coupled for 180 to 600 meters. Multiple taps permit fine tuning.

VARIOMETER



E410—Completely assembled, price **$3.75**
Perfect in design and construction. Accurate wood forms. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency. Will operate perfectly indefinitely. This variometer will equal in results most of the moulded variometers selling at much higher prices.
E411 Not assembled but all parts complete $1.90

GALENA DETECTOR

Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish. E732 Each...... 98c

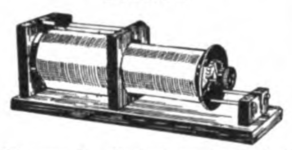
PANEL MOUNTING VARIABLE CONDENSER

Notice our very low prices on this high grade condenser for panel mounting. Mechanically perfect. Guaranteed to suit you or your money back. No knobs nor dials included.
E812 43 plate .001 Mfd. $2.95
E813 21 plate .0005 Mfd. $2.55
E814 11 plate .00025 Mfd.......$2.15
E815 3 plate Vernier.......... 1.85

KNOCKED DOWN VARIABLE CONDENSERS

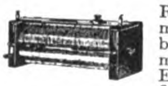
You can save money by assembling your own condensers. Formica top and base. Complete with all parts not assembled.
E820 41 plate .001 Mfd........$2.48
E821 21 plate .0005 Mfd........ 1.88

ARLINGTON RECEIVING TRANSFORMER



Will tune in all stations up to 3,500 meters. Very efficient on short waves and for radiophone reception. Used with our Detector Two Step Amplifier it produces very excellent results. Also does good work with crystal detector. Silk covered windings on formica tubes. Very fine mahogany finish wood work. Base size 6x18 inches. Slider controls primary, 12 point switch on secondary. Can be tuned very close. A wonderful value at our price.
E720 Price...................$6.95

TUNING COIL



Range up to 950 meters. Wound with bare copper wire, machine spaced. Ends of mahogany finished hard wood. Two easy sliding contacts on polished brass rods, four binding posts. Substantial, efficient, attractive. Length 8¾ in. E722, price...........**$2.45**

ANTENNA WIRE

Solid Bare Copper Wire size 14
E240 100 ft. coil............... 45c
E242 500 ft. coil...............$2.15

Solid Bare Copper Wire size 12
E244 100 ft. coil............... 72c
E246 500 ft. coil...............$2.85

Seven Strands No. 22 Copper Wire Cabeled
E248 100 ft. coil............... 94c
E249 500 ft. coil...............$4.25

HEAD SETS "PHONES"

Double sets complete with head bands connecting cord.
E751 Murdock No. 56, 2000 ohm., $4.85.
E752 Murdock No. 56, 3000 ohm., $5.80.
E756 Brandes Superior, 2000 ohm $7.60.
E758 Western Electric, 2200 ohm., $12.00.
E760 Barawik, 2000 ohm., $4.65.
E762 Barawik, 3000 ohm., $5.55.

SOLID GENUINE CONDENSITE CELERON PANELS

Notice our very low prices on this fine quality grade 10 genuine solid sheet Condensite Celeron (a product with mechanical chemical and electrical properties like formica and bakelite). Machines well without chipping. Won't warp. Waterproof. Highest mechanical and di-electric strength. Attractive natural polished. Black finish which can be sanded and oiled for extra fine work.

Panel Size Inches	⅛" thick Art. No.	Price	3/16" thick Art. No.	Price	¼" thick Art. No.	Price
6x7	E450	$0.50	E460	$0.75	E470	$0.98
6x10½	E451	.75	E461	1.18	E470	1.47
6x14	E452	1.05	E462	1.55	E472	2.05
7x18	E453	1.55	E463	2.30	E473	3.10
7x21	E457	1.78	E467	2.65	E477	3.60
9x14	E454	1.60	E464	2.30	E474	3.10
12x14	E455	2.10	E465	3.10	E475	4.15
12x21	E456	3.15	E466	4.65	E476	6.20

BINDING POSTS

Brass, polished nickel finish. Washer and 6/32" screw extending ⅝".
E370 Large size—barrel and knob ¾" long, dozen.............95c
E372 Smaller size—barrel and knob 9/16" long, dozen......84c
E374 Large size with composition knob, dozen.......................60c
E376 Large size with hole for phone tip or wire, dozen.....................95c
E378 Small size with hole for phone tip or wire, dozen.....................48c

CABINETS

Fine looking cabinets, solidly built. Made of genuine solid mahoganed in elegant hand rubbed finish. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are Transportation paid.

Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x7"	5½"	6½"	7"	E420	$2.48
6x10½"	5½"	10"	7"	E422	2.75
6x14"	5½"	13½"	7"	E424	3.30
7x18"	6½"	17½"	10"	E426	3.90
6x21"	5½"	20½"	7"	E425	3.90
9x14"	8½"	13½"	10"	E428	3.70
12x14"	11½"	13½"	10"	E430	4.40
12x21"	11½"	20½"	10"	E432	5.25

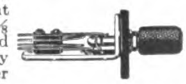
SWITCH CONTACT POINTS

Brass, polished nickel finish. All have ⅝" long size 6/32 screws. All prices the same.
Dozen 20c **Hundred $1.40**
Order by Article Number.
E360 Head, ¼"; Diam., ¼" High.
E362 Head, 3/16"; Diam., ⅛" High
E363 Head, 3/16"; Diam., 1/16" High
Solder Lugs to Fit Contact Points
E365 Dozen 12c—Hundred 60c

SWITCH LEVERS

Moulded composition knob. Exposed metal parts polished nickel finish. Wiping contact. Fitted with panel bushing, wire lug, spring and two set nuts. A high grade switch.
E380—1" Radius. Each.......$ .35
E381—1¼" Radius. Each....... .35
E382—1½" Radius. Dozen....... 3.00
Switch lever stop. Brass, polished nickel finish. E386—Dozen 20c, hundred $1.40

RADIO JACKS AND PLUGS



Jacks are polished nickel finish. Mount on panels ⅛ to ⅜ in. thick. Extend back on panel only 2-7/16 in. Silver contact points.

Jacks Only:
E390 Open circuit, each... 48c
E391 Closed circuit, each.. 59c
E392 Two circuit, each.... 72c
E393 Single circuit filament control............... 80c
E394 Two circuit filament control................ 99c

E395 Plug. Large space with set screws for attaching cord. Each...... 85c

THE BARAWIK CO. 102 South Canal Street CHICAGO, ILL.

PITTSBURGH CONCERN EXHIBITS IN SAN FRANCISCO

THE Radio Electric Company of Pittsburgh, pioneers in the manufacture and distribution of radio apparatus, shipped a wonderful radio display to The Emporium, one of San Francisco's largest department stores, for exhibition in the Shriners' Radio Show. Coming over a distance of 3,500 miles, this concern displayed enough apparatus to start a small store, in addition to distributing thousands of pamphlets and circulars of different representative lines of radio equipment. They were represented by Mr. Higby, Purchasing Agent and Credit Manager, and Mr. Curley, Assistant Sales Manager, who were in charge of the company's booth at the show.

The general direction of this show, held in honor of the Shriners' convention, was in the hands of Mr. Charles S. Mauzy, of The Emporium. A very entertaining program was given daily, which consisted of motion pictures on the action of various radio phenomena, radiophone concerts, orchestra music, and fancy dancing.

Messrs. Higby and Curley will stop at various cities on the return journey, to meet their dealer patrons. It is estimated that they will be gone about ten weeks.

ARMY RADIO NET GROWS TO 51 STATIONS, INCLUDING PART OF ARLINGTON STATION

The Signal Corps radio message center in the Munitions Building at Washington now controls 51 separate radio stations throughout the country, connecting every corps area and numbers of small stations with the Army headquarters in this city. During the past few days, stations at Camp Custer, Michigan; Miller Field, Staten Island; Scott Field, Illinois; Rockwell Field, California; Camp Lewis, Washington: and Arlington, Virginia, have been added to the net of the Signal Corps.

CAN "CANNED MUSIC" WHEN BROADCASTING!

If broadcasting is to continue in its present state of popularity, the entertainment sent out by some stations must improve, an official of the Department of Commerce said. "Why is it," he asked, "that some broadcasters send out 'canned music,' particularly when the records are not very good and the transmission is poor?"

Today nearly every householder has a pronograph and a set of favorite records, but if he hasn't, he can hear "jazz" at almost any shoe-shining parlor. He doesn't want to listen to inferior records.

Except in communities where good talent for vocal or instrumental music is unavailable, there is no excuse for putting on phonograph records and cluttering up the ether, it is pointed out by radio officials.

The H. H. Eby Manufacturing Company, Philadelphia, have designed a new binding post similar to their Ensign and Junior posts which are already familiar to the trade.

This post, which they have named "Ace," has a nickel-plated brass base with solid 8-32 thread stem extending approximately ½ inch below the base. The base of the post is heavily knurled to prevent turning when mounted, and a hole is drilled through the neck sufficiently large to take a No. 15 bar wire.

This post is supplied with a black insulated knob ½ inch in diameter by approximately 7-16 inch high, and makes a very attractive post for use on certain apparatus.

★ ★ RADIOADS ★ ★

A CLASSIFIED ADVERTISING SECTION READ BY 60,000 BUYERS

The rate per word is five cents, net. Remittance must accompany all advertisements. Include name and address when counting words.

ADS FOR THE SEPTEMBER ISSUE MUST REACH US BY AUGUST FIRST

RECEIVING APPARATUS

FOR RELIABLE BROADCAST RECEPTION buy a "Master Radio Broadcast Receiver." Write at once for complete circular. Master Engineering Company, Omaha, Nebr.

FOR SALE: Variable condensers: plates 4c, rotary washers 10c dozen, stationary 5c, shafts 25c, supporting rods 5c, tops and bottoms 25c pair, knobs 15c. Parts 23 plate $1.85; 43 $2.85. Assembled $1.00 extra. Tool and die work. Gravenstede, 84 Hancock Ave., Jersey City, N. J.

MURDOCK PHONES. With each pair of No. 56 type Murdock Phones we will give as premium one Dubilier mica by pass condenser, suitable for either regenerative or crystal circuits. No. 56 Phones 2000 ohms $5.00 each. 3,000 ohms $6.00 each. Twelve hour service or your remittance returned. Postpaid and insured. The Kehler Radio Laboratories, Dept. R, Obilene, Kansas.

VARIABLE CONDENSERS. Buy them direct —save money. 23 plate, $2.25; 43 plate, $2.85. We pay the postage. Electrical Equipment Co., 113 N. Broad Street, Trenton, N. J.

FOR SALE—All new, New York Variable Condensers, 11 plates $2.40; 23 plates $2.90; 43 plates $3.65; Variometer $4.90; Variocoupler, $4.90; Amplifying Transformer $4.90; Switch Points per dozen 25c; Switch Stops per dozen 40c; large Rubber Binding Posts 9c; Metal Binding Posts 4c; Crystal Cups 9c; Mounted Radiocite 35c. Add postage. W. E. Roehl, 614½ Fannin, Houston, Texas.

FOR SALE—High grade regenerative receiving set, $80. Satisfaction guaranteed. Also have two-step amplifier. Harry Cook, Fairfield, Iowa.

MUST SELL—High grade regenerative receiver, $85. Also at a bargain a regenerative receiver with two-stage amplifier. Grebe C.R.9 type. Jay Tapp, 126 E. Anaheim St., Long Beach, Calif.

SPECIAL INTRODUCTORY OFFER—A Rapco Device with your Victrola or Sonora and a Baldwin Type C phone gives you a highly efficient loud speaker that duplicates the performance of the most expensive types. Invented by a prominent engineer, to sell at $2.50, the first 150 orders received will be filled at the special introductory price of $1.25. Money back if dissatisfied. V. S. McEntee, 2004 Times Bldg., New York.

FOR SALE—Vacuum tube receiving sets, $20. High grade material and workmanship. Receiving range equal to any. Prompt delivery. Central Mfg. Co., Fairfield, Iowa.

FOR SALE—Honeycomb receiver with 2-stage amplifier including bulbs and batteries and loud speaker, $130. A. E. Hall, 1623 Francisco St., Berkeley, Calif.

RADIO SPECIAL: Switch lever, knob, 12 contacts, 2 stops, 2 binding posts, $1.00; those excellent Eveready B Batteries all sizes, postpaid; a neat sturdy 23 plate variable, .0005, $3.75; moulded and nickel plated sockets, 90c and $1.00. Immediate delivery. Also a receiver-detector with 2 step $125.00 and a single circuit receiver-detector 1 step in same cabinet, $50. Pacific Radio Equipment Co., Box 27, Station "A", Berkeley, Calif.

KENNEDY EQUIPMENT—"The Universal Standard." Regular prices F. O. B. Reno. Westinghouse Regenerative Receivers; phones, Magnavox, V.T.S., B batteries, etc. Also, Exide Storage Batteries—the one A battery that will outlive your set. Immediate deliveries or your money refunded. Satisfaction guaranteed. Send your order to B. W. Casselberry, 620 Plumas Street, Reno, Nevada.

FOR SALE—$40 takes regenerative receiver, complete with bulb, "B" battery and fones. This set has received principal broadcasting stations. Range 1,500 miles. Boex-Brazek, 514 Northern Ave., Green Bay, Wisconsin.

FOR SALE OR TRADE—$60 receiver, $40. Two variometers. R. W. Haynes, 1236 American, Long Beach, Calif.

A Few Cents Will Do It!

If you have any used or excess Radio Equipment on hand advertise it in these columns. If you want to buy used apparatus use these "RADIOADS."

A small investment may bring big satisfaction.

FIVE CENTS PER WORD

Get your "RADIOAD" for the next issue in the mail right now and turn that spare equipment into cash.

USE THESE LITTLE ADS—THEY BRING BIG RESULTS!

ARMSTRONG SUPER-REGENERATIVE CIRcuits—Wonderful results in R. F. amplification from only two tubes, instead of six or eight. These circuits will not work unless you know constants and all apparatus used. Complete tested diagrams, containing all hitherto unpublished constants and full instructions, for fifty cents. R. I. Co., Red Bank, New Jersey.

SITUATIONS WANTED

MANUFACTURERS AND DEALERS—Radio man with ten years experience as operator, manager of retail radio store and manufacturer, holding Comm'l 1st license, desires to connect with reliable concern. Will go anywhere. Address "H," 575 Gower St., Los Angeles, Calif.

TRANSMITTING APPARATUS

C. W. MEN—Double choke filter coils. Fully mounted on brass standard. Guaranteed A-No. 1. Closed core construction. Twin coils, $4 postpaid. Radio, 141 So. Commonwealth Ave., Los Angeles, Calif.

FOR SALE—½ K.W. spark set, worked 1,250 miles, $30. Lloyd West, 342 Main St., Riverside, Calif.

FOR SALE—½ K.W. type "R" Thordarson transformer, $15; Benwood gap 10 point aluminum case, $15; ⅛ H.P. 3450 R.P.M. Westinghouse induction motor, $15. All these almost new in first class shape. C. Schneider, 76 Caselli Ave., San Francisco.

MISCELLANEOUS

CABINETS. We manufacture all sizes, from any variety of wood desired. No lock-box corners. Only high grade tongue and groove or double tongue joints employed. Prices low. Prompt delivery guaranteed. Boxtoy Company, 2000 E. Vernon Ave., Los Angeles, Calif.—(2T-J&A)

AUDION RENEWALS—Tungsten filament Detectors renewed $3.00. Tungsten filament Amplifiers renewed $3.25. Tungsten filament 5 watt Transmitters renewed $5.00. We do not accept tubular Audiotrons, RAC-3 or other multibase tubes for renewal. W.E., V.T.1 with Oxide coated filaments renewed for $4.00. If in doubt write us, enclosing 2c stamp. Ten years experience, results guaranteed, safe delivery assured. TERMS, CASH WITH ORDER OR C. O. D., PLUS COLLECTION CHARGES. Trimount Laboratory, Milford, Mass. (Superseding all price lists prior to Aug. 1st, 1922.)

LIGHTNING—Wonderful new electrolyte charges discharged batteries instantly. Eliminates old Sulphuric Acid method entirely. World has waited half a century for this invention. One gallon retails $10.00, free to agents. Lightning Co., St. Paul, Minn.

RADIO BOOKS

"Arc Radio Manual." published by the engineers of the Federal Telegraph Company of San Francisco, and written in simple, interesting manner. Well illustrated with diagrams and photographs of the various types of arc radio apparatus used on shipboard and in shore stations. Price $2.50 per copy, postpaid in the U. S. For sale by Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

Build your own Radiophone. Instruction book ten cents. Radio Service Institute, No. 2000 14th Street, Washington, D. C. —3t

Send 10 cents for our new large 32 page catalog describing our course entitled "How to Learn Radio at Home." National Radio Institute, Dept. 1331, 1345 Penn. Ave. N. W., Washington, D. C.

Wanted!

Copies of the March, 1922, issue of "RADIO." We will send you "RADIO" for Three Months in return for copies of the March issue. If you are already a subscriber we will extend your subscription for three months.

MU-RAD
BROADCASTING RECEIVERS

(*Patents Pending*)

TYPE MA-12

TYPE MA-12

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification and detector.
PRICE: With 2 telephone plugs, $128.00.

TYPE MA-13

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification, detector and two stages audio frequency amplification.
PRICE: With 2 telephone plugs, $160.00.

TYPE MA-13

THESE receivers have been produced with the deliberate idea of providing greater sensitiveness than has ever before been obtained in a commercially marketed radio receiver. Coupled with this is a beautiful sharpness, clarity and crispness of signal that is unfamiliar to users of the average highly sensitive receiver. Both sets are complete receivers, the only additional equipment required being vacuum tubes, batteries, telephone receivers and a small coil or loop to pick up the wave energy, or they may be used with an antenna if desired. A pick-up coil as small as 3 inches in diameter may be used for distances up to 200 miles from the average broadcasting station.

IN appearance these sets exemplify the art of the finest woodworkers, machinists and laboratorians. Their details of design and construction conform to the highest engineering standards. Complete instruction book is furnished with each set and each is tagged with our guarantee against defects. Bulletin No. 13 on request.

DEALERS : WRITE

MU-RAD LABORATORIES, Inc.

800 Fifth Avenue, Asbury Park, N. J.

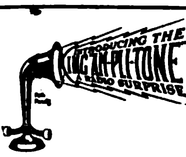
Order Your Radio Apparatus By Radio Mail Service

Keep this issue of Radio—Order direct from this page as you need new apparatus. Write your name and address plainly giving article number and inclose money order or bank draft. Send currency by registered letter only. Postage is covered in prices listed. Send your order direct to our San Francisco office. We guarantee safe delivery. 48 hour service or your money back.

RICHMOND LOUD SPEAKER

R500—Swivel adjusting device on this loud speaker allows horn to be swung into any position—any phone can be used by simple adjustment of only one screw.

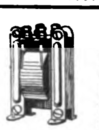
Price without phone $7.00



KING "AM-PLI-TONE"

R501—Has polished cast aluminum body with nickel plated base and horn. No sheet metal used. Double volume as two head phones are blended into one powerful tone.

Price $12.00



JEFFERSON AMPLIFYING TRANSFORMERS

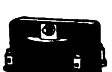
R502—Is positively unequalled for audibility, amplifying power. Mounted in brass frames. Bakelite construction. Primary resistance approximately, 1800 ohms. Secondary resistance approximately, 8500 ohms.

Price $4.50

10c CHARGES STORAGE BATTERY AT HOME with F-F BATTERY BOOSTER

R503—Charges automatically and operates unattended—ammeter shows current flowing. Use with 105—125 volt A. C. current. Complete in Portable Automatic Charging unit. Bantam Type 6 charges 6 volt Battery at 6 amperes.

Price $15.00



GENERAL RADIO COMPANY AMPLIFYING TRANSFORMERS

R504—These highly sensitive transformers are in daily use in Government, Army, Navy and college and commercial laboratories as well as thousands of homes.

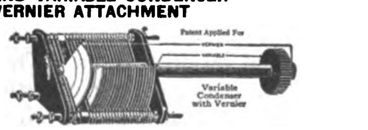
Price $5.00

SKINDERVIKEN TRANSMITTER BUTTON

R505—All you need with this ultra-sensitive microphone to install a complete detectophone in your home is a receiver, battery, and, if you wish, an induction coil.

Price $1.00

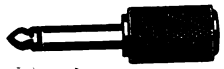
PEARLAND VARIABLE CONDENSER WITH VERNIER ATTACHMENT



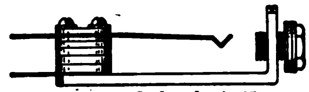
Simple—efficient. Vernier attachment allows 20 times as fine adjustment as plain condensers.

R506—44 plate capacity approximately .001 Micro Farads.
Price $10.00

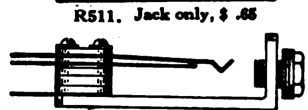
S507—22 plate capacity approximately .0005 Micro Farads.
Price $8.00



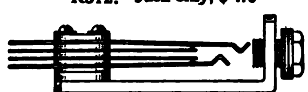
R510 Plug only, $1.00



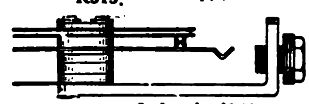
R511. Jack only, $ .65



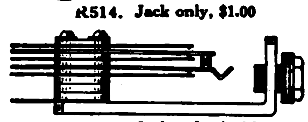
R512. Jack only, $ .75



R513. Jack only, $ .90



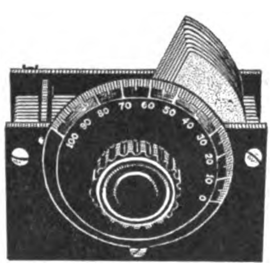
R514. Jack only, $1.00



R515. Jack only, $1.25

FROST—RADIO Improved JACKS and PLUGS

The smallest, neatest, most perfectly finished jacks and plugs that have ever been offered to the radio trade. Specially designed for panel work. Standard structure—interchangeable. Nickel plated, highly buffed finish throughout.

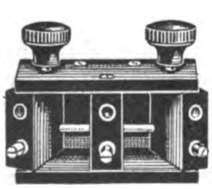


DAYTON VARIABLE CONDENSER

Sturdily constructed. Plates of hard aluminum. No sliding contacts. High frequency resistance low. High grade formica used throughout.
34 plate condenser capacity of .000031.
18 plate condenser capacity of .00002 at zero setting.

R516—18 plate condenser type 18 P. C. Price $3.95
Same capacity as average 21-plate condenser.
R517—34 plate condenser type 34 P. C. Price $4.80
Same capacity as average 43-plate condenser.
R518—Bakelite Knob and Dial .... $1.00 extra

STERLING INDUCTANCE COIL MOUNTING



R519—Manufactured from genuine Bakelite—not moulded. Plugs mounted on bearings allow for changing coupler between coils. All metal parts nickel plated.

Price $4.00

CUNNINGHAM TYPE C-300 DETECTOR TUBE

"Amplifies As It Detects"

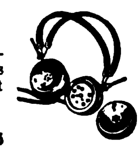
R520—Amateur requirements designed this tube—latest product of the great research laboratories of the General Electric Company. Standard 4 prong mounting. Type C-300 completely silent in operation.

Price $5.00

RADIOTRON VACUUM TUBE DETECTOR

R521—Produces excellent results in regenerative circuits. Specially suited for detector use and is an unusually fine audion frequency amplifier. Has familiar hissing point and low B Battery potential requirements.

Price $5.00



TYPE C HEADSET
Loud Speakers

R522—Radioists everywhere are obtaining wonderful results with these phones as loud speakers. Tests prove them best for the purpose.
Immediate Delivery Units Only

Price $7.75

BRANDES "MATCHED TONE" RECEIVERS

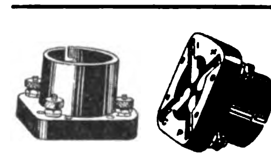
R523—To give maximum efficiency receivers must be matched perfectly in tone. Figure out loss of signal strength with ordinary phones. Order these Brandes receivers.

Price $8.00

FROST FONES

Combine expert radio engineering skill and finest of materials. Excellent results one or two steps of amplification.

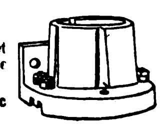
R524—2000 Ohms .... Price $5.00
R525—3000 Ohms .... Price $6.00



KELLOGG LAMP SOCKETS

R526—Socket mounted on glossy black composition base. 4 binding posts for connections.

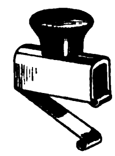
Price, each ...... .75c



CROSSLEY V T SOCKET

R527—Biggest selling socket on market today. Practically unbreakable. Made of one piece of porcelain.

Price, each .... .60c



EXTRA QUALITY SLIDERS

R528—These fine quality, neatly made, ¼" sliders are made from fine material and have proved themselves to be highly satisfactory.

Price, each .... .20c

ELECTROSE INSULATORS

R529—Diam. 1½", height 5". Mechanical strength 1000 lbs. Weight ¾ lb.

Price, each .... .25c

R530—Ball type. Diam. 2¼", length 3¼". Mechanical strength 250 lbs. Weight ½ lb.
Price, each .... .40c

R531—Strain type. Diam. 1½", length 10½". Mechanical strength 1000 lbs. Weight 1¼ lbs.
Price, each $1.00

KLOSNER VERNIER RHEOSTAT

R508—With single knob for both rough and fine adjustments.

Price $1.50

FILAMENT RHEOSTAT FOR PANEL MOUNTING

R509—All metal parts are nickeled. Smooth and noiseless in operation.

Price $1.00

Radio Mail Co.

48 hour Service or your Money Back

681 MARKET STREET SAN FRANCISCO, CALIF.

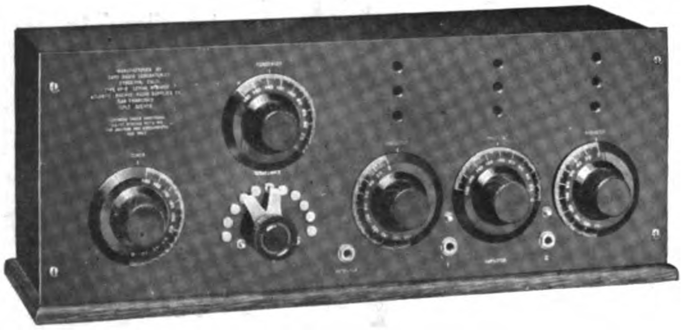
Your Choice

"Your final choice—why not your first?"

A-P is one of the oldest trade terms in radio, universally recognized as symbolizing excellence, performance and quality. The A-P apparatus illustrated and described below is carefully constructed and tested to measure up to these standards fully. Designed particularly for receiving radio concerts and other broadcasted features, it enables any home to be radio equipped with dependable and attractive apparatus at moderate cost. It is simple to operate, so that splendid results should be secured from the start, even by a beginner. For further information write for A-P catalog, mentioning the name of your radio dealer if possible.

A-P

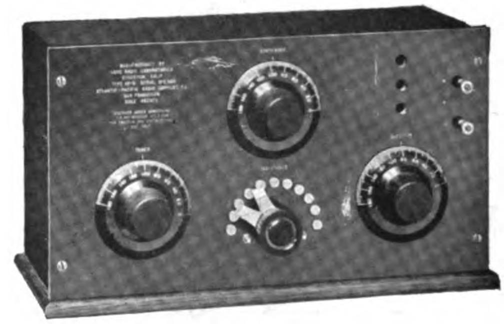
line of "CHOICE" APPARATUS



Type AR-2 Receiver Detector and 2-stage Amplifier

Licensed under Armstrong U. S. Patent No. 1,113,149, October 6, 1914, for amateur and experimental use only.

TYPE AR-2 set combines in a single beautiful cabinet a Receiver, Detector, and two-stage Audio Frequency Amplifier. The famous Armstrong Regenerative Circuit is incorporated in the set in such way as to enable broadcasted features to be received loud and clear over long distances. The Audio Frequency Amplifier is designed to give maximum amplification without distortion, and enables the set to be used with a Magnavox or other loud speaker to secure large volume. In every detail this set is of typical A. P. quality. Particularly noteworthy are the solid mahogany cabinet with a beautiful light walnut finish, and the genuine Bakelite Dilecto panel. Wavelength range 175 to 1600 meters. A neat, compact and efficient home set, quickly installed and easily operated. Blue print of circuit and instruction card with each set. Price **$135**, f. o. b. San Francisco.



Type DR-5 Radio Receiver and Detector

Licensed under Armstrong U. S. Patent No. 1,113,149, October 6, 1914, for amateur and experimental use only.

Type DR-5 is the same receiver incorporated in Type AR-2 combination set described at the left, but built in a beautiful mahogany cabinet by itself without the Audio Frequency Amplifier. Specifications provide highest grade parts throughout, insuring quality and performance. The Armstrong Regenerative Circuit is co-ordinated with the action of the set so efficiently that it oscillates and regenerates freely and easily over its entire range of 175 to 1600 meters. All inductances of special Pyramid windings. Circuit diagram and instruction card with each set. Price, **$85**, f. o. b. San Francisco.

Manufactured by

Oard Laboratories, Stockton, California

Sole Agents

Atlantic-Pacific Radio Supplies Co.

Operating KZY Broadcasting Station — 646-50 MISSION STREET, SAN FRANCISCO, CALIFORNIA — Radio Supplies

Dealers and Jobbers invited to stock this apparatus—write for particulars

September, 1922 25 Cent

RADIO

The Oard PHANTOM no ground circuit used in–

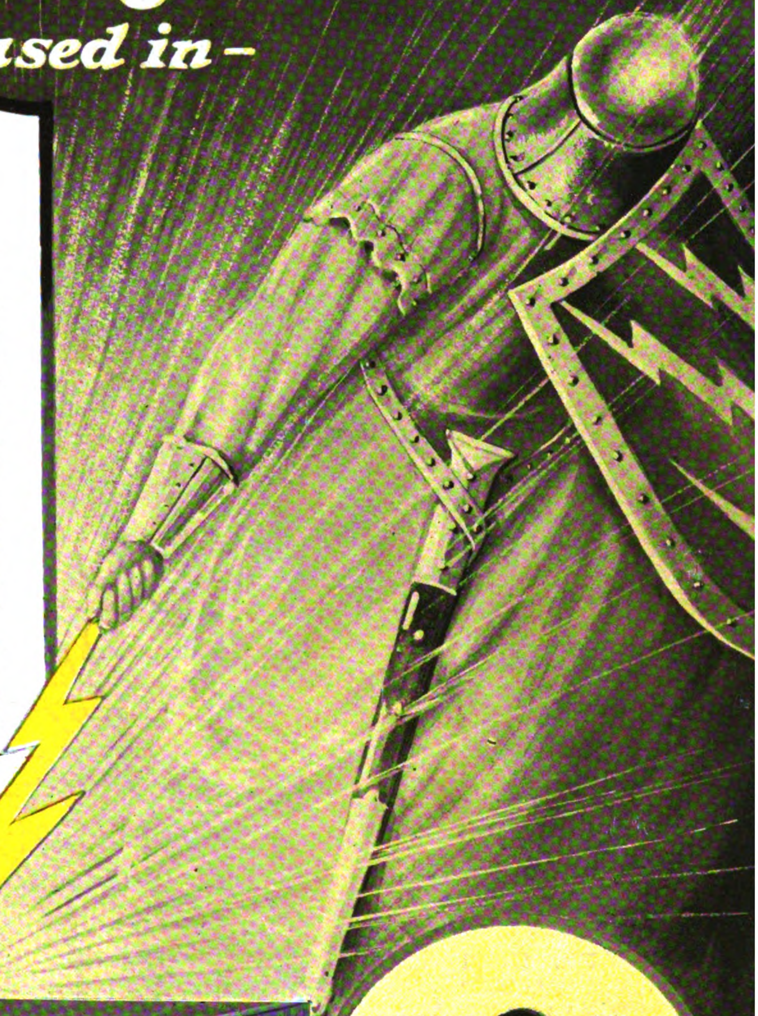
The A-P Special

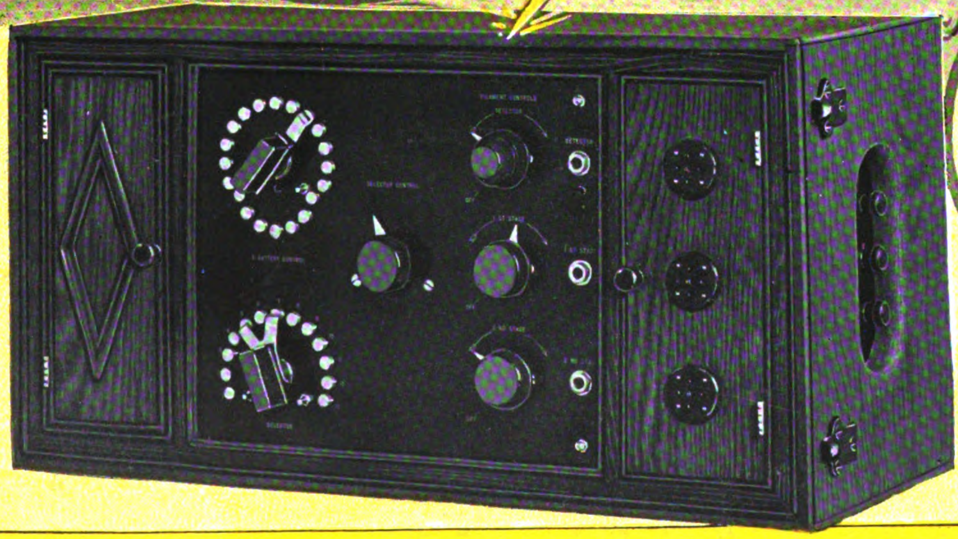
Receiving Set

One of the most important, most revolutionary developments since the discovery of radio. The receiving set thousands have been waiting for. A set that requires no ground, no aerial. For general use a single wire not exceeding 15 feet in length, concealed in the picture moulding, laid on the floor, or, if out-of-doors, placed on the ground, is all that is necessary. Stations 400 miles distant have been heard under these conditions. For distant service a wire not over 50 feet long will produce better results than can be obtained with the elaborate 150 to 200 foot aerial and ground, or loop system required by other types of receivers.

The *A-P Special* has the apparent advantages of radio frequency amplification without its delicate and complicated adjustments. It is remarkable for its simplicity of control and marked selectivity, and ideal both as a home set and for use as a portable in camping or outing.

Bulletin F contains complete information on this wonderful set. Write for it and name of our nearest dealer. We are now in position to make prompt shipments.





Set closed with cover for use as a portable

U.S. AND FOREIGN PATENTS PENDING

Atlantic-Pacific Radio Supplies C

Operating K.Z.Y. Broadcasting Station

646-650 Mission St. San Francisco, Cal.

Radio Supplie

RADIO

Established 1917 as Pacific Radio News

VOLUME IV — SAN FRANCISCO, SEPTEMBER, 1922 — NUMBER 9

Contents

Published Monthly by

Pacific Radio Publishing Co., Inc.

Pacific Building, San Francisco

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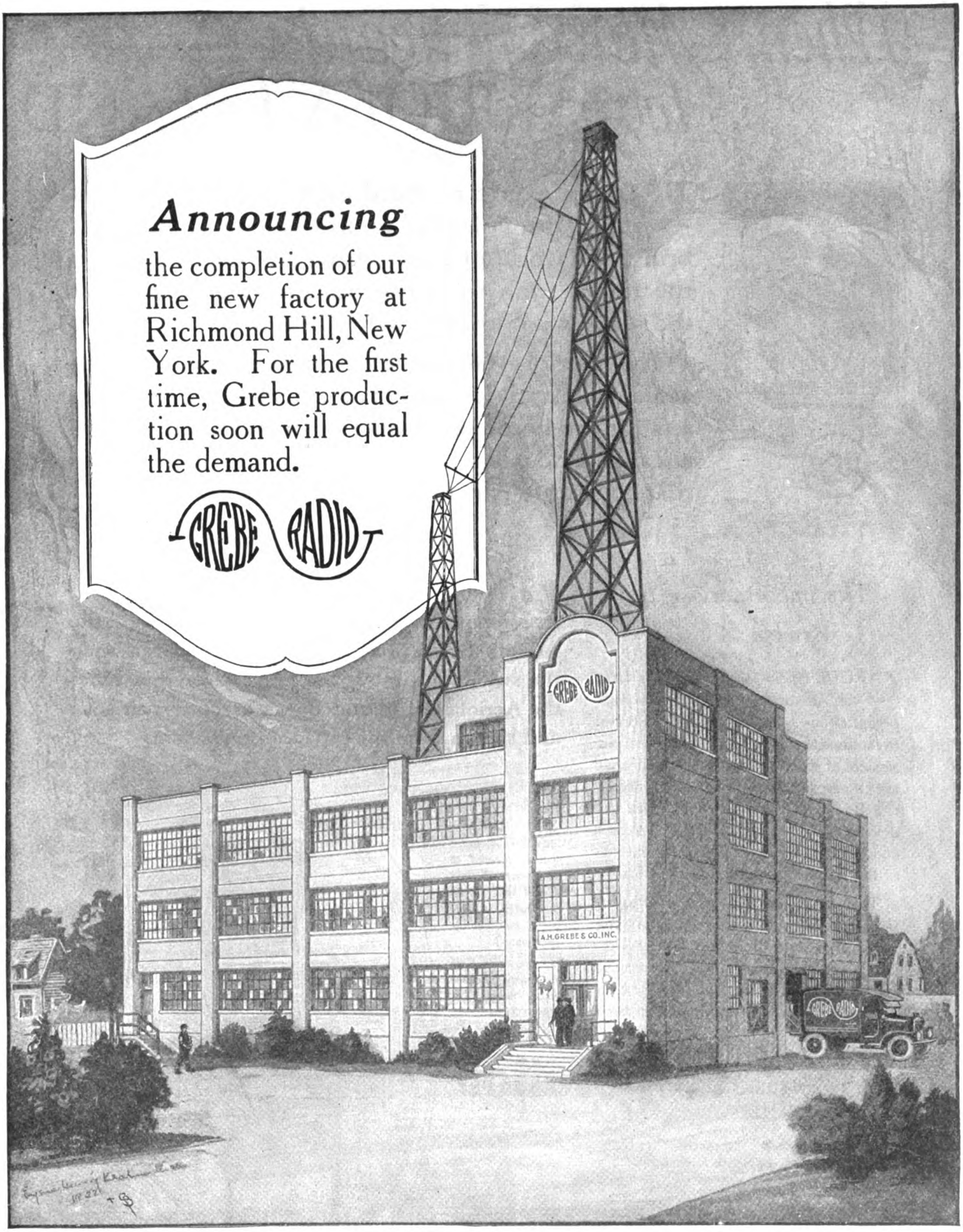
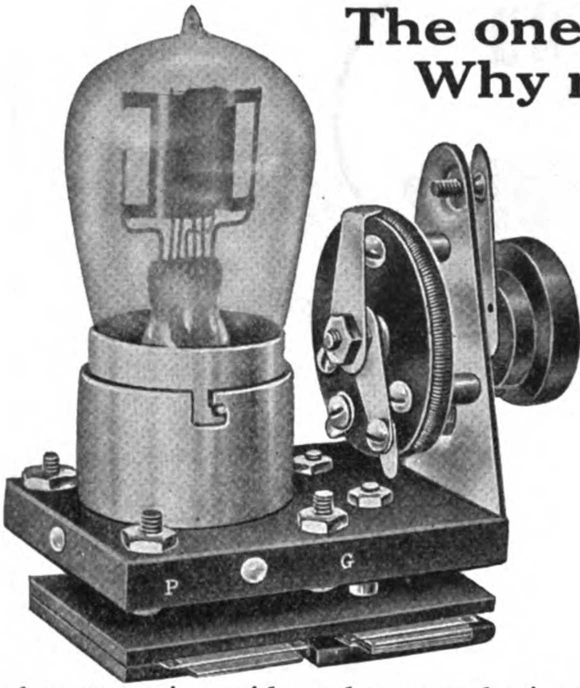

Announcing
the completion of our fine new factory at Richmond Hill, New York. For the first time, Grebe production soon will equal the demand.
GREBE RADIO
GREBE RADIO
A.H. GREBE & CO. INC.

QUALITY



The one thing you pay for in the end
Why not get quality when you buy

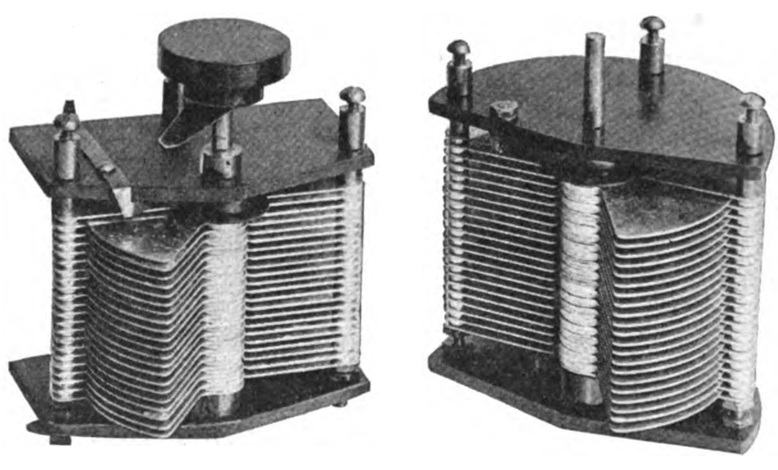
Your First Radio Instruments
Buy
Wireless Shop Apparatus
AND BE ASSURED OF THE QUALITY

NO. 40 WIRELESS SHOP DETECTOR UNIT

A complete detector control, designed for back of panel mounting. By using this new unit it is very easy for the novice to build up a receiving set. All that is necessary is to drill three holes in your front panel, mount the unit and wire it to your tuner. Unit consists of socket for tube, rheostat, mica grid condenser and mica by-pass condenser. The bulb is not included. And the price is so low that you cannot afford to assemble the separate instruments yourself. A knob and pointer is supplied. Price (postage extra)........ $5.00

The No. 40 detector unit and No. 41 amplifier unit is fully described in our bulletin No. 3, which will be mailed for the asking.

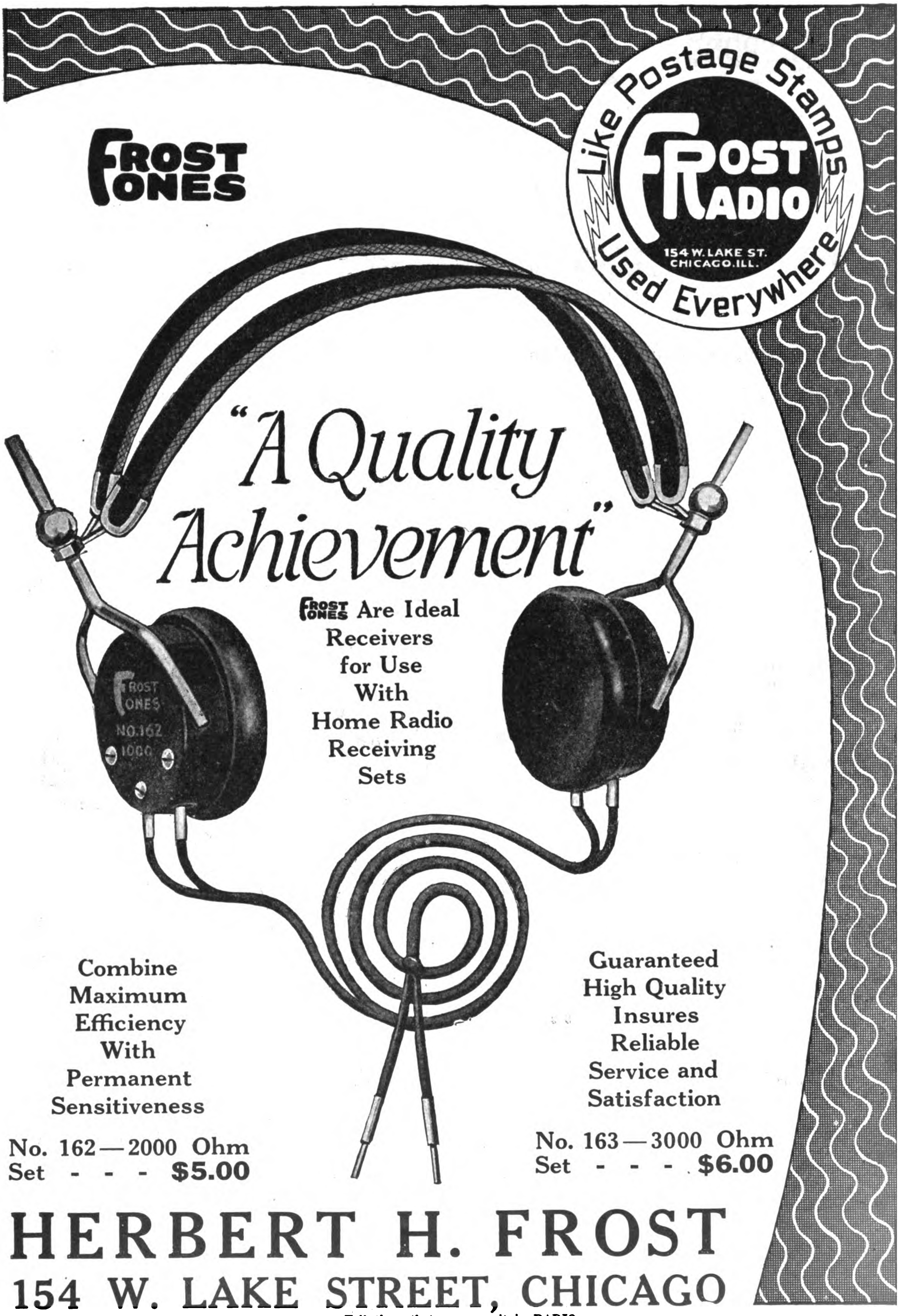
Variable Condensers



When you buy a variable condenser, you want the product of a real instrument shop. Of the many different instruments used in radio work, the variable condenser and head receiver are two that must be made right, by men that know, and have passed through the experimental stage. "Wireless Shop" variable condensers have an enviable reputation for "QUALITY", and this reputation has been honestly earned by strictly high grade material and workmanship. We have been manufacturing variable condensers for nearly eight years, and have developed a special line of equipment for performing each and every manufacturing operation required. "QUALITY" not "PRICE" is our slogan. The "PRICE" is as low as is consistent with "QUALITY". The 23 plate, No. 230, sells for $3.60. The 43 plate, No. 430, for $5.25. Twelve other sizes are fully described in our bulletin No 1. Ask for it.

THE WIRELESS SHOP
A. J. EDGCOMB

1262 West Second Street **Los Angeles, California**

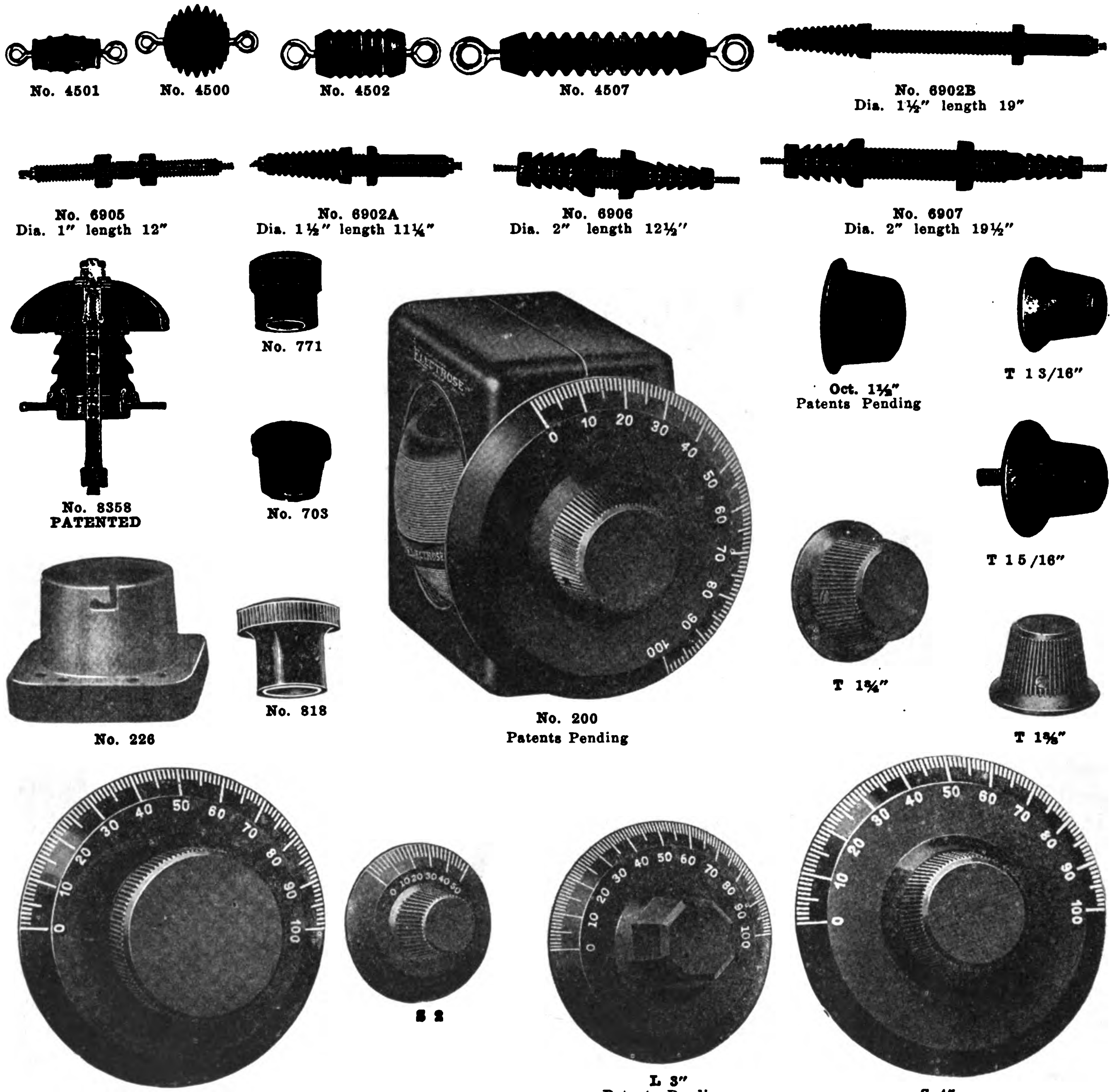

FROST FONES
Like Postage Stamps Used Everywhere
FROST RADIO
154 W. LAKE ST.
CHICAGO, ILL.
"A Quality Achievement"
FROST FONES Are Ideal Receivers for Use With Home Radio Receiving Sets
FROST FONES NO. 162 1000
Combine Maximum Efficiency With Permanent Sensitiveness
No. 162—2000 Ohm Set - - - $5.00
Guaranteed High Quality Insures Reliable Service and Satisfaction
No. 163—3000 Ohm Set - - - $6.00
HERBERT H. FROST
154 W. LAKE STREET, CHICAGO

ELECTROSE RADIO INSULATORS AND PARTS

TRADE MARK REG. U.S. PAT. OFF. & FOREIGN COUNTRIES

ELECTROSE insulation, made in America and used throughout the world, and approved by the United States Government, Army and Navy and commercial operating companies.

ELECTROSE was the insulation selected for use in connection with the first high power transmitters employed in the Navy, the first high power radio traction employed on board a submarine, the first radio equipment to make a record in air craft, the first radio set to fly across the Atlantic, and the recent world's record of long distance commercial telephone transmissions carried out from the U. S. S. America.



No. 4501 — No. 4500 — No. 4502 — No. 4507 — No. 6902B Dia. 1½" length 19"

No. 6905 Dia. 1" length 12" — No. 6902A Dia. 1½" length 11¼" — No. 6906 Dia. 2" length 12½" — No. 6907 Dia. 2" length 19½"

No. 8358 PATENTED — No. 771 — No. 703 — No. 200 Patents Pending — Oct. 1½" Patents Pending — T 1 3/16" — T 1 5/16" — T 1¾" — T 1⅝" — No. 226 — No. 818

G-4" — S 2 — L 3" Patents Pending — S 4"

"ELECTROSE" RADIO STANDARD PRODUCTS

Panels, sheets, bases, tubes, rods, dials, vacuum tube sockets, variometer rotors and stators, vario couplers, receiver shells and caps, condenser supports, antenna insulators, insulated connectors and bushings, horns, lightning switches, lightning arresters, transmitter key knobs, binding posts, switcharm knobs, dial knobs, and any other style of knobs.

SOLE MANUFACTURERS

ELECTROSE MFG. CO.

60-82 Washington St. 27-37 York St.
66-76 Front St. 1-23 Flint St.

BROOKLYN, N. Y., AMERICA

Globe Commercial Co., San Francisco, Cal., Factory Representatives on the Coast

Sept., 1922 | RADIO | Vol. 4 No. 9

Radiotorial Comment

As the novelty of radio telephony begins to wear off listeners-in will begin to demand a better quality of broadcasting than is now generally available. Most people are still entranced by the wonder of it, but in time the radiophone will become as commonplace as the ordinary garden variety of telephone. A radio concert is marvelous, but it does not yet satisfy a real music-lover.

This limitation does not apply to the radiophone's more utilitarian function of broadcasting news, which is becoming of increasing value and interest to isolated individuals. For the simultaneous distribution of information over large areas no better medium has been found. But radio can compete with such agencies as the phonograph as a regular means of home entertainment only when better programs are furnished and better transmitting stations erected.

Just now there are dozens of mediocre stations all over the country. The operators thereof are indulging in a wild duplication of service in order to satisfy their desire for personal publicity. Most people resent this. It will only be a matter of time before many of these stations will shut down, although some of them are in much the same position as the man who grabbed the bull's tail—it is hard to let go.

The expense of maintenance is high and poorly distributed among those who benefit from the broadcasting. A few broadminded manufacturers are holding the bag. It is likely that all branches of the trade will voluntarily assume a sales tax while business is good. But eventually the owners of receiving sets must be called upon for contributions if good service is to be continued.

In the opinion of some far-seeing men, line radio or "wired wireless" offers the logical solution to the problem. By the payment of a small monthly charge the owner of a receiving set can hook up to a telephone or power wire on which radio frequency currents, carrying speech and music, have been superimposed. But whatever the remedy, it should be applied quickly, for the business future of radio is dependent upon adequate broadcasting.

Radio frequency amplification of short wavelengths is beautiful in theory but difficult in practice. Those who have not tried it tell the most wondrous tales of what it does, but most of those who have chased this alluring will-o'-the-wisp, following the instructions of those who have not, have been lost in the slough of despond. The successful ones are as rare as a staticless day in June.

The main difficulty is due to a lack of understanding of the limitations of present day vacuum tubes and transformers or other inter-tube connectors. These devices, while well adapted to audio frequency amplification, and even to radio frequency amplification of long wavelengths, are not suitable for increasing the strength of the high frequency currents which correspond or are identical with short wavelengths.

The reason, in a word, is capacity. The effect of capacity, as is well known, increases with the frequency of the current. A capacity whose effect is negligible at low or audio frequencies becomes bothersome at high or radio frequencies. The voltage built up by means of a transformer, high resistance, or inductive connection between tubes, is somewhat neutralized or partially short-circuited by any capacity in parallel with it in the circuit.

At high frequencies the ordinary vacuum tube offers low reactance or opposition to the flow of electric current between its grid and filament. Consequently, much of the voltage amplification that may be gained in the coupling is lost in the tube, the net gain being small. A similar loss is caused by the distributed capacity of the ordinary inductance coil or transformer winding.

So we are forced to the conclusion that until the laboratory types of low capacity tubes become commercially available, it will be difficult, if not impossible, to construct an efficient all-wave amplifier utilizing an untuned plate circuit. Furthermore, these low capacity tubes, unfortunately, have a correspondingly low amplifying power.

However, by using a tuned plate circuit, that is, a circuit in which a condenser or variometer is used to introduce a condition of resonance for the particular wavelength being received, some amateurs are getting good results with resistive coupling. These facts are brought out in detail in an article in this issue by D. K. Lippincott.

Another and more effective method for obviating these difficulties is the Armstrong super-heterodyne circuit, in which the incoming high frequency currents are first reduced by the heterodyne method to about 50,000 cycles per second, then amplified through a number of stages, and finally reduced to audio frequency. The disadvantage of this method is the expense of the large number of tubes and the large battery facilities necessary, as well as the critical adjustment required.

A cheaper but less sensitive noise producer is the new Armstrong super-regenerative circuit, wherein, in its simplified form, a current of 15,000 cycles, or thereabouts, from an oscillating tube is made to decrease the resistance of the detector grid circuit upon which it is superimposed, so that the detector tube is able to amplify the incoming high frequency currents to a far greater extent than is possible in the ordinary regenerative circuit. This combination is easy to construct but hard to operate. It is still very much in the stage of a delicate laboratory experiment and, until further developed, should be attempted only by an experienced operator.

Design of a Low Powered Circuit for Duplex Operation

Ninth Installment of "The C. W. Manual"

By J. B. Dow, Lieutenant U. S. N.

THE present trend of radiophone construction is toward apparatus which is capable of duplex operation wherein a two way simultaneous conversation may be maintained as in wire telephony. The self contained duplex feature of such apparatus also permits of direct connection to land lines without the necessity for complete isolation of the receiver from the transmitter or the use of separate directive antennae for transmitter and receiver.

Two types of duplex apparatus are in use to a very limited extent at the present time. One of these types employs a sensitive relay which, thru the medium of microphone currents, automatically places the antenna of the talker's station on the transmitter. When the speaker breaks his conversation, the relay automatically places his receiver on the antenna again. This might more appropriately be termed a "break in" system. As might be expected, a number of mechanical and electrical difficulties limit the successful operation of such equipment at the present stage of development.

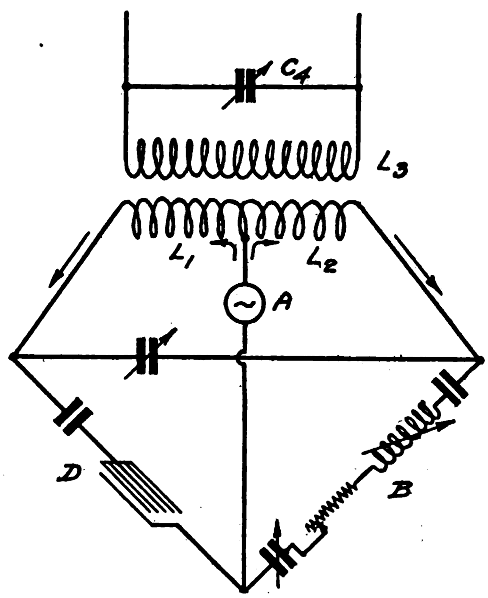


Fig. 66. Equivalent Bridge Circuit of Transmitter, Receiver and Balancer

The second type of duplex equipment balances out, insofar as the talker's receiver is concerned, any interference which might otherwise be caused by his own transmitter. At the same time, the receiver is operative, in that any received signal from an outside source will be heard.

Several types of this apparatus have been developed to a greater or lesser extent and it might be well to mention that, in principle, they are all more or less identical. Of these, the Carson system has been the most successful up to the present time.

Schematically, the Carson system consists of a balanced network (see Fig. 66) containing the source of high frequency oscillations, A; the artificial antenna, B; the real antenna or radiating member, D; and the divided inductance, L_1, L_2, which is, in effect, the primary of the receiver coupler to which is symetrically coupled the secondary, L_3.

In Fig. 66, assuming the current flow at a particular instant as indicated by the arrows, it divides thru the two equal and symetrical inductances, L_1 and L_2, part flowing to the radiating system, D, and part to the dummy circuit or balancer circuit, B. Now if the currents thru the two inductances, L_1 and L_2, are equal, no induced potential will occur across the receiver secondary, L_3, and consequently no signal will be detected by the receiver, which has originated from the source A.

If, however, a potential is induced in the branch, D, from an outside source, as for example a distant station, an unequal current will flow thru L_1 and L_2 with a result that induction will take place in L_3 and the signal will be detected.

The problem which presents itself then is that of dividing the currents in the branches L_1 and L_2 equally.

It is a well known fact that for a given frequency of

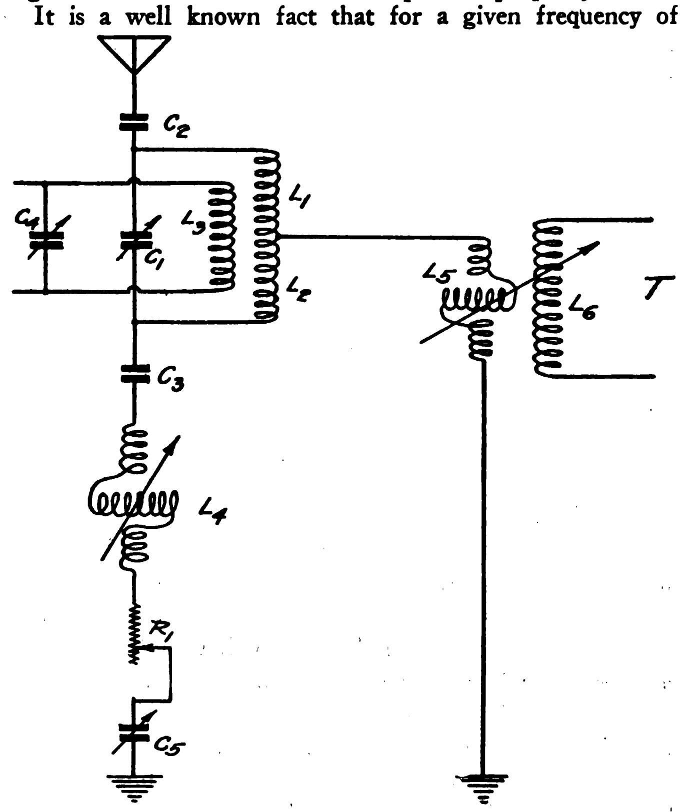


Fig. 67. Circuit Diagram of Carson Duplex Radiophone

oscillation equal currents will flow in each branch if the impedances are equal. For one definite frequency, equal impedances could be obtained with a large capacity and small inductance value in one branch and a small capacity and large inductance value in the other, but with the slightest change in frequency the impedances would change, resulting in unequal current distribution. By considering the equation for impedance it will be seen that in order to hold the same impedance in two circuits regardless of the frequency, the capacity, inductance, and resistance must have identical respective values in both circuits.

The problem then resolves itself into one of determining the proper values for capacities, inductances and resistances in the circuits.

The circuit of Fig. 67 represents a network which, in view of the capacities between component parts and the dissimilarity in the effects of lumped and distributed capacity, becomes very complex and ordinary methods of solution wherein definite circuit constants may be obtained, are not applicable. As an example, the receiver, secondary coil L_3, is coupled to the primary, L_1 and L_2, which is also a part of the transmitting circuit. Any change in the capacity relations between these three inductances, then, would influence the adjustment of the other. To minimize this effect, these three inductances, or rather the two, for L_1 and L_2 are identical, must be shielded insofar as the altering of capacity relations is concerned. This is done by enclosing L_3 in a thin copper shell, slotted so as to prevent the shell's forming a short circuited loop. Another deviation which prevents the use of ordinary principles of design is the fact that a dummy antenna or balancing circuit consisting of lumped constants is used to balance a real antenna with distributed constants.

In the circuit of Fig. 67, T is the transmitter inductively related to L_5, which is an inductance of the variometer type having a minimum inductance of 20 microhenries and a maximum of 80. These values, as well as those of future ones, are based upon the requirements of a 200 to 400 meter set. One side of this inductance is connected to earth and the other to the center tap of the shielded inductance L_1 L_2, where the circuit divides. The values of L_1 and L_2 should be 60 microhenries each.

The lower branch of the above mentioned divided circuit comprises the balancer. This contains the small series condenser, C_3, having a capacity of approximately 300 micro-microfarads; the variometer, L_4, having an inductance continuously variable from 5 to 30 microhenries, and shielded within a copper shell to eliminate variable capacity relations with adjacent apparatus; the resistance, R, which is continuously variable from 0 to 10 ohms, and the variable condenser, C_5, which has a maximum capacity of about 2000 micro-microfarads. This latter variable condenser must also be shielded for reasons previously stated.

The upper branch of the circuit contains the real antenna and the series capacity, C_2, which has the same capacity as that of C_3.

The variable capacity, C_4, across the receiver primary, L_3, facilitates tuning in for receiving, but has practically no effect upon the wavelength of the transmitter.

Assuming that such a circuit as the one illustrated in Fig. 67 is adjusted to the desired wavelength, which is dependent upon the adjustment of the variometer, L_5, and that it is desired to balance the circuits in such a manner that the transmitted signal will not be heard in the sender's receiver, the first step is to adjust L_4, R_1, and C_5, in such a manner as to approximate the constants of the real antenna. Usually, the correct values will be unknown and it will be necessary to adjust and readjust until silence is obtained in the receiver for several transmitting wavelengths. It must be understood here, that it is quite easy to obtain the necessary balance for one transmitting wavelength, but this will only suffice for that particular wavelength, and any very small adjustment in the transmitter itself would be liable to make the set noisy.

For the successful operation of a duplex circuit of the type described above it is necessary to go to extremes in shielding the apparatus, particularly the balancer and transmitter. Both cabinets, as well as the front panels where possible, should be covered inside with thin copper sheet or wire netting and all battery and generator leads should be run in lead armor. The armor of adjacent conductors should be connected together at intervals with soldered connections and grounded to maintain it at zero potential.

NOTES UPON THE SUBJECT OF OPERATION

1. The use of alternating current for filament heating often increases the life of the tubes from two to three times.

2. Protective fuses should be used in filament circuits to insure the tubes against excessive currents which are liable to destroy same. It must be borne in mind, however, that ordinary fuses do not function rapidly enough to protect the filaments against sudden increases in the current. Very fine iron wire operates as a protective device for filaments more satisfactorily than the lead-tin compositions, but when exposed to air the life of such a fuse is very short.

3. An impromptu *voltmeter* for high voltages such as are employed in the plate circuits of vacuum tubes may be made by connecting a number of 110 volt two candlepower lamps in series and estimating the voltage by the number of lamps in series and the brilliancy.

4. In smoothing out systems, little is gained by inserting a choke coil in the negative lead from the generator because this side of the circuit is usually grounded and is therefore at zero potential.

5. The circuit of Fig. 68 should be used in preference to that of Fig. 69 for the reason that if the filament battery became grounded or leaky to earth, the input inductance would not become short circuited and prevent the set from oscillating. Theoretically, however, the circuit of Fig. 69 is the better because the grid is more easily maintained at a negative potential.

6. An antenna having a natural period not greater than 70 per cent of the transmitting wavelength should be used for best results.

7. A counterpoise should always be used where practicable to reduce undesirable resistance. Frequently the radiation may be doubled in this manner.

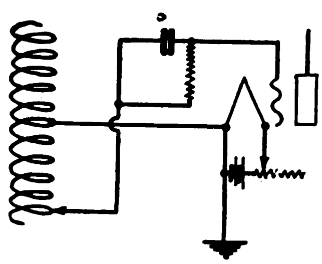


Fig. 68

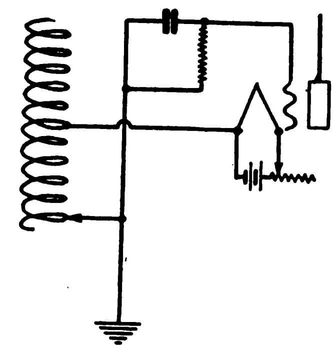


Fig. 69

8. Very often a given transmitter cannot be made to oscillate on the lower wavelengths and the cause may generally be traced to an excessive natural period of the antenna or to excessive antenna resistance which results in high impedance at the high frequencies concurrent with short wavelengths. Shortening the antenna in the first case or installing a counterpoise in the second will usually clear the difficulty.

9. A landline may be linked with a radiophone directly thru the modulation transformer for transmitting and thru a quarter inch spark coil for receiving, using the primary in the landline.

10. In adjusting a vacuum tube transmitter, use a small milliameter in the grid circuit to measure the current flow. If the grid current is excessive, the current drawn from the generator will be excessive. A large grid current results in poor modulation.

11. The actual output when using two tubes as oscillators in a transmitter will be approximately twice as great as when only one is used, but the radiation will by no means be doubled. The reason is that the current squared times the resistance determines the output.

12. Porcelain insulation in antenna systems being used with C. W. is greatly superior to other types commonly used. In this connection, glazed porcelain only must be employed.

13. When using two or more small generators in series to obtain high voltages, insulate each machine from the other in order to prevent the breaking down of insulation between the windings and the frames.

14. Do not attempt to decrease the output of a tube transmitter by dimming the filaments without first decreasing the plate voltage, or a chain of phenomena will result

Continued on page 83

The Professional Radio Operator

By Volney G. Mathison

Photographs by the Author

WITH the radio art expanding in a tidal-wave sweep to ever widening fields of utilization, an increasing multitude of experimenter enthusiasts are looking with serious interest toward commercial wireless operating as a future means of gaining a livelihood. The crowded wireless schools attest this, and the wholesale outpour of commercial licenses to successful candidates is tangible proof. Throughout the amateurs' ranks there are regiments of novices who have small outfits installed only for learning to operate and for helping on the road to the desired government certificate; while a still greater number of others, amateurs in the real sense of the word with no immediate intention of becoming professionals, still regale themselves with the mildly exciting idea that some day they too will run the gantlet of the radio inspector's speeded-up omnigraph and have a try at sticking their fingers in the commercial pie.

Few among this great body of amateurs have any accurate conception of commercial radio operating, as it is today. Popular ideas on the professional operator's work are molded largely by wireless school advertising skillfully calculated to attract students; or again, the layman's imagination is fired through contact with some adventurous trail-blazer of his locality, who, having ventured on a summer trip across a placid lake or pike-poled along a little stretch of sunny sea-coast, has returned to his native haunts to be forever afterward the hero of the home circle of radio bugs.

Such sources of information obviously can not well be trusted to give any comprehensive insight into the commercial wireless game as it really is, with its shortcomings and its tremendous possibilities, nor should such one-sided and haphazard views be made the basis of a decision to become a commercial operator. Radio is still so new and is now passing through such a peculiar transitory stage that only a large actual experience in the commercial field itself can enable any one competently to judge its present position and to predict with any degree of accuracy what the future will bring.to it.

Based upon eight years of such experience, the present article has been prepared to assist the prospective operator, be he already a determined learner or merely one of the joyous bugs with the desire lurking like a latent disease in his system, to decide whether in his own particular case the game is worth his while; and, if so, to help him with practical information and advice on the road into the professional domain.

THE RADIO OPERATOR AN ULTRA-MODERN

AMONG the many highly specialized professions which the far-reaching applications of electricity have brought into existence almost over night, there are hardly any so new as commercial wireless operating. In 1906 there were not fifty wireless operators in the United States. In Germany, the pioneer nation in the commercialization of the researches of Hertz and the applications of Marconi, there may have been a few more; for the Germans built and installed radio equipment for the Mexican government as early as 1901.

These first radio operators, in our own country, were virtually all old Western Union men. Many of them knew only the Morse, that is, the land-wire code, which indeed was mostly used on the air; and their knowledge of radio was fully as imperfect as their apparatus —straight-gap transmitter, a couple of single-slide tuning coils, and a chunk of carborundum.

Our pioneer brasspounders, happily unhampered by radio inspectors and legislated restrictions upon wavelengths and decrement, generally crashed forth with their bursting-shell gaps on any old wave the outfit happened to radiate. Not a few of the early operators, it is a fact, were wholly ignorant of even the elementary principles of resonance and tuning. In those days the call signals were miscellaneous two-letter combinations— which shows how few there were—selected by each station or operating company for itself; and before the international adoption of the present familiar SOS, the recognized distress signal was CQD, imported probably from land-wire practice.

Though the United States Government issued a number of so-called "Certificates of Skill" to wireless men as early as 1910, full official recognition of the radio operator dates back no farther than 1912, when coincident with the passage of our first general radio legislation, formal operators' licenses were created and legally required in all commercial wireless stations, both on shipboard and ashore.

By the latter part of 1914, more than three thousand commercial operator licenses had been issued, although many of these were only of second grade. During 1921, the number of issued licenses passed the 20,000 mark. From this it should not be inferred, however, that there are 20,000 licensed radio operators among us today. Since an operator's license has a life of but two years, it will be seen that only those certificates issued within the last twenty-four months are valid. It is estimated that the number of actually usable commercial operator licenses in existence at present is about

Commercial radio station at Unga, Unga Island, Alaska (KVI), constructed by the author. In this picturesque village of the "Samuel Jones" stories, something of the untamed spirit of earlier Alaskan days is still discoverable.

seven thousand. During these ten years —1912 to 1922—there were issued about 125 extra first grade licenses, which require a thirty-word-a-minute Continental and a twenty-five word land-wire code test. Owing to expirations, as just explained, there are now perhaps thirty operators in the country holding extra first class licenses.

THE RADIO OPERATOR'S SALARY

IN NO other kind of work have the current wages fluctuated to such an extreme extent as have those of the wireless operator. The early shipboard radio men of 1906 received from eighty to one hundred dollars a month. Considering the price levels of those days, and compared with the land-wire wages generally prevailing at that time, this was a fairly satisfactory salary; for it must be kept in mind when comparing wages that the radio operator, that is to say, the shipboard operator, is rated as an officer, and receives an officer's accommodations and maintenance.

The commercial wireless operators' pay stayed around the hundred dollar mark but a short time. In 1910, interest in amateur radio began to sweep over the country like a scandal through a small town. Stations of all powers and radiating all wavelengths began to spring up everywhere. Incidentally, there was one high-power fanatic on the east coast possessed of a ten-kilowatt transmitter and five acres of ground plates, who nightly tortured the ether with a weird nasal note which stuck with you all over the Atlantic like a bad dream, and which if perpetrated upon the air today would probably wreck the radio inspector's decremeter and put the criminally-inclined amateur on the rock-pile in a striped suit for life.

The wireless companies, quick to see a new and better field from which to recruit employees, fostered interest in amateur radio through the establishment of wireless magazines and associations; and opened schools where radio instruction was offered at a very nominal cost —in some cases as low as five dollars a month. Popular interest in radio steadily augmenting, in a remarkably short time we operators of the pie-tin condenser and hay-wire helix type were become as numerous as mosquitoes in New Jersey; the old wire men were gradually frozen out; and a great decrease in salaries began.

In 1912, beginners were paid $45 a month. At this time assignments were very easy to get, because the operators' ranks were made up largely of tourists and college vacationers who seldom stayed more than a trip or two. In 1913 a strike was attempted, which was unsuccessful—due perhaps to the increasing influx of the travel-hungry, who came down to the piers in five thousand dollar cars to go to sea for $40 a month.

The lowest point was reached in 1914, in which year the standard salary in the commercial service was thirty dollars a month on the Pacific coast and twenty-five dollars on the Atlantic. This munificent wage was paid to the operator by the wireless company; and the company in turn received from the ship-owner—I have been informed by a ship-owner—the sum of $125 a month and up for each operator and antiquated outfit they furnished. If the operator behaved well, his monthly pay was raised two dollars and fifty cents every six months, or five dollars a year. Those of the older men who were operating before the wages went down like a torpedoed coal-barge and who still stayed, generally received from $45 to $55; and a very limited number, perhaps six or seven, of the moss-backed Morse men got their old rate of eighty dollars.

The shore-station operators at this time were paid from eighty to ninety dollars a month; but since no maintenance was furnished to them, their position was hardly preferable to that of the shipboard men.

In 1915, the monopoly of commercial radio which had existed from the beginning was shattered, on the Pacific coast at least, by the development of a Poulsen arc set suitable for installation on shipboard. Irked by the arbitrary leasing policies of the older concerns, a great many ship-owners promptly had arc equipment installed on their ships. This encouraged the formation of other radio companies; and, after weathering many heavy gales of patent litigation—which, indeed, wrecked more than one of them—these also began to build commercial wireless apparatus and to install it upon many vessels.

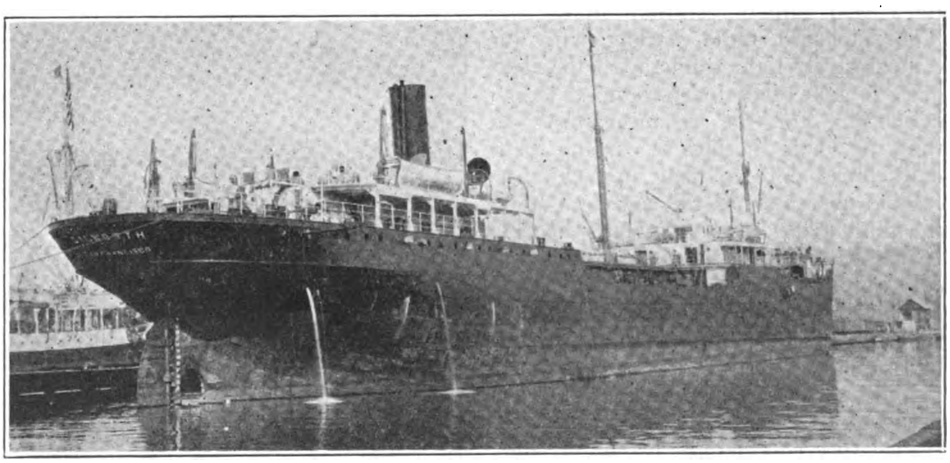
The steamship companies that leased or bought outright the equipments of these newer concerns were privileged to pay their own operators. Since the wireless companies therefore had nothing to do with the men, further than to assign them to vacant positions, they often helped the operators to get a little better than the average wages. In 1915 the pay on the arc ships was $45 for freighters and oil-tankers, and $60 for the first operators on the passenger steamers. Operators sailing on ships with privately owned equipment at this time received from $55 to $65.

But while wages were slowly improving through the breaking down of the monopoly of the leasing companies, this was a mere preliminary to the sudden salvaging of the operators' submarined salaries which was wrought by the world war. With wages in every line of work ashore fattening like a steer on spring clover, radio operators became extremely scarce; and the mushroom growth of the American merchant marine created a still acuter situation. The thirty-dollar beginner of 1914, in 1918 was getting eighty dollars; in 1919, $110; and in 1920, $125. In addition to this, a good many were sailing as combination operators and supercargoes at salaries ranging from $150 to $225 a month.

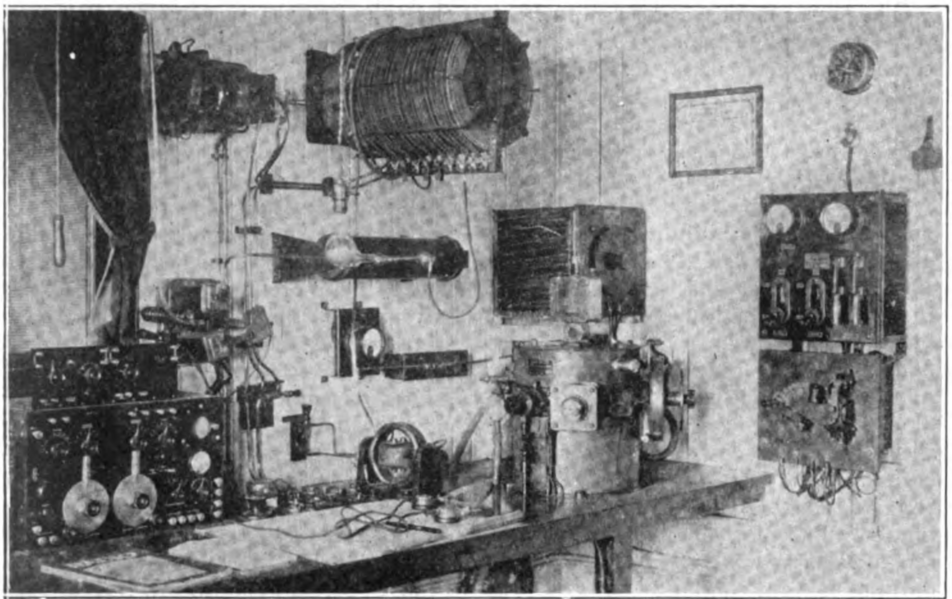
This peak was but short-lived—hardly twelve months. In 1921, a cut to $107 was resisted, unsuccessfully. In the present year another cut to $90 was put into effect on governmentally-owned vessels. The use of combination operators and supercargoes or pursers has been generally discontinued. The prevailing salary, therefore, in the American merchant marine today is $75 for the second operator on passenger ships and $90 for the first operator, or for the single operator on vessels where only one man is carried. On some of the largest Shipping Board passenger liners, the chief operator still receives $107. At this writing, a few of the private steamship companies have not yet followed the government in making the latest general cut from $107 to $90; but they probably will.

SHORE-STATION SALARIES

IT WILL be remarked that throughout this article I am dealing mainly with the vicissitudes of the shipboard radio man. The prospective operator's



Arc-equipped tank steamer "Dilworth" lying at Honolulu. While the rest of the bunch have to fuss around getting the cargo ashore, the wireless operator is away disporting himself on a surf-board at Waikiki.



A modern shipboard arc set. With this set, which has an antenna less than thirty feet above the transmitter, communication recently was maintained with KFS (San Francisco) while off the Japan coast, or a distance of 4611 miles. (SS "Stockton")

interest must primarily be directed toward the sea; for here is virtually the only kind of operator employment immediately open to the beginner. Not only do the ship operators outnumber those employed ashore thirty to one, but the land radio stations require expert and experienced men; and while it is certainly true that there are scores of amateurs with operating ability far superior to that of some commercial men, yet they will not be likely to find any opportunity to take up radio operating ashore for the reason that there is keen competition among the very best ship operators for these shore berths, and very justly the radio companies would not think of rejecting their old men in favor of newly-fledged and unknown operators, however remarkable their qualifications.

Such is the situation at present; and although there is no doubt that the future is destined to bring an almost inconceivable utilization of radio in fields other than the marine, nevertheless it seems to me that the conditions just outlined will largely continue to obtain. The shipboard radio station, with its comparatively light traffic, is the obvious place to gain preliminary commercial experience. For the encouragement of those to whom the idea of earning their daily bread only to hang in jack-knife fashion over a ship's rail and feed it to the finny tribe does not greatly appeal, it may be said that the time is undoubtedly coming when the beginner will not, as now, have to cavort very long upon the briny deep to become eligible for a berth ashore.

The salaries of operators in all branches of land radio work are controlled to a considerable extent by ship-operator wages—although the prevailing pay of the Morse or land-wire men may also have something to do with it. Increases in marine operator pay during the last eight years have forced the establishment of higher wage scales ashore, though not in proportion. Likewise, the cutting of shipboard wages will tend to the reduction of land operator salaries. This will not take place to any appreciable extent, however, because on the other hand with traffic steadily becoming heavier, better men are required to handle it.

While there are not at present many commercial coastal radio stations handling ship traffic, the number of them will increase. The salaries paid to the old-time operators with whom these stations are manned average about $145 a month. In high-power or trans-oceanic stations, about the same or somewhat higher salaries prevail. Living quarters are often furnished, but usually no maintenance.

On the Pacific coast, the progressive Federal Telegraph Company, perfecters of the Poulsen arc, are operating an extensive overland triplex radio system handling traffic between the larger coastal cities in direct competition with the land-wire concerns; and this company pays its operators $150 a month for forty-eight hours weekly work and eighty cents an hour for over-time. These operators are all regularly licensed radio men, though the transmitters and receivers to which their head telephones and their sending keys are connected are many miles away from the city offices where they work. All they have to do is telegraph; and this they do at a speed of from thirty-five to forty-five words a minute, turning out perfect typewritten copy. The receiving apparatus, as well as the arc transmitters, on this marvelous circuit is all out in the city suburbs, the several pairs of phone leads being extended over leased wires to the operating desks in the down-town offices. As one of the company's division heads remarked to me the other day, the operators at their tables, with nothing in sight but phones, keys, and typewriters, find that for them the romance in radio has been pretty thoroughly removed. The expert apparatus tenders who are constantly on watch out in the transmitting and receiving stations proper of this ultra-modern system, receive about the same pay as the operators.

Another very new employment for a limited number of experienced arc operators has been created through the development of the aerial mail service, in conjunction with which is maintained a chain of two and five kilowatt arc stations between San Francisco and Chicago. The present operator's salary in these stations is $165 a month, without maintenance.

A considerable number of radio operators are shipped at Seattle and San

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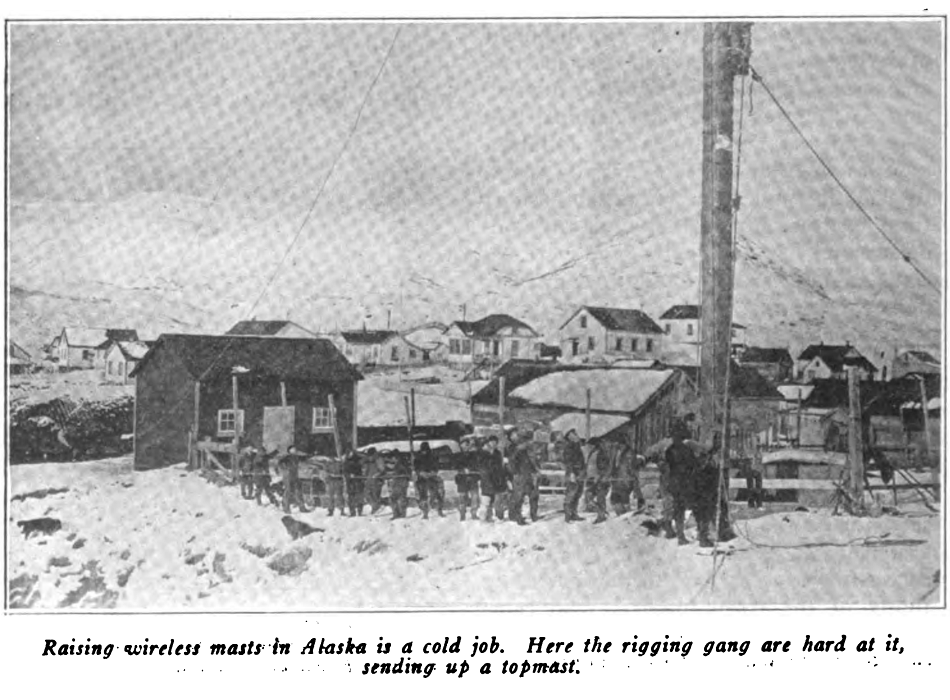


Raising wireless masts in Alaska is a cold job. Here the rigging gang are hard at it, sending up a topmast.

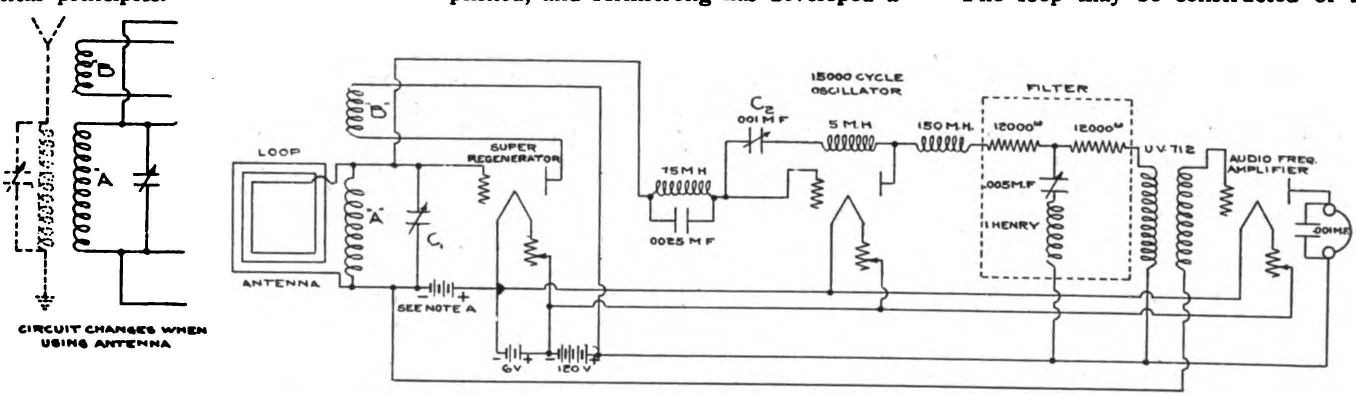
Getting Results with Super-Regeneration

By G. M. Best

A GREAT amount of information has been published recently about the new Armstrong circuit, or "super-regenerative" circuit, as it is called by its originator, and it is to be regretted that no two published circuits are alike in detail, or in some cases, even in principle, thus causing a large amount of confusion. Hence it seems in order to describe here the results of experimental work performed by the writer, with the idea of determining which of the published circuits were correct, and what types of apparatus were most suitable for the use of the average experimenter, who is not always equipped with the best of everything, or a large bank account, either. As a detailed theoretical treatise of this new circuit will appear in a later issue of RADIO, only a brief reference will be made here to fundamental principles.

In the ordinary regenerative receiver, consisting of a feedback from the plate circuit into the grid circuit of the detector, some of the energy in the plate circuit is superimposed on the energy of the grid circuit, increasing the grid current and therefore causing an increase in the plate current, due to the amplification factor of the tube. This is called regeneration, and can be carried up to the point where the resistance of the circuit becomes zero and the tube commences to oscillate, without distortion of signals. When the tube oscillates, further amplification is impossible, and the limit of the present regenerative circuit is reached.

Super-regeneration is a method by which the regenerative principle can be carried much farther than the present limitations, due to the fact that it prevents oscillations and allows regeneration to be carried on to its fullest extent. This is accomplished by introducing into the ordinary regenerative receiver some source of alternating current that will periodically vary the grid voltage of the detector tube to such an extent that the resistance of the circuit can be made equal to zero or nearly so, and yet prevent the circuit from oscillating at the period dependent upon the constants in the circuit. If the external generator is made to produce a frequency sufficiently high to be out of the range of the human ear, say between 10,000 and 20,000 cycles, the voltage in the grid circuit of the detector will be alternately increased and decreased, according to the frequency of the external generator. While the voltage is increased, the resistance of the detector circuit will be greatly decreased, and the current will build up to large values; when the voltage is reversed the current will be practically zero. It is during the period that the resistance of the circuit is small that the super-regeneration is accomplished, and Armstrong has developed a simple means within the reach of anyone who has a fair working knowledge of vacuum tubes and their associated apparatus.



Armstrong Super-Regenerative Circuit for Either Loop or Outside Aerial

NOTE A—For W. E. Co. "E"; 205-B, or VT—2 tubes, Cunningham C-302 and Radiotron UV-302, on 120 volts plate, use 9 volts. Two No. 703 or No. 751 Eveready batteries will do. For Cunningham C-301 or Radiotron UV-301, use 4.5 volts, one No. 703 or No. 751 Eveready battery.

The circuit diagram shown herewith is one which has given excellent results, and presents no difficulties that cannot be surmounted by a little patience and attention to details. The best way to mount the apparatus is to lay it out on a board, placing the various pieces of equipment so that the leads will not be too long, and yet providing sufficient separation so that unnecessary coupling will be avoided.

Three tubes are required, one being the super-regenerative amplifier and detector, the second the external generator or oscillator, and the third the audio frequency amplifier. While five watt power tubes will give considerably greater energy output than the ordinary receiving tubes, it is not absolutely necessary that power tubes be used, as good results have been obtained using Radiotron or Cunningham amplifier tubes, on 80 volts plate. Most of the circuits already published show one audio frequency amplifier working with 200 volts, or even more, on the plate, to produce signals of sufficient strength to operate a loud speaker. A two stage audio frequency amplifier working with 80 to 100 volts on the plate, and with the proper grid potentials, will accomplish the same results, and will thereby avoid the expensive battery and large filament current consumed by the power tubes. In the diagram shown here only one amplifier is shown and the voltage of all three tubes is assumed to be 120 volts. Use hard tubes, the soft variety being unsuitable for this sort of work. A common "C" or grid biasing battery can be used, the correct values being given under Note "A," in the diagram, for 120 volts on the plate, using the various makes of tubes.

The loop may be constructed of 20 turns of No. 16 or No. 18 insulated wire wound on a frame 3 ft. square, when 360 meter reception is desired. Taps should be provided for the shorter wavelengths.

For 360 meters inductance *A* should be a 50 turn honeycomb coil, and the tickler-inductance *B* should be either 75 or 100 turns, depending upon the constants of the tube. The external oscillator has the following inductances, which may be either Giblin-Remler or any of the other compact types of coils; 75 millihenries (1250 turns), 5 millihenries (400 turns), and 150 millihenries (1500 turns). These are placed in the positions shown in the diagram and are not inductively coupled to each other, the generator employing capacitive coupling to produce the desired frequency.

With the proper capacities indicated in the diagram the generator will oscillate at some frequency around 15,000 cycles. The .0025 mf. condenser can be made by placing several small grid

Continued on page 84

Radio Frequency Amplification

By Donald Lippincott

THE topic of the day for the radio chapter of the Ananias Club seems to be radio frequency amplification. Several causes probably contribute to this state of affairs. The fact that the Armstrong patent is being more vigorously enforced is probably the foremost one, for radio frequency amplification is often spoken of as a substitute for regeneration. But whatever the reason, interested and disinterested parties have scattered such a mass of conflicting statements that the ordinary amateur is reduced to a state of hopeless bewilderment. Add to this the further fact that the most outspoken opponents of this method of increasing the range of reception are those who have tried it, and one sees why it is coming to be considered a jinx.

When such a pass is reached the simplest thing to do is to discard 99 per cent of what you hear and figure it out. If you haven't sufficient mathematics, common sense will do instead. Let's start at the beginning. It may seem like repeating a lot of obvious facts, but we will run the risk of that because perhaps we may have overlooked one of them just because it was obvious.

First and foremost, we are dealing with quantities that are exceedingly small even as radio quantities go. If we weren't we wouldn't have to amplify before we detect. The fact means that terms which are ordinarily dismissed as negligible may be as great or greater than the quantities we wish to use. As this statement stands, it merely points out an unavoidable limitation, but it also suggests a precaution: leaky insulation, sloppy connections, slipshod work and waste power should be avoided. Moreover, they induce noises, and you can't expect to hear distance if a dab of soldering paste is holding a Chinese New Year celebration of its own where you left it between the input binding posts.

Next, the audion tube is operated by fluctuations in voltage impressed on the grid. If we can make these fluctuations produce ones of greater amplitude on the grid of a second tube we have amplification. But the effect of these voltage fluctuations is simply to produce variations in the impedance of the plate circuit. Since this circuit includes a source of constant voltage, the final effect on this tube is a fluctuation in plate current.

To utilize these current fluctuations to produce voltage changes to be impressed on the grid of the second tube, we pass the current through an impedance. The variations in the potential drop across the impedance are the voltage changes we seek. This always holds true, whether we use inductive, reactive or resistive coupling.

Now, to produce large variations in voltage by this method, an impedance must be high. This condition is fulfilled in most of the transformers and couplers on the market. But a high impedance shunted by another impedance gives an impedance not so high. A condenser is an impedance and the filament and grid of a tube form a condenser which is shunted across the coupler. At audio frequencies this has an impedance so great that it may be neglected. The current by-passed is practically zero. But at radio frequency—360 meters for example—the current by-passed by this condenser is about 1000 times as great, and while 1000 times zero is zero, 1000 times "practically zero" is something else again.

It is this capacity effect that is responsible for most of the difficulties encountered with radio frequency amplification. It is not equally pronounced with all tubes. Inter-electrode capacity is affected by the same factors that determine the capacity of any condenser. Other things being equal, the tube with the smallest electrodes and the greatest separation will give the best results.

Even more disastrous than inter-electrode capacity is high distributed capacity in the inter-tube transformer or reactor. A coil wound with enameled wire and impregnated with paraffin will have sufficient capacity effectually to sap off any voltage it may be able to build up. Yet radio frequency transformers of exactly this construction have been sold in considerable quantities and are no doubt responsible in large measure for much of the ill repute from which radio frequency amplification now suffers.

Another fruitful source of trouble is the desire to conserve tubes and at the same time get maximum effect on both strong and weak signals by using the same tube for either radio or audio frequency at will. A telephone key switch seems the handiest way to make the change, but a telephone key, with its parallel strip spring, is a most excellent condenser, and when it is included in the circuit one might just as well connect the grid to ground directly—it wouldn't kill the set any deader.

If it does seem best to hook up in some way which will allow the use of the same tube for either audio or radio frequency, there are two possible methods. Either a special type of anti-capacity switch must be used, the set being so designed as to give the shortest possible leads and simplest connections for the radio frequency hook-up, or else an inter-tube coupler must be used, which will function on either frequency. In this case the shift is made by simply interchanging the tubes, or if a hard detector tube is used, all that is necessary is to change the filament current to the sensitive point for the desired tube. It seems probable that with this type of coupler each tube does a part of the detecting and that some amplification takes place at both frequencies for all adjustments.

The remarks in the foregoing paragraphs on the effects of capacity are all based on the assumption of forced oscillations. If the inter-tube circuits are tuned an entirely different state of affairs exists. Under these circumstances the circuit is in effect an inductance shunted by capacity, *i. e.,* a parallel resonant circuit. Such a circuit has an infinite impedance for the tuned frequency and an extremely low impedance for practically all others. Our oscillating voltage can be impressed on the grid with a minimum of loss and the results are startling.

Some of the manufacturers of inter-tube coupling devices are now showing circuits whereby they can be tuned. The diagram of the manufacturer should always be followed for this purpose, for the method of tuning depends on the inherent characteristics of the coupler. Other manufacturers tune their transformers to the desired frequency when used with some definite make of tube, the idea being to get maximum results on 360 meters and some results throughout the entire band. It is very difficult to get exact duplication in manufacture, however, and thus far the writer has never been able to get dependable results with this type of construction. The resonant range has always been found to be very narrow and the discrepancies between different transformers and tubes of the same make sufficient to make one sample, perhaps, perfectly satisfactory, while the next one tested would prove completely dead.

Still another factor enters into this question of the tuned circuit. The plate of the first tube is effectively in parallel with the grid of the second. A tuned plate circuit is one of the recognized methods for getting regeneration. If you believe that regeneration always involves distortion, or if you hold no license under the Armstrong patent, that path is closed to you. But if what you want to hear is code, or if you are after distance, and distortion means nothing in your young life, a single stage of tuned radio frequency with a good coupler and careful construction and operation will bring in stations you didn't know existed.

Continued on page 54

The New Super-Regenerative Receiver

By Kenneth Harkness, Chief Engineer Radio Guild, New York

MAJOR ARMSTRONG'S super-regenerative circuit is merely a new arrangement of well-known apparatus. This invention is particularly interesting to amateurs because it is essentially a means for amplifying the short wavelengths to which amateurs are restricted for transmission.

In fact, in the reception of 200 meter waves the amplification is four times as great as in the reception of 400 meter waves.

It is possible for any amateur to build one of these receivers, as the assembly is simple. The difficult matter is the tuning. Probably many have failed to obtain any response or at least only mediocre results, from the receivers they have built and have been disappointed. To these we can only recommend that they try again, and persevere until they are successful. We have now constructed four super-regenerative receivers for test purposes, each of which employs a different combination as given by Mr. Armstrong. With the first it took us a day to even obtain a signal of any kind. It took us two days more to tune it in such a way that the signals came in loud. The subsequent receivers did not take quite so long to tune because we had become more familiar with the method. It will be understood, therefore, that a great deal of patience and perseverance is required to tune, but once the combination has been found it is not difficult to maintain. The results obtainable are well worth the time and energy expended.

There are several different circuits which can be used. Undoubtedly the most popular will be that which was given by Major Armstrong in his address to the Radio Club of America. This circuit is comparatively stable. The necessary parts required to construct a receiver of this type are as follows:

- 2 Open Circuit Jacks
- 1 Variocoupler
- 1 Variometer
- 1 D. L. 1500
- 1 D. L. 1250
- 1 5 Milhenry Air-Core Choke
- 1 Iron Core Choke Coil (about .1 henry)
- 2 Non-inductive Resistances of 12,000 ohms each
- 1 Potentiometer
- 1 .0005 Mf. Variable Condenser
- 2 .001 Mf. Variable Condensers
- 2 Fixed Condensers, .001 Mf. each
- 2 Fixed Condensers, .005 each
- 3 Tube Sockets
- 3 Rheostats
- 1 Audio-Frequency Amplifying Transformer
- Filament, Plate and Grid Batteries.

In this list a variometer is indicated. This is placed in the plate circuit of the first tube. This variometer can be omitted if the secondary of the variocoupler is especially wound with 100 turns of wire. Variocouplers especially designed for super-regenerative receivers are now obtainable on the market.

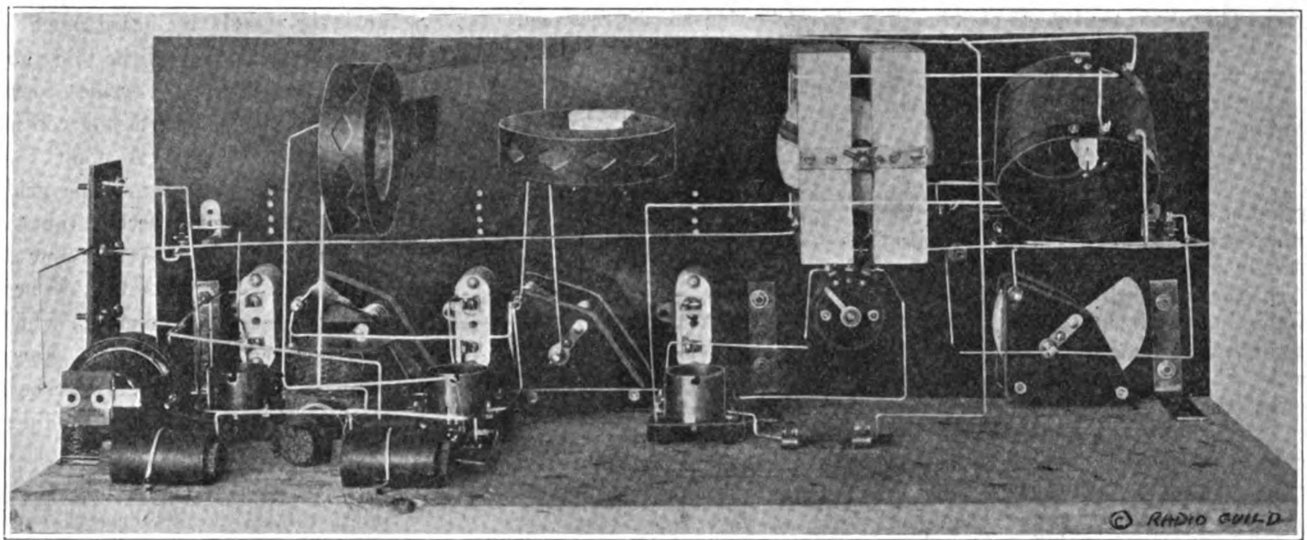
The only other special apparatus in this list, which may not be very familiar are the choke coils and resistances. These are required for the filter circuit which prevents the strong intermediate frequency produced by the second tube from paralyzing the third tube. As a matter of fact, there are several different types of filter circuits which can be used. One type is shown in the circuit. This was used by us and excellent results obtained. It consists of two non-inductive resistances of 12,000 ohms each, one .005 mfd. fixed condenser and one iron-core choke coil of about .1 henry inductance. (See Fig. 2.) This filter combination is now on the market and may be purchased as a single unit.

Another piece of apparatus which has caused a good deal of inquiry amongst amateurs is the 5 milhenry choke. This choke, with a variable condenser, is placed between the plate and grid of the second tube. A D. L. 300 honeycomb coil may be used for this choke. The value of a D. L. 300 is over 5 milhenries, but it will serve the purpose and give excellent results.

All the rest of the apparatus is quite familiar. The loop may consist of 12 turns of No. 20 wire spaced ½ in. apart wound on a form 3 ft. square. It may be in the form of a spiral or a solenoid. A clip should be provided to tap any required number of turns on this loop.

The usual instructions for assembling any receiver apply to this one. To expect good results the wiring must be carefully made and all points soldered. Use stiff wire and make all turns at right angles.

The best type of tubes to use in this circuit are Western Electric E tubes. The results obtained are well worth the higher price. These tubes can now be purchased. With these tubes we have found the best values of plate batteries to be about 100 volts for the first two tubes and 200 volts for the third tube. Biasing batteries are absolutely essential in the grid circuits of each tube. For the first two tubes the values of the grid batteries may be anywhere from 6 to 20 volts. It is best to commence with 6 volts and gradually increase the



Back view of a three-tube super-regenerative receiver constructed by Mr. Harkness. The wiring diagram for this receiver is given in Fig. 1

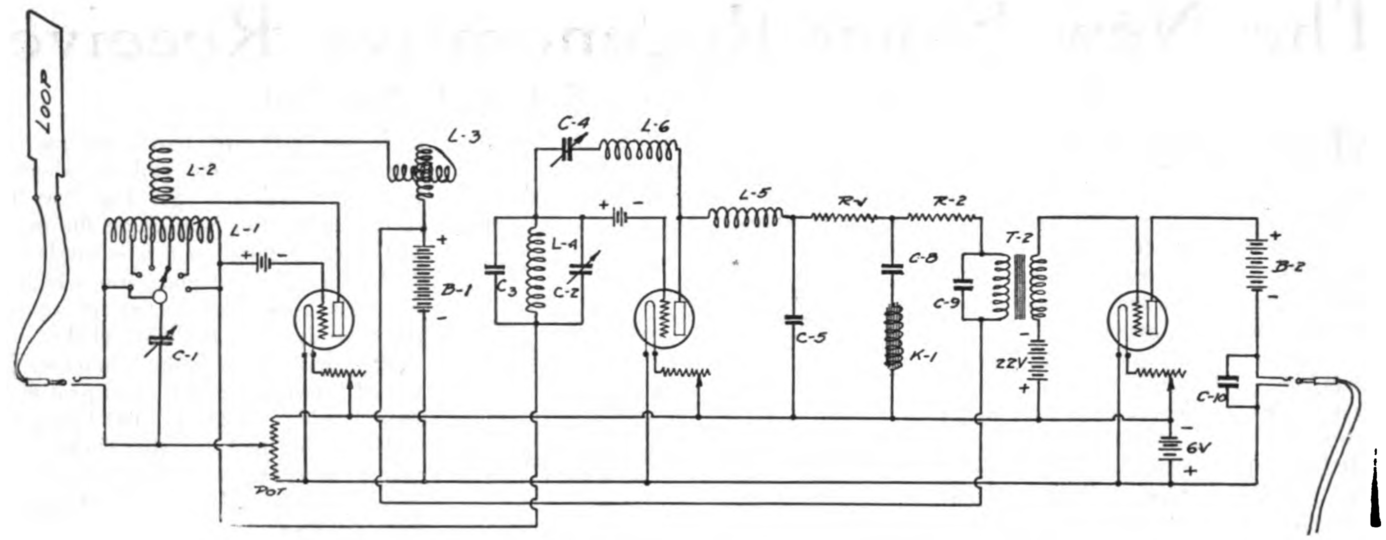


Fig. 1.—Wiring diagram of the three-tube super-regenerative receiver.

value until the best results are obtained. A 22-volt battery may be used for the grid bias of the third tube.

It is rather difficult to give directions for tuning a super-regenerative receiver. In the first place, it must be realized that it is an entirely new method of reception and the conditions which apply to other methods of reception do not necessarily apply to the super-regenerative receiver. As with everything else, the individual will learn more by practice than by information and advice from others. Those who have regenerative receivers have learned to tune them by actual practice and they must similarly learn to tune the super-regenerative receiver. However, we can give a few hints which will be found useful.

The constructor should first look for certain effects to determine if his circuit is functioning properly. When the filaments of the tube are lit a penetrative high-pitched whistle should be heard in the phones. If this is not heard, vary the condenser (C_4) which couples the grid and plate coils of the second tube. If there is no response, vary the plate and grid batteries of the second tube. If there is still no response there is either a break in the circuit or it has not been properly wired. When the fault has been found, the whistle indicates the second tube is oscillating. The first tube must then be made to oscillate. To obtain this adjust the condenser across the loop and adjust the feed back coil. The feed back coil may be the especially wound secondary of the variocoupler or the ordinary secondary and a variometer in series with it. Adjust also the voltage of the grid battery of this tube. When the first tube oscillates it will easily be recognized by a loud roar in the phones.

With both tubes oscillating a movement of any of the variable elements in the circuit should produce a series of heterodynes of harmonics in the phones.

The following are the constants:

C1—.0005 M. F.; L1 and L2—Vario-coupler.
L3—Variometer; L4—D. L. 1500.
L5—D. L. 1250; L6—D. L. 800.
C2—.001 M. F.; C3—.0015 M. F.
C4—.001 M. F.; C5—.005 M. F.
R1, 2—12000 ohm resistances.
C8—.005 M. F.; K1—.1 Henry Iron Core Choke.
Tr—Audio Frequency Amplifying Transformer.
C9—.002 M. F.; C10—.002 M. F.
Pot.—200-400 ohms Potentiometer.
B1—100 V.; B2—200 Volts (with 5 watt tubes)

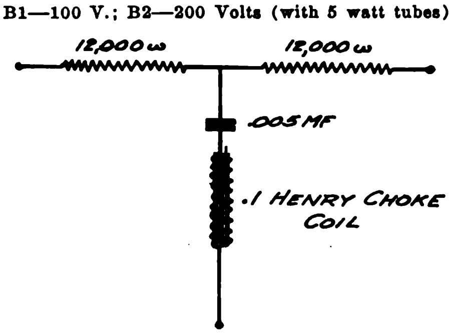


Fig. 2.—Filter System

If any condenser is moved a series of loud whistles running up and down the scale should be heard. No progress can be made until this condition is arrived at. Those who have built super-regenerative receivers and have not obtained this effect may as well realize that their circuit is not functioning properly. They must make the adjustments just outlined and obtain this effect.

When the proper state has been obtained the circuit should then be tuned. First of all the loop or grid circuit of the first tube is tuned roughly to the wavelength it is desired to receive. For 360 meters about 6 turns on a 3 ft. loop and about 20 turns of the primary of the variocoupler will be the correct value. Final adjustment is obtained by the condenser across the loop. Voice or music from a transmitting station may be audible, but whistling and roaring noises may accompany it. Then vary the condenser C_2 across the grid coil of the second tube and the condenser C_4 coupling the grid and plate coils until the signals are heard much louder. The feed back coil of the first tube may again be varied. Terrific roars and whistles will be heard but continue to tune until the critical point is found where these disappear. The grid voltages of the first and second tubes should be gradually increased and new adjustments made all around. When the proper values of C_2 and C_4, which provide marked amplification, have been obtained these condensers may be left in these positions and final adjustments made with the feed back coil of the first tube, and the potentiometer. One point will be found where the whistling and roaring ceases and the incoming signals are enormously amplified. It will take a long while to find the correct adjustments and, other than this general outline, there is no fixed rule in the matter. The potentiometer across the filament battery is of considerable assistance in finding the critical point. The grid voltages are particularly critical. The best results are obtained with fairly high voltages, but, to tune the circuit, commence with a lower voltage.

Make sure that the proper values and tubes are used and then persevere and patiently experiment until the results are obtained.

The main thing to remember is that the super-regenerative receiver works wonderfully well. If you are unable to make it work, don't blame the circuit, but blame yourself. Continue to try until you are successful. When you have found the combination it is no longer difficult.

STATION 3 B V, WEST CHESTER, PA.

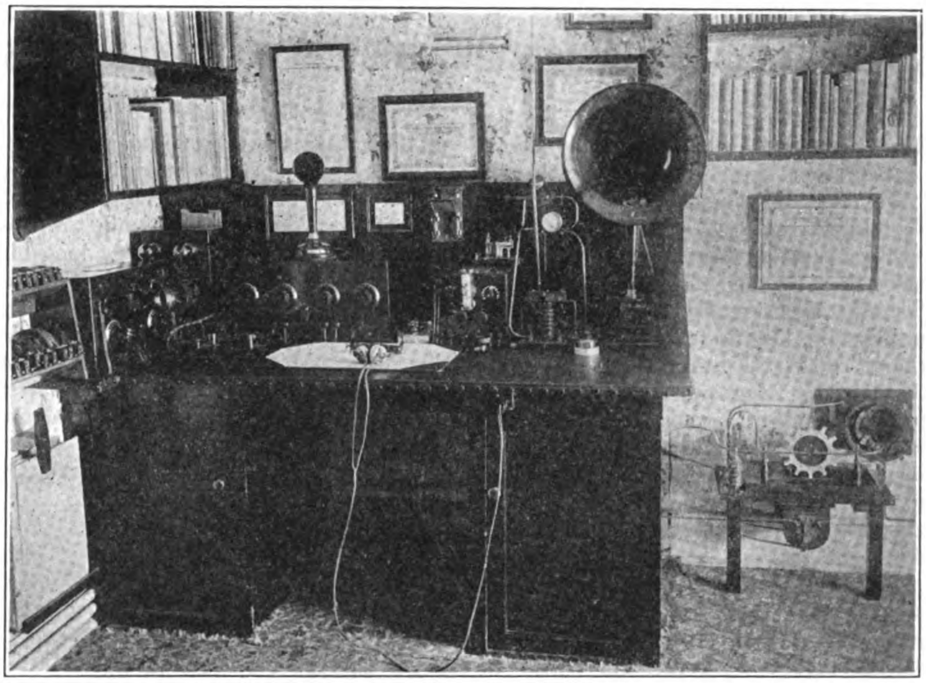
By PAUL G. WATSON

All the apparatus used in 3BV is home-made with the exception of the Magnavox. The receiving set is wired for both long and short waves, two tuners being employed for this purpose. The audion panel is wired on the "Ultr-audion" plan and contains all necessary audion controls. A pre-war "Auditron" is used in this detector, and gives much better results than any of the more modern tubes.

The amplifier is a 2-step audio frequency type, in outward appearance similar to a "Deforest," but radically different inside. The circuit of the Federal Tel. & Tel. Co. of Buffalo, N. Y., is used in connection with Acme "A-2" transformers.

The short wave tuner is composed of a "Simplex" variocoupler, two "Simplex" variometers, and a "Cotoco" .001 mfd. variable short wave condenser. A switch is arranged on the short wave condenser, so that it is automatically short-circuited when the dial is turned to a position just beyond 180. The primary switch of the tuner is a back mounted affair and gives much better results than the old type of switch.

The long wave tuner is composed of a coil mount, two .001 mfd. "Cotoco" condensers and a series-parallel switch. The tickler or feed back circuit is employed. All the connections in this tuner and in fact all the other pieces are made with No. 14 hard drawn wire, giving the best possible results. Connections between the various pieces are made with No. 10 wire, reducing resistance to a minimum.



3BV, West Chester, Pa. Layout of 3BV

A three pole double throw switch changes the two audion leads and the antenna from one tuner to the other. By using this system of transfer no dead end losses occur.

Unfortunately I am unable to get a. c. for a respectable transmitter, so I am forced to use a spark coil, but have worked 44 miles, to 3CC with this coil, after tuning it closely.

The antenna is a 6-wire affair, 90 ft. long, with 16-ft. spreaders. A 25-ft. vertical section tapering to a 4-ft. spreader serves as a portion of the

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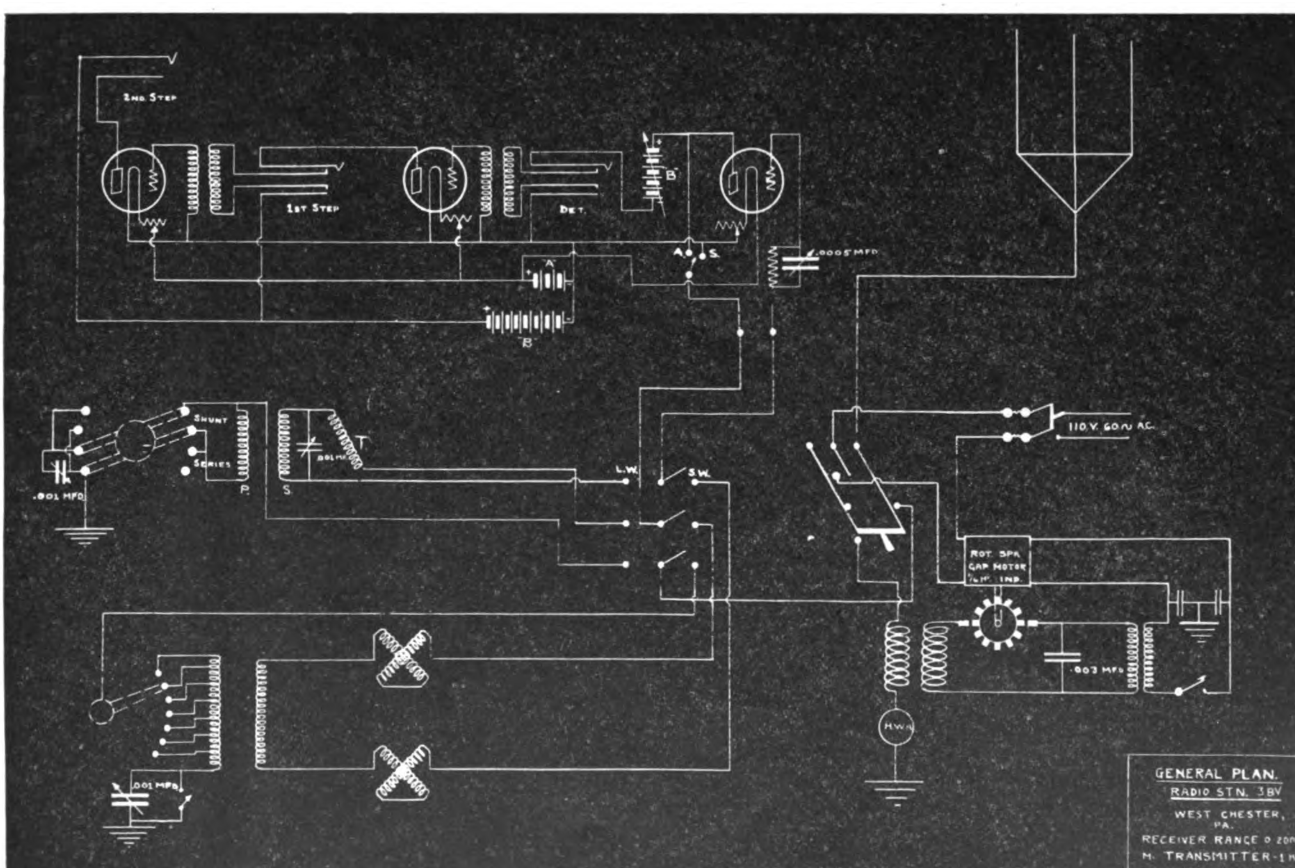


General Plan of Station 3BV

Scratchi Discusses the Business Lookout

By David P. Gibbons

To Editor RADIO (Magazine which make new crop of such to resemble 30 cents Russian).

Hon. Sir:

Since grasping present-time position as newspaper radio expert my Cousin Scratchi have rapidly develop himself into really brainless wonder. I desire therefore, Mr. Editor, to demand some sniggestings from you how he can improve this defect, because I think, mightbe, you are quite good at advice dispensing, since peppy books all tell student that everyone have something which we are very good at it, and I do not know what else you can be good at.

My cousin are fast losing fine opinion of high intelligents among the generally public and are also losing, in additional, small amount of conscients which he formally possess, if any. Each a. m. and p. m. his letter box are fully charged with jammed mail from all sectors of this glorious land where liberty still wave a little. Each envelope contain 11 or 8 knotted problems which display how highly ignorant the trodden-down proletariats have recently became.

"How have you succeed to obtain such great mastery of radio to answer all these deep questionings?" I quirk at him, night before this one. "Did you uptake loud-praised corresponding course for this while key tapping on old scow maru?"

"Most silly question of all!" he rap me back, "Key tapper on all marus become daily more vacant in top story and have too slight cash balance for foolishnesses after he pay for sufficiently passionate sox and neckties every trip. To learn radio through mail carrying gent are muchly similar to learning box-fighting or brick-lying professions in that style—possible mightbe, but not very so."

"But have not many thousands," I demur, "given full-page testimony of grand results from those coursings? Do not one gent rush homeward to snappy real estate and say loudly for neighbors, 'Holloa, dearie! Just got other thousand dollar weekly raise?' And do not other bimbo explanate freely how he grow fresh set of brains in single eventide by making sign on dotty coupon and forwarding three cash dollars every Saturday hence fourth?"

"They do indeed," Scratchi sneak over, "and also many thousand elsewise honest people inform simple stranger that climates of San Francisco are very finest in universe!"

I get snarled up by this, Mr. Editor, and cannot upthink suited back-kick until too lately.

I switch to higher wave then, and require from him if Hon. Ad. Manager do not still endeavour to grab off some of his valued space on radio page.

"Not so muchly these passed few weeks ago," he respond, "since ecstatic season which are now drawing towards glad finish have drove many possible radio bugs to sea and mountain trippings, and camperouts who are busy writing on postal views, 'Having splendor time, wish you were here,' have not sufficient time space to examine newest unregenerate style receptors. Also, again, quite several of the sprung-up, night-flying companies which make smartly

Johnny used the clothesline for a counterpoise

aleck living off poor fish have discover that fish do not desire to be stung twice in same place. Not matter how dumb, novice who have just paid 12 iron bucks for 40-cent sea shell amplifier will make notable pause before donating 5 additional green ones for peanut size bottle of liquor which make crystal work like two stepper and extract all static from ether."

"Since one are born every minute, all are not yet dead!" I reflex in heavy brisbrainy manner.

"You inform them, monkey wrench," he make slangy crackle, "you are always amongst nuts."

"But do not many vacationers desire to buy classy receiving sets to take along and get home town news and musical programs while seeing how grand nature are?" I pose with stump him idea.

"Desire to do so, truly," he circulate, "but most of such who leave home fires for a change and a rest, return themselves back with quite small change while gracious hotel keeper have the rest."

"Do you, then, observe that radio boom are popping up distress signals," I rogate, "and are on road to join other passed crazies like jazz and bobby hair?"

"By no means at all," he flare at me, "soon as all bathing togs are back again on usual nail in closet, greatest indoor sport will bloom again into magnitude which shall make movie and auto businesses look like umbrella mending industry. When new Armstrong circuit are placed on counters and midget-wave transmitters shoot forth really music and song, bird who cannot speak the language will become rare as the goof who still wears derby hat and white vestcoat. I shall then have to install several new letter boxes for daily stream of edisonaires and 4 or 5 new waste baskets to remove such as require too much heady work."

"Would not this grand volume of information fill greatest part of radio dept. space?" I interrog.

"I shall have sufficient of it when I throw away all press-agency photos of sweet young things listening to radio in shrunk-up bath suits, which make most radio depts. look like copy of Barber Shop Gazette. I shall gain further space by rejecting free ads. in broadcastors programs of the Dambigo or the Knobby Reducing Pianos, and shall insert some relied-upon knowledge about wireless in places now occupied by pipe-addick writers of Sunday Magazine Sector."

"Where shall you obtain this vast increase of knowledge to sail abeam of all those startled developings which make old timers dizzier than ever?" I deploy.

"That are dark-color newspaper secret," my Cousin modulate in low note, as he shut down for customer regulated period.

I do same thing, Mr. Editor, and hoping your input continues to amplify on steepest part of curve,

I am please to indict myself,

Your interesting reader,

HILOLI NOGO.

THE CQ HOUND

Listen, old-timers, and your fones will resound
With the terrible squeal of the CQ hound,
Whose sending won't stop for fire or flood,
Though every old-timer thirsts for his blood.
It's always "Hello, and how am I now?" and
"QSU now, for it's time to chow."
He is always on deck, though "QTC NIL,"
His messages read, "Is this you or Bill?"
Oh! For his presence and a huge rettysnitch,
A double-barreled shotgun, a barrel of hot pitch.
That never again could we hear that sound,
The eternal squeal of the CQ hound.

NAVY ELIMINATES MUSH

Recent experiments conducted at the Mare Island Naval Radio Station are reported to have eliminated "mush" and harmonic interference by means of a current transformer. Tests conducted with the co-operation of commercial stations in the vicinity show that these companies experienced no interference while the high power arcs at the naval stations were in operation.

The Conscience Shop

By Earl Ennis

THE Papyrus Club is one of the loitering-places of the overly-wealthy. Over its billiard tables and in its stuccoed grill, are pulled many of the strings that effect the "big business" transactions of the outer world. Among the sterling figures whose names and connections were of inestimable value to the already firmly entrenched reputation of the Papyrus Club, were Homer Madsen, president of the Citizens Trust Company, and Marcus Waterford, president and general manager of the Development Oil Company. Madsen had been a director in the club for ten years, and Waterford, while never having attained that distinction, occupied the equally enviable position of being Madsen's proxy on such occasions as the latter was unable to attend the board meetings.

Waterford lived at the club. Madsen, while occupying a palatial home in Cloyn Court, nevertheless passed the greater part of his time at the club also. Both were familiar figures in the lounging room, where evening after evening, they could be found at cards or chess.

One week before the occurrence of the mysterious events now to be discussed, the stock of the Development Oil Co. had been manipulated by Madsen and Waterford so as to drop sharply in price and carry to ruin the savings of thousands of small investors. Among these unfortunates was the "clientele" of a boarding house where lived Walter Rivers, contractor and engineer, and also Miss Katie Ferguson, whom Walter had admired for months. All but Walter had lost their all in the "drop" from which the manipulators had reaped a rich harvest.

Because of his pity for his fellow boarders, and especially because of his admiration for Katie Ferguson, Walter Rivers had assumed the task of compelling the rascals to return their ill-gotten gains. He soon reached the conclusion that they could not be touched by law, and in a flash of inspiration he determined to try to touch the conscience of Madsen, whom he divined to be the power behind the deal.

By diligent search he had secured the architect's plans of the Madsen home and armed with this information was able to lower a radio receiving set down the chimney leading to an open fire place in Madsen's private apartments. He did this by posing as a telephone lineman shooting trouble.

Meantime Miss Ferguson had quietly learned of Madsen's habits and especially that he was accustomed to read before his fire place just before retiring each evening.

ON the night following the day of Walter's excursion to the Madsen home and the installation of the odd-looking apparatus in the chimney thereof, Madsen and Waterford passed the evening as usual—this time at billiards. At about 10:30 o'clock, Madsen tired of the game and decided to go home. As he left the club in his machine, the engine of an automobile directly across the street purred suddenly into life, and edged along until it was directly behind the limousine. Only when Madsen's driver turned his machine into the gravelled drive, did the second car drop the trail and turning abruptly about, return downtown.

"Madsen jumped from his chair with a startled exclamation."

A few moments later the second car halted before an all-night drug store. Katie Ferguson alighted and paid and dismissed the driver. Then she made her way to the telephone booth in the store and called Rivers at his office.

"He has just gone home," said Katie, cryptically.

"All right," Walter replied. "That is fine. Grab a surface car and come up. Everything is set."

With nerves that tingled with anticipation Katie hurried out of the drug store and boarded a car. Fifteen minutes later she was in Walter's office. The young engineer had extinguished all the lights save the drop-light over his desk; the room was shrouded in mysterious shadows. Katie began to tremble, but Walter's quiet voice and unconcerned manner steadied her.

"Now tell me about it," she said, her inner excitement revealing itself in her voice. "What are you going to do?"

Walter smiled.

"Well, for one thing," he explained, "I'm going to give Madsen the scare of his life. For another, I'm going to make him a present of a conscience. I told you this was a conscience shop. Behold the conscience!" He pointed to the mysterious instrument on the laboratory table, and the odd spiral above it.

Katie shook her head.

"You will have to be more explicit, I don't understand at all."

"The idea is this—" Walter explained. "This instrument is a wireless telephone of the very latest type. It works without any overhead wires, except for this small spiral. The instrument we installed in the chimney yesterday is the receiving end of the same instrument with a loud speaking attachment. Whatever we say in this instrument is picked up and repeated by the one in Madsen's chimney."

Katie's eyes began to glow.

"You mean——?"

"I mean that at 11:30 we are going to hold a conversation with our friend Madsen. That is, I am going to hold the conversation. He is going to listen. He will have to listen, because we have figured that he will be sitting in front of his fancy fire place. As far as Madsen is concerned, my voice, which will in reality come out of the fire place, will seem to come out of space. Unless I miss my guess, it is going to give Mr. Madsen the shock of his life!"

He looked at the clock. There remained but a few moments of the hour he had set for the test. Walter tested the various parts of his instrument. Then he touched the switch and a generator beneath the table began to purr.

"That is where I get the current that transmits the waves from this spiral antenna through the air to the similar spiral antenna in the chimney," he said.

Continued on page 56

A Radio Primer

By H. A. Eveleth

THE RADIO TELEPHONE TRANSMITTER

TO transmit the complex vibrations of the voice and music there must be available a source of high frequency alternating current of constant amplitude to act as a carrier of the speech or music and a means to alter or modulate the wave form of the high frequency current to correspond to the vibrations of the sounds being transmitted. The high frequency or undamped oscillations are inaudible at the receiving station, but when these oscillations are modulated at the sending station similar variations occur in the wave form of the current received at the listening station and speech or music is reproduced.

Undamped oscillations may be generated by a suitable arc, by a high frequency generator or by the three-electrode vacuum tube. The tube method is the most practical and 5-watt, 50-watt and even 250-watt power tubes are available for generating undamped oscillations.

There are several ways by which the C. W. radiation of the antenna may be modulated. The method of absorbing power from the aerial may be easily understood. One tube, called the generator tube, is so connected that it generates undamped oscillations which set up by induction similar currents in the antenna ground circuit. A second tube, called the modulator, is connected in parallel or shunt with the generator tube, but in series with the grid of the modulator is connected the secondary winding of a transformer, the primary winding of which is in series with a battery and a microphone or telephone transmitter into which a person speaks.

Referring to the modulator tube, the resistance between the plate and filament depends on the potential of the grid and the potential will vary according to current variations in the microphone. More or less current will, therefore, be absorbed from the output of the generator tube. This will cause similar absorption of energy from the aerial-ground circuit and the changes in wave form will be detected at the receiving station.

In actual practice, motor-generators are usually used to furnish the filament current and the high voltage plate current. Condensers and choke coils are used as a filter to eliminate audible sounds caused by the commutator segments. In addition there must be variable condensers and inductances for tuning the different circuits and the whole system must be carefully tested to secure good modulation so that the speech or music will be clear and natural at the receiving station.

When concerts are broadcasted microphones with horn attachments are placed in proper locations in the broadcasting room and the walls and ceiling of the room are usually draped with cloth to prevent echoes and eliminate the distortion that would occur were this precaution not taken. Phonograph records are played by substituting a special microphone for the usual phonograph reproducer, the vibrations of the needle varying the resistance of the microphone.

Dr. Chas. P. Steinmetz and Senator Guglielmo Marconi during the latter's visit to Schenectady, N. Y.

WIRELESS STATION ABANDONED

Podhu, probably the most famous wireless station in the world, has sent its last message. "MBD," its famous sign call for which ships' operators have listened eagerly for the last nineteen years, is now replaced by "MFT," the sign of Clifden, the Irish station of the Marconi Company, which has taken up the duty of talking to people who go down to sea in ships, telling them at midnight what has been happening throughout the world during the preceding twenty-four hours.

Perched on the rockbound coast of Cornwall, Podhu has made history. It was the first high power wireless station to be built and from here the first wireless message was sent across the Atlantic with 2000-meter wavelength on December 12, 1901, to St. Johns, Newfoundland.

It was from Podhu, in 1920, that the first wireless telephony test between England and a liner at sea was carried out.

ANOTHER PRIZE CIRCUIT CONTEST

The publishers of RADIO have been authorized by the Winkler-Reichman Co. of Chicago, manufacturers of the "Thorophone," to offer a prize of $50 for a new or an improved circuit, giving the clearest and strongest reception of radio signals. As they stipulate that the winning circuit give as good a reception on a loop as does their A-10 circuit with an outside aerial, the prize winner will probably have to provide for radio frequency amplification, and thus may come within the provisions for the $100 Radio Frequency Amplification Contest now being conducted by the publishers of RADIO. On this account the closing date for both contests is extended to October 15, 1922. In the event that a circuit wins both first prizes the designer thereof will receive $100, with prizes of $25, $15 and $10 for the second, third and fourth contestants.

All apparatus used—tubes, variometers, variocouplers, condensers, etc.—should be of a type readily obtainable on the market. Each contestant should give a bill of material with his circuit, showing the make, catalog number and the manufacturer's address of all apparatus used in his receiving set. When possible, alternative equipment should also be named.

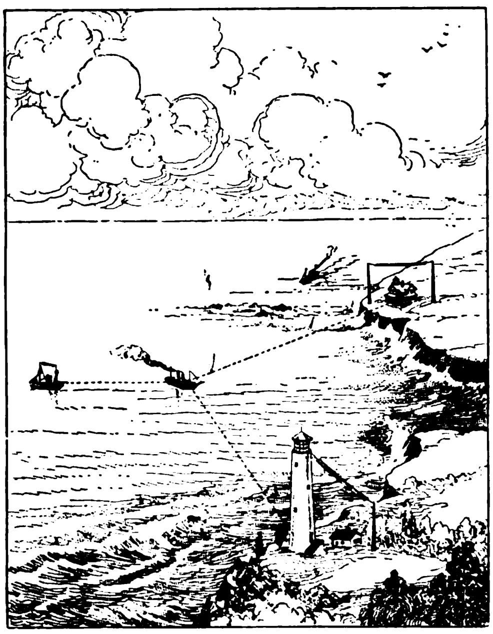
Contestants are required to submit manuscript written on one side of the sheet with all sketches and diagrams legibly drawn in ink on separate sheets. Photographs of completed equipment should accompany the manuscript. No consideration can be given to circuits that have been previously published, or to any one circuit that has not been successfully tried out in practice.

The publisher reserves the right to print all worthy ideas, not prize winners, at the usual space rates. No manuscript entered in this contest can be returned. The contest is open to any one, radio clubs included, except the manufacturers of radio equipment. Prizes will be paid upon publication. Address all communications to the Editor, care of this publication.

SUCCESSFUL TEST OF KOLSTER RADIO COMPASS

An official test and demonstration of the Kolster radio compass and position finder as an aid to navigating a fog-bound vessel was made Aug. 2 on board the lighthouse tender Sequoia around San Francisco Bay and outside the heads. H. W. Rhodes, superintendent of lighthouses, was host to a large party of Navy and Government officials as well as a score of steamship men.

Leaving the dock at 10 a. m., the Sequoia proceeded into the bay, where visual bearings and radio bearings were taken simultaneously. After charting these observations, and while the Madrona was still obscured by the morning fog, the Sequoia set her course and maintained it the entire distance to the Madrona, using the radio compass only to guide her to the anchorage.



Sketch Showing How Ship's Position Is Determined with Radio Compass

Again leaving the dock at 1:30 p. m., the Sequoia proceeded outside the heads, where the Madrona had preceded her, and carried out further tests successfully.

Later in the afternoon cross bearings were take on the San Francisco lightship and the Madrona, which had proceeded to a point off Duxbury Reef. During these runs Dr. Kolster was blindfolded and brought the ship back to her original course.

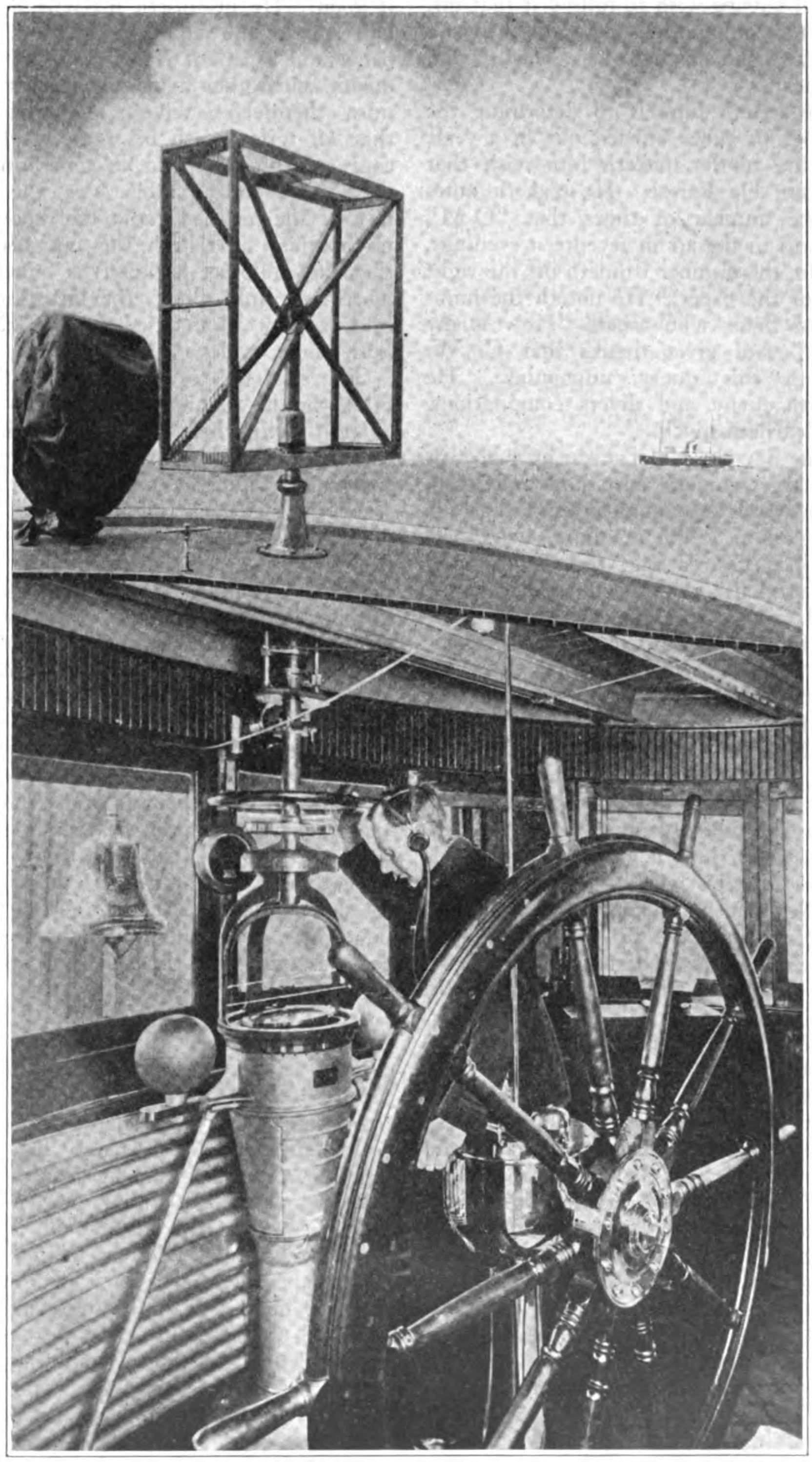
Members from the Ship Masters' Association were given an opportunity to use the compass, and, although inexperienced, were able to obtain accurate bearings.

The Bureau of Lighthouses has adopted the Kolster system of radio beacons on shore with the direction finder on board the ship in the hands of the navigator in preference to the system of placing the direction finders on shore. The San Francisco lightship is now permanently operating as a radio beacon station and additional Pacific Coast radio beacon stations have already been authorized for Cape Flattery, Columbia River, Blunt's Reef and Los Angeles. It is intended to make additional installations of the radio beacon stations along the coast as soon as practicable.

Dr. F. A. Kolster, inventor of the system, and representatives of the Federal Telegraph Company, manufacturers of the apparatus, were on board the Sequoia to explain to shipping men the operation of the system.

By means of the Kolster radio compass mariners can make their way into port in a fog without sending wireless messages to the stations on shore. The instrument is operated by the captain in the pilot house of the ship and the course is set for the lightship in spite of the fog.

A radio telephone circuit between Copenhagen and Bornholm was recently opened to the public. The arc system is used for transmission and the rates charged are lower than for similar service by telegraph.



Kolster Radio Compass Installation on the "Sequoia"

"And It Came To Pass ---"

Wherein Radio Liars Cometh Up for Discussion

By S. P. W.

AND it came to pass that a certain ham was appointed a statistician in the city of the government; even one of those who hath at his tongue's tip data of great interest, like unto the fact that if all the spaghetti manufactured in the United States in three weeks were placed end to end it would reach from New York City to Oshkosh, Wis., should anyone wish to follow it that far. And the combination of a radio man and a statistician in one was fearful and wonderful.

He setteth himself to determine the number of tubes burned out in a year, and the results maketh him wish that he were De Forest. He maketh notes on the number of times that "O M" is heard in the air in seventeen evenings, and lo, the number runneth off the right side of the paper. He noteth the number of hams who asketh "How is my tone?" and gives thanks that C. W. maketh this query unpopular. He maketh many and divers compilations, and learneth much.

One day the Chief, even he who was in charge, cometh unto him and saith, "The word hath gone around that the followers of Radio are liars, every one, and it is desired that this blight upon the moral life of our country be investigated." And speaking further, he delegateth our friend to look into the matter. The report followeth:

The belief that all radio men are liars is found to be indeed well founded, for the writer hath traveled the length and the breadth of the land, and lo, they all telleth tall stories. And the nature of these radio liars (for each class falleth into a group by itself), is various, in this wise:

The radio liar whom we all knoweth is he who maketh up wonderful tales of distant parts wherein his call hath been picked up. He enlargeth upon his DX operation at all times; he disregardeth the report post-cards he receiveth, for he careth not for facts. He talketh boastingly before beginners, and speaks knowingly of "reaching out." In club meetings he addresseth the chair and all and sundry on the rights of "us DX men." He carryeth around cards from stations that reporteth him from distances of two or three hundred miles, and claimeth to have many more at home, which haveth a way of becoming mislaid. And of all radio liars he is the most numerous and the most harmless, for lo, all wise operators knoweth him, and heedeth not his empty words.

And in the second place cometh the married-ham liar, and indeed his sins are many and various. He telleth his wife that he cometh home at 9 o'clock when he leaveth for radio club meetings, and he returneth not till 11. His wife asketh him how much his new two-step costeth and he saith $8. She reproacheth him for the new tubes he buys, and he explaineth that they are only four bits per. He spilleth acid on the rug, and claimeth that it doeth it good. He promiseth his wife a new hat, and lo, the money goeth for a new panel and a pair of Baldwins. He condoleth with other hams who hath taken unto themselves wives, and claimeth that *his* wife loveth his radio, and encourageth him to spend his time humped over the operating table. Yea, the perfidy of the married radio liar knoweth no bounds; he telleth the tax assessor that the radio set is merely a bunch of worthless junk, albeit, the latter sin is confined not to married hams! (Nor, saith some, is it a lie!)

The operator of the spark station blinketh the lights for a block, and agreeth with his wrathful neighbors that the service is rotten. He causeth sparks to jumpeth out from the gas stove in the house of the folks next door, and calmeth them by saying that it is only their personal magnetism leaping to a ground. He causeth various uproars in the telephones of his neighbors, and then taketh the lead in asking them if they noticed the horrible noise, and lo, they suspecteth him not, as was his aim. He bloweth fuses in his own home continually, and telleth his father that it is due to the culminative effect of mother's new percolator. And his father, having respect for the wisdom of his first-born, believeth him. He telleth his dad that he getteth an "A" in four subjects, so that he getteth that new rotary and signeth his father's name to a report card that beareth as its highest mark a "B—." He truly is an Ananias the Second.

The new owner of a radiophone receiving set becometh a most proficient, albeit innocent, liar. He telleth of the many and mighty carrier waves he picketh up, and lo, it is only his tubes howling. He saith that he heareth long distance telephones (very faint ones, that surely cometh from afar off), when it is only young Winters in the next block experimenting with a microphone in the ground lead of his receiving set. He denieth indignantly that he is causing trouble by using an oscillating regenerative set, and sweareth that his is a Westinghouse, and not an oscillating regenerative. He almost persuadeth his dealer to make good a tube that burneth out with half the rheostat in the circuit, until the dealer learneth that the battery in use was "the small one," as "the current consumption of the filament is very low" and the plate potential quite high, according to the instruction books. He lieth convincingly because he lieth unknowingly; truly he is a lovable liar, and the time will soon come when he will lie with intelligence and understanding, as becometh a real ham.

Of late there hath sprung up a new variety, and he is called the dabbler in C. W. Truly is he a great liar, for he claimeth that he hath discovered an electrolytic rectifier that heateth not up. He cutteth up his mother's favorite saucepan for aluminum, and the water-pipe for lead; when they are found to be missing he calmly layeth the blame on the junkman. He contendeth that his modulation is good in the presence of divers and enthusiastic witnesses to the contrary. He causeth weird gurglings and howlings and sputtering and rasping in the air, so that the ears of his fellow hams are blasted, yet he stateth that he doeth no such thing. He burneth out divers 5-watters, and replaceth them hastily, fearing to admit his ignorance in burning them out. He laugheth at spark stations and calleth them obsolete and old-fashioned, asking the owners thereof where their magnetic detector is, and other questions in the same spirit. He even claimeth that he hath a good I. C. W. scheme that is efficient, simple, cheap and that giveth a good and steady tone. Truly, he is a mighty liar.

Thus concludeth the report of the investigator, who submiteth it to his superiors with the feeling of having accomplished a good job. But lo, and the end was not yet, for his chief calleth him upon the carpet and saith unto him, "Thinketh thou that this report is complete. Wherefore hath thou found not the radio liars who write some of the copy we see in the daily papers? Art blind? And by what token hast thou neglected to report on the radio liar who filleth out his government license blanks with information on a set that existeth only in his imagination, and diagrameth an aerial that would be his were it altered in some five or six ways? Hast thou never been an amateur? And how come——" his chief continueth for an hour.

And our hero returneth to his office, and he sitteth there wrapped in thought for many hours, and then rewriteth his report in this wise:

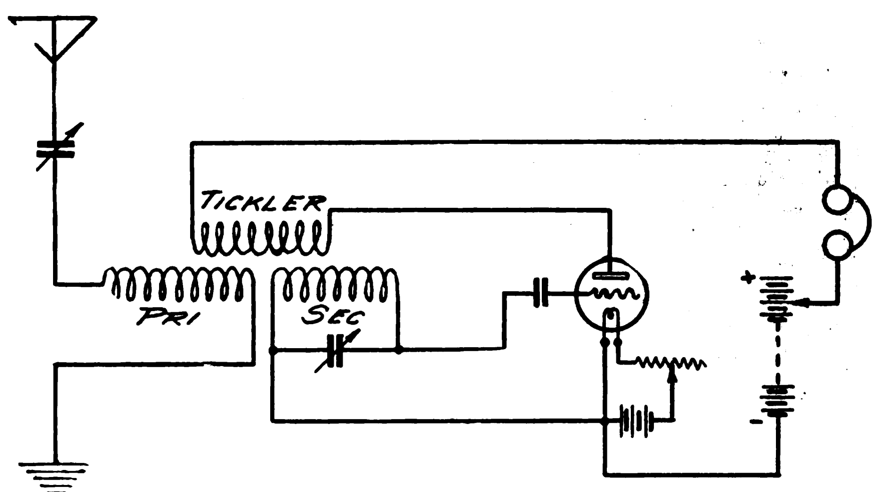
"It is written that 'All men are liars.' That goes double for radio men."

And lo, he hath said a mouthful!

A Regenerative Set with "Duodirectional" Tickler Coil for Short Waves

By B. F. McNamee

BEFORE describing this set, let us say a word about connecting tickler coils. It is a familiar fact that if the current flows in the wrong direction through the tickler coil the signals will be weakened instead of strengthened by it. To be sure, there is a method of figuring out the proper way of connecting it up, but most of us simply try it first in one direction and then in the other, and compare results. The trouble with this method is its inconvenience, and the fact that it sometimes leaves us in doubt as to the right direction when we test on certain signals.



Hook-up for "Duodirectional" Tickler Coil

Some experienced amateurs have adopted the following rule: first place the two wires on the tickler terminals the way you think they should go and then, before fastening, reverse them, on the theory that you're sure to get them wrong the first time.

The following is a description, with dimensions, of an excellent short wave regenerative set in which the tickler coil cannot be connected in the wrong direction. The additional excuse for this article is that the set can be made with a minimum of time and expense.

Take a 4-in. diameter cardboard tube about 6 in. long and shellac it inside and out. For the primary wind 45 turns of No. 20 or 22 double cotton covered copper wire and bring out the two ends only. The primary and secondary windings are to be placed end to end on the same tube, so start the primary winding near one end. Start the secondary winding about half an inch from the end of the primary. The secondary consists of 30 turns of any small size of insulated wire wound with the turns slightly separated; No. 26 or 28 cotton or silk covered will do. The turns may be separated by winding a heavy thread with the wire. No taps are taken on either coil.

The tickler consists of 70 turns of any small insulated wire (the writer used No. 32 double silk covered) wound on a cardboard tube, or turned block of wood, just small enough to slide back and forth inside the 4-in. tube with clearance. This clearance should not be greater than one-eighth of an inch all around; a smaller clearance would be better.

The method of mounting the coil and tickler is left to the builder; for experimental purposes they can be successfully used without any mounting. The tickler coil must be capable of sliding at least the full length of the outer tube.

The series condenser in the aerial circuit has a maximum capacity of .0005 mfd., and the shunt secondary condenser is .001 mfd. maximum. With these values this set will work efficiently and regenerate or oscillate on wave-lengths from below 200 to above 600 meters.

If used with an amplifier, the primary of the amplifying transformer should be shunted by a fixed condenser of about .0005 mfd. capacity.

Now for the special tickler feature. Connect the tickler coil in any direction you please. Try it under the secondary; if it works there, O. K., but if it doesn't, simply slide it under the primary and it's sure to be right.

The answer is that the current at any given instant in the primary is flowing around in the opposite direction to the current in the secondary; consequently if the tickler current is in the wrong direction for one of them, it must be right for the other.

ANNOUNCEMENT OF UNIVERSITY OF CALIFORNIA EXTENSION DIVISION

CORRESPONDENCE COURSE IN ELEMENTARY RADIO

By Ellery W. Stone

The text for this course will be published in RADIO (Pacific Bldg., San Francisco), commencing with the October, 1922, issue and running for seven months thereafter. Questions covering each assignment will be supplied and corrected by the Extension Division of the University of California, 301 California Hall, Berkeley, to whom all requests for enrollment should be sent. The enrollment fee for the entire course is $7.00, which includes a subscription to RADIO during the period that the lectures are published.

There will be fifteen assignments in accordance with the following outline:

1. Electronic Theory of Matter; Electrical Definitions.
2. Radiation; The Family of Electromagnetic Waves.
3. Radiators and Receivers; the Antenna-Ground Circuit.
4. Tuning.
5. Single and Double Slide Tuners; Variable Condensers.
6. Loose Couplers; Variometers.
7. Detection; Crystal Detectors.
8. Telephone Receivers; Loud Speakers.
9. The Vacuum Tube as a Detector.
10. The Vacuum Tube as an Amplifier.
11. The Armstrong Principle of Regeneration.
12. Tube Transmitting Circuits for Radiotelephony.
13. Tube Modulating Circuits for Radiotelephony.
14. Radiopone Broadcasting.
15. Practical Hints for Radiophone Reception.

A RADIOPHONE WITHOUT A WAVELENGTH

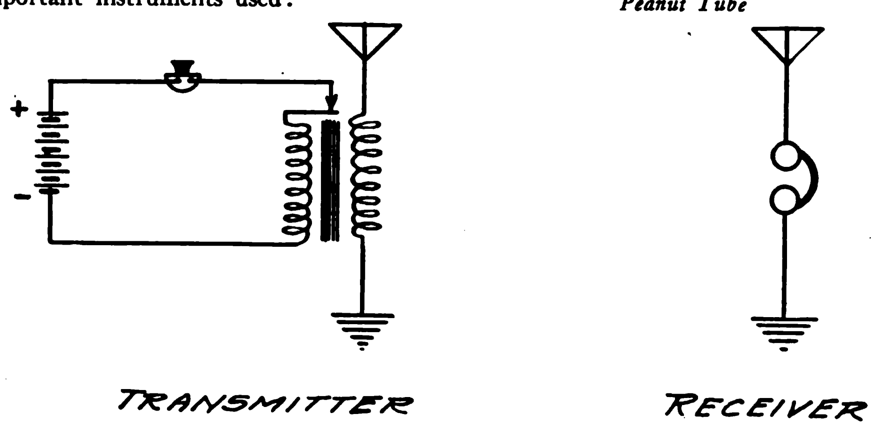
By LYNDON F. SEEFRED, RADIO 6EB

FOLLOWING is a simple experiment showing how one may talk by voice over the radio and still not interfere with radio telegraphy. There is also no wavelength to this system, as it could not be heard on an ordinary radio receiving set. The receivers were connected between the antenna and ground at the receiving end.

Voice was heard distinctly until the arc lights were turned on at the street corners and interfered with same. Voice could be heard approximately 100 feet from the transmitter with just a pair of "Brandes Superior" 2000-ohm receivers and by holding one of the terminals of receiver cord in my hand. Later I walked down the street and still holding one terminal of cord, I connected the other to grounded guy wires of electric light poles and still heard the voice clearly. Finally, being at a distance of two blocks, I was only able to hear the voice faintly. Then I went over to an amateur radio station one-quarter of a mile away, where there was a good-sized four-wire antenna. I connected the receivers across the antenna and ground, and the voice was heard again very plainly.

With a little experimenting I believe one could use a large X-ray coil with necessary condensers or a small extra transformer to keep the high amperage from burning out the transmitter, and talk much greater distances with such a hook-up and a few alterations.

The following is a hook-up and the important instruments used:



Hook-up for Radiophone without a Wavelength

1. Antenna—Four wires No. 12 soft drawn copper, 400 ft. long, counting lead-in, and 15 ft. spreaders. Poles—45 and 50 ft. high, respectively.
2. Ground—Water-pipe and wires buried.
3. A ¾-in. "Splitdorff" spark coil with vibrator screwed up tight.
4. Long distance transmitter.
5. Seven Columbia dry cells.
6. The receiving equipment is described previously in this article.

Using the same transmitting instruments with the exception of an antenna and ground, a one-wire line telephone was tried out with success, the voice sounding "ghostly-like." Connect one terminal of the secondary to the line and leave the other blank.

A TWENTY KILOWATT VACUUM TUBE

By DR. IRVING LANGMUIR

IT has long been realized that, following out the principles made use of in the smaller tubes, it would ultimately be possible to construct tubes of large power. There have been many difficulties to overcome, however. After years of work by W. C. White and H. J. Holte, they have succeeded in designing and perfecting pliotrons which are capable of generating about 20 kw. of high frequency current. In principle these tubes resemble the smaller tubes which are now usually called radiotrons, in that they also have three electrodes. These large tubes are used in circuits much like those used by amateurs when they cause the tube to generate oscillations. In the construction, however, there are many differences.

Dr. Langmuir with 20 kw. Radiotron and Peanut Tube

The 20 kw. tube has a very large, rugged filament, many times the diameter and length of the ordinary radiotron. The grid is in cylindrical form and surrounds the filament, and the plate is a metallic cylinder about 1½" diameter and 8" long, which is sealed directly to a glass tube through which pass the leads carrying current to the filament and grid.

Thus the plate, instead of being inside the tube, as in ordinary radiotrons, forms a part of the outside wall of the tube. In order to dissipate the relatively large amount of energy liberated at the plate, the plate is water cooled, which is rendered particularly easy by the fact that part of its surface forms a part of the wall of the tube.

These 20 kw. tubes are ordinarily operated with about 20,000 volts d. c., which is obtained from ordinary 60 cycle alternating current by rectification, using two or more kenetrons, together with large condensers for smoothing out the rectified alternating current.

A bank of ten tubes of this kind operated in parallel is capable of generating 200 kw. of power, which is about all that is required for most trans-oceanic radio communication. It is probable that outfits of this kind will displace the larger and more expensive alternators, the most successful type of which has been the Alexanderson alternator.

The 20 kw. tube merely marks one stage in the development of still larger tubes. It will undoubtedly be possible when the need arises and when the necessary development work has been completed, to construct tubes of many hundreds or even thousands of kilowatts. Such devices will probably be used not merely for radio purposes, but may ultimately play an important part in such problems as the electrification of railroads and the transmission of power to long distances by means of direct current.

CONTROLLING IRRIGATION BY RADIO

Radio control of an irrigation project comprising some 200,000 acres in Arizona is the latest use to which radio has been put by the government. The Salt River Valley Water Users' Association has installed a radio equipment at the head of the Verde River, their natural water supply. There is no railroad or means of communication between Phoenix, Arizona, and the upper reaches of the river, where sudden storms cause the ordinarily low water to rise with great rapidity, frequently flooding the ranches and farms below and causing enormous damage. Gauges are placed in the upper Verde and also at Cave Creek, so that any appreciable rise can be noted and broadcasted from the station to the manager's office in Phoenix, and to all ranch owners who listen in.

An Amplifier with A. C. Filament and Plate Supply

By P. D. Lowell

Associate Physicist Bureau of Standards, Adapted from July, 1922, A. I. E. E. Journal

WHEN an electron tube is used as the detector with a. c. supply, there is impressed on both the plate and the filament a 60-cycle hum which, although small, becomes very objectionable when amplified by one or two stages of audio-frequency amplification. When a crystal detector is used with radio-frequency tube amplifier no 60-cycle voltage is supplied to the detector circuit. The radio-frequency transformer whose output is delivered to the detector circuit prevents the passage in any appreciable amount of 60-cycle current supplied to the radio-frequency stage, and such voltages are not present in the crystal detector circuit and do not reach the input of the audio-frequency stage.

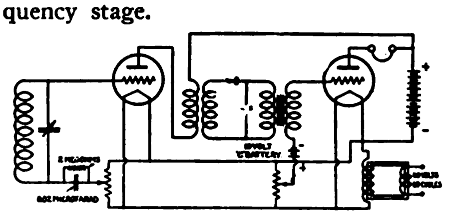


Fig. 1. Two-Stage Amplifier Using Crystal Detector

The employment of a crystal detector may at first seem objectionable, since with the crystal as ordinarily used, it is rather difficult to find a point of good sensitivity. But tests on this amplifier show that careful adjustment of the crystal detector is not necessary, because the radio-frequency amplification preceding the detector usually gives sufficient signal strength, so that a point of sufficient sensitivity can be easily found.

This circuit, as shown in Fig. 1, gives quite good results. The 60-cycle hum is practically eliminated and the crystal detector gives almost as good rectification as the tube detector. It is found that better amplifying action can be obtained by inserting condensers of about 0.02 microfarad capacity, shunted by 2-megohm grid leak resistances in the grid circuits, in series with the sliders of the balancing resistances. The grid condensers and grid leak resistances allow the grids to assume a normal voltage which is more favorable for amplifying purposes. The leak resistances allow any accumulated charge on the grids to leak off to the filaments.

Still better amplification and quieter operation was produced by replacing the series grid condenser and leak in the audio stage with a 10-volt battery giving a negative charge to the grid. A battery of dry cells was used for this purpose; since only an extremely small current is required, the life of the dry cells is practically their shelf life. This gave a circuit as shown in Fig. 2.

Alternating current rectified by means of a gas-filled two-element rectifier tube (a "Tungar") was tried as a source of filament power, but the residual hum was much greater than when unrectified alternating current was used. This is because of the fact that during rectification the wave form becomes distorted and it becomes impossible to stabilize the grid voltage by means of the balancing resistances.

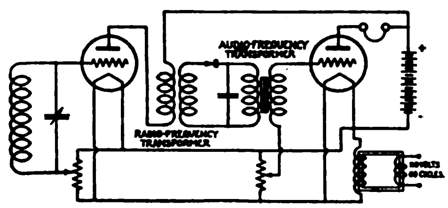


Fig. 2. Two-Stage Amplifier Using Crystal Detector with Grid Condenser for Radio Stages and Grid Battery for Audio Stages.

In the above-mentioned tests a plate battery was used for convenience, but this was replaced by alternating current, which had been rectified by means of an electron tube and smoothed out with condensers of large capacity. The rectification circuit for the plate voltage supply is shown in Fig. 3.

In Fig. 3 the primary P of the transformer *T* is connected to the power mains, and winding *R* gives 8 volts for the filament of the rectifier tube *W*. Winding *S* gives 300 volts, which is rectified by the tube *W* and smoothed out by the condenser *Q*, which has about 10 microfarads capacity. This gives at terminals *M* and *N* a high-voltage direct current, which is quite suitable for use on the plates of the amplifier tubes. Rheostat *Z* varies the brilliancy of the filament of the rectifier tube and, simultaneously, the voltage for the plates.

The use of a loud-speaking telephone receiver, such as the "Magnavox," was made possible by applying to the field coil of the loud speaker an alternating current rectified by a "Tungar" rectifier tube. The impedance of the field coil was sufficient to smooth out the pulsating current to such an extent that the hum was not annoying. It was also advantageous to couple the loudspeaking reproducer circuit to the plate circuit of the last amplifier tube by means of a one-to-one ratio telephone transformer with a 0.02-microfarad condenser in series with the telephone circuit. This helped considerably to reduce the residual hum in the telephones.

The final circuit is shown in Fig. 4, and included three stages of radio-frequency amplification, loud-speaking reproducer, and the necessary power transformer and rectification circuits.

This final circuit gives good amplification, with a slight residual hum which is not great enough to be objectionable

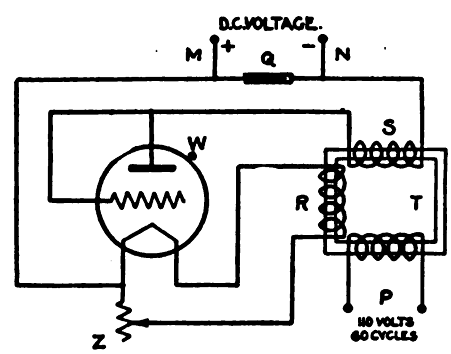


Fig. 3.—Rectification Circuit for Plate Voltage Supply

when receiving signals of ordinary readable strength. The residual hum is, of course, more objectionable when extremely weak signals are being received. Radiotelephone music and conversation are clearly reproduced.

The amplifier was operated under normal conditions, using the usual

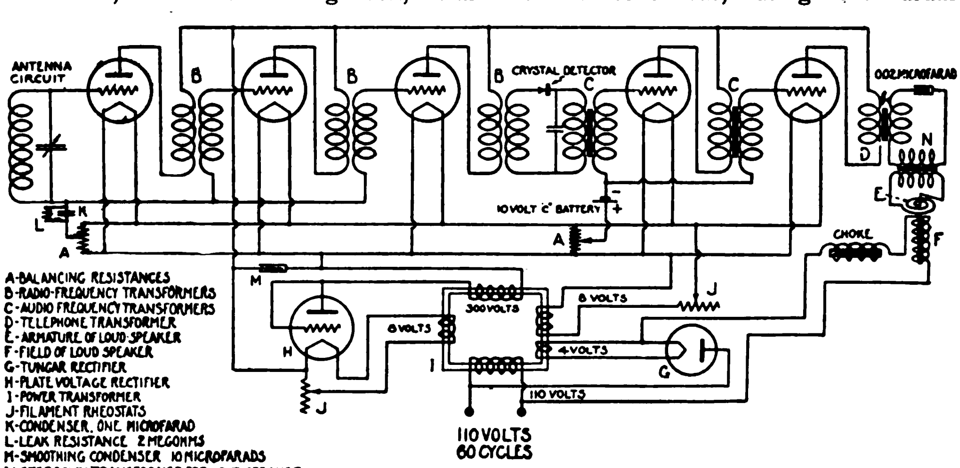


Fig. 4. Five-Stage Amplifier Using Crystal Detector

sources of direct-current supply, and then switched over to alternating-current supply. This comparative test showed the a.-c. supply to give as good amplification as the d.-c. supply.

For the reception of damped waves, the amplifier as constructed operated most satisfactorily for frequencies from 400 kilocycles to 1500 kilocycles per second (750 to 200 meters). This frequency range was determined by the working range of the radio-frequency transformers used. By using suitable radio-frequency transformers, it is expected that the amplifier will be effective for the reception of damped waves for frequencies as low as 30 kilocycles (10,000 meters). This amplifier has also been found effective for the reception of undamped waves when used with a separate heterodyne.

The special transformer with five windings and the rectifier tube were assembled in one box, and the amplifier tubes and amplifier transformers and other apparatus were assembled in a separate box. This was done to avoid having the amplifier immediately adjacent to the special transformer, from which it would pick up considerable 60-cycle hum. The assembled rectifier unit measured about 8 in. by 9 in. and weighed about 21 pounds. The assembled amplifier unit measured about 8 in. by 11 in. by 14 in. and weighed about 21 pounds.

DUPLEX RADIO-TELEPHONE SYSTEM ON AIRCRAFT

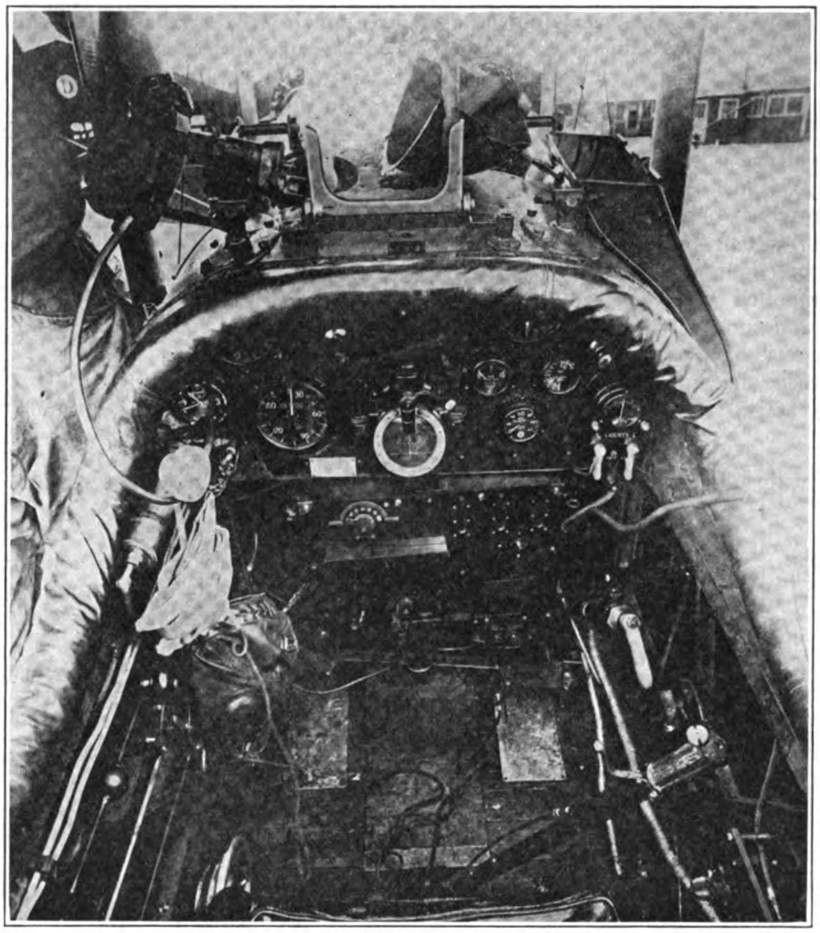
By S. R. WINTERS

The transmission and reception of radio-telephone messages simultaneously from aircraft in flight are possible by an arrangement recently devised by the Air Service of the United States Army. Heretofore wireless installations on air-going machines have been primarily for the purpose of receiving messages. It was in this capacity that radio-equipped aircraft were so useful in scouting over enemy-occupied territory in the recent World War.

The twofold service—transmitting and receiving—afforded by recent installations of specially-designed radio-telephone outfits is known as the duplex system. Two electric generators are employed, with the introduction of a new change-over switch, which obviates the use of several instruments heretofore installed with the conventional installation of SCR-73 set. Two antennas are required, one for the transmitting and one for the radio-telephone receiver, but the sending and reception of music or vocal speech can be negotiated at the same instant.

Preliminary tests of aircraft thus equipped have been conducted, the results at reasonable distances being satisfactory. Long-range tests have not been made as yet, although it is probable that this duplex system may demonstrate its efficiency when subjected to distant assignments. Already music has been successfully relayed from a radio-telephone on the ground to aircraft soaring 4000 ft. in the air.

considered is to install the antenna within the envelope; another is to suspend it below the ship, drawing it up upon landing; while a third contemplates hanging the wires of the aerial along the sides and over the top of the ship. Experiments will determine which of these methods is the most efficient.



Installation of Radio Set on DH4
Official Photograph U. S. Army Air Service Photographic Section

ARMY AIRSHIP SETS

Army plans for new radio sets for their semi-rigid airships call for central power stations which would include generators geared to gasoline engines, after the fashion in which a magneto is driven, but never before attempted. The French tried out belt-driven electrical generators, but with little success. However, representatives of the Air Service Engineering Department at McCook Field expect to develop a central power plant that will give sufficient power for putting ½ kw. in the antenna and also power for lighting, heat and electrical control work.

The Army Air Service plans to use the new Signal Corps set 135, combining radiophone and telegraph circuits good for distances up to 75 miles and 200 miles, respectively. The range will be greater than is planned for the big Martin bombers, however, as better facilities for erecting aerials are available on airships than on planes. One method

Naval radio experts are loath to reveal their definite plans for the radio equipment of the ZR ships, but it is said that they may parallel the Army's ideas, although their ships will be about twice the size of the largest Army semi-rigids now planned, giving them more latitude and more room for equipment.

TUBES NOW AVAILABLE FOR SHIPS

F. P. Guthrie, head of the Radio Division of the Shipping Board, states that all privately owned ships, as well as Government operated vessels, may now be equipped with a special receiving tube which will be produced by the Radio Corporation to sell for $10 each. The tubes, which can also be used for amplifying and transmitting, will be a big improvement over the crystal detectors and spark transmitting sets now in use. Heretofore the Radio Corporation has refused to sell its tubes except to amateurs and for experimental use.

Radio Equipment at KDKA

By D. G. Little, Radio Engineer Westinghouse Electric & Manufacturing Co.

KDKA, the Westinghouse broadcasting station at East Pittsburgh, Pa., has gradually grown since November, 1920, until today it has a power output of 1000 watts. In keeping with the growth of the station a special studio was arranged for the artists and announcer, particular attention being given to the acoustic properties, so that echoes, reverberation and other disturbances have been largely eliminated. The usual carbon microphone has been replaced by a condenser type transmitter for picking up the sound waves. Resistance coupled amplifiers are employed for increasing the relatively weak output of the pick-up transmitter to a power sufficient to control the radio set. The natural oscillating frequency of all the units in the pick-up and amplifier system has been placed, so far as possible, outside of the audio frequency range, so that the radio signal is practically a perfect reproduction of the original sound. Special filter circuits are arranged to eliminate generator hum in the power supply to the radio transmitter.

The path of the speaker's voice from the studio to the receiving station is shown in diagrammatical form in Fig. 1. The sound wave picked up by the transmitter in the studio, theater or church is amplified before it is transmitted by means of a telephone line to the radio station, where it is further amplified and used to control the output of the radio transmitter. The radio transmitting set is supplied with power directly from the works' power plant through a step-down transformer for the vacuum tube filaments and through special motor generator sets, which change the 220 volts direct current to 2000 volts direct current for the tube plates. The radio transmitter changes this power from 2000 volts direct-current to alternating-current power at a frequency of 833,000 cycles per second (360 meters wavelength) which is supplied to the radiating system, consisting of an antenna and counterpoise.

A general view of the radio transmitter now in use at KDKA is shown in Fig. 2. This set furnishes about one kilowatt high frequency power to the antenna. Fig. 3 shows the circuit diagram. For convenience in studying the circuits represented by Fig. 3, which carry a wide variety of frequency, this diagram has been divided into four sections by means of the dotted lines at the right. The lower section, which may be considered as the power supply, carries only direct current at 2000 volts and low-voltage alternating current at 25 cycles. This 25-cycle current is used only for heating the filaments. To prevent any of the 25-cycle current being superimposed on the grid-filament and

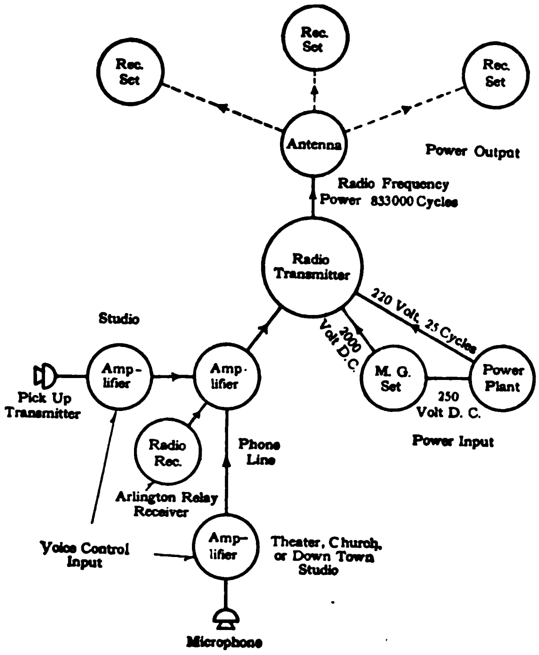


Fig. 1—Schematic Diagram of Radio Broadcasting Station

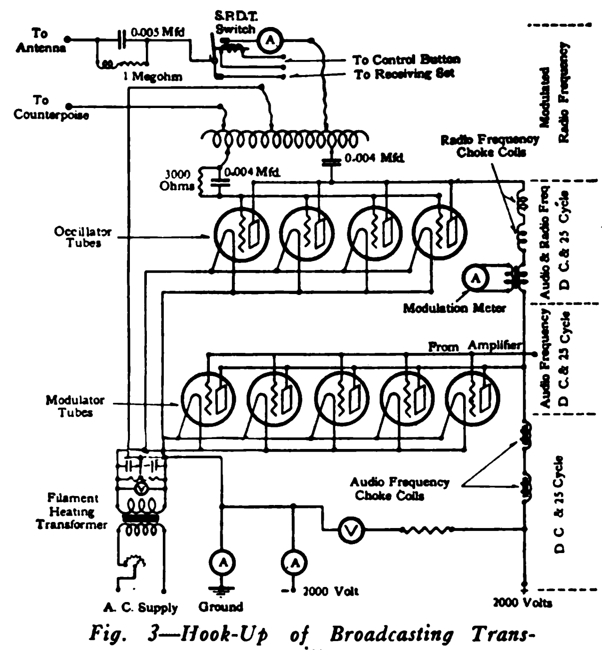


Fig. 3—Hook-Up of Broadcasting Transmitter

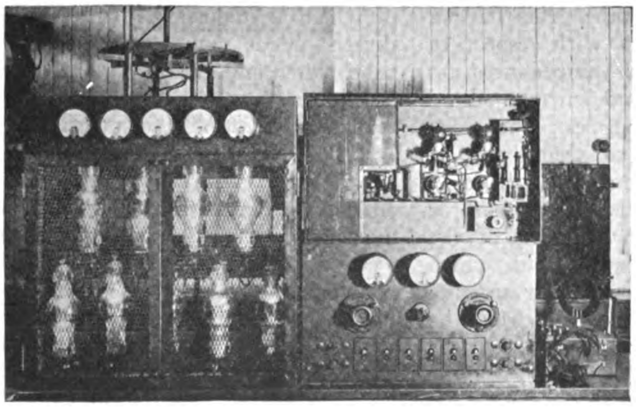


Fig. 2—General View of Equipment in the Operating Room

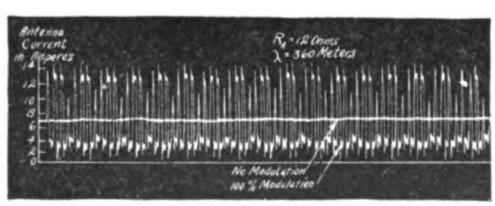


Fig. 4—Oscillogram of Rectified Antenna Current for Modulation of Vowel a

plate filament circuit, the return of the grid circuits and the 2000 volt circuit is connected to the mid point of a resistor, which is shunted across the filament, each half of the resistor being shunted by a condenser for by-passing the radio and audio frequency circuits.

In the next section of Fig. 3, in addition to the power circuits described, audio frequency voltage is impressed upon the grids of the modulator tubes, varying the potential of these grids with respect to their filaments according to the voice waves, through the medium of the pick-up transformer and amplifiers.

The four 250-watt power tubes in the upper part of the set are the oscillators, which, in conjunction with the condensers and oscillation transformer, change the 2000-volt direct-current power into alternating-current power at 833,000 cycles, thus generating the carrier wave, which is impressed on the antenna through a remote controlled double throw switch, which allows the same antenna to be used for receiving when the station is not broadcasting. The amplitude of the radio frequency wave thus generated is constant as long as the plate voltage remains constant, and fluctuates with the plate voltage when the latter is varied. Thus, the upper section of Fig. 3 carries only modulated radio frequency waves, while the third section carries both radio frequency and audio frequencies, in addition to the 2000 volt direct-current and the 25-cycle alternating-current power circuits.

The function of the five modulator tubes, also rated at 250 watts each, is to vary the voltage on the plates of the oscillator tubes according to the voice frequency impressed upon their grids by the speech amplifiers. This system is known as power modulation, the modulation being accomplished by means of the constant choke coil in series with the positive lead to the modulator and oscillator tube plates. The modulator tube grids are held at a static potential of 80 volts negative with respect to their filaments, by means of a battery. The audio frequency from the speech amplifier then adds to or subtracts from this 80-volt grid potential. At an instant when the modulator tube grids have impressed upon them by the amplifiers a low negative, or zero potential with respect to their filaments, the tube impedances from the plate to the filament are low and a large plate current flows in the 2000-volt direct-current circuit to the modulator tube plates. Because of the very large inductance (50 henries) of the audio frequency choke coils in series with the plate supply, the total generator current can change very little in a brief interval of time. Hence, part of the generator voltage occurs across the choke coils, thus lowering the voltage impressed on the oscillator tube plates and hence the radio frequency output of the set. The next instant, when the modulator tube grids have a high negative potential with respect to their filaments, the plate impedances are high and little or no current flows through the modulator tubes. The choke coils, tending always to keep the total generator current constant, create a voltage which adds to the generator voltage and thus forces most of the current into the oscillator tubes, which increases the radio frequency or antenna output accordingly. In this way the audio frequency choke coils cause the voltage applied to the oscillator tube plates to fluctuate in proportion to the speech voltage impressed on the grids of the modulator tubes by the speech amplifier. As the amplitude of current in the antenna varies directly with the plate voltage on the oscillator tubes and as this voltage varies from nearly zero to 4000 volts, the antenna current varies accordingly. Fig. 4 shows an oscillogram of rectified antenna current taken when the announcer is speaking loudly into the pick-up transmitter. It is seen that the antenna current varies from nearly zero to nearly twice its no talk value. This variation in antenna current at voice frequency is know as modulation.

The radio frequency choke coils in series with the oscillator tube plates serve to stop any radio frequency from entering the modulator and power supply circuits. These choke coils are of air core construction and are about five millihenries inductance each. They thus offer a high impedance to the radio frequency, but negligible impedance to the audio frequency.

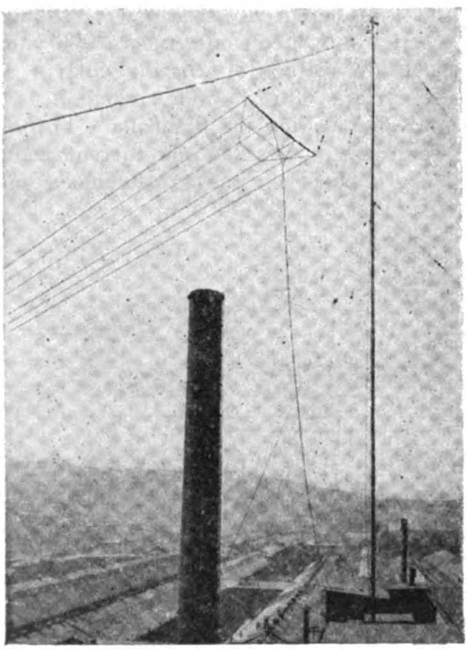


Fig. 5—Antenna at KDKA

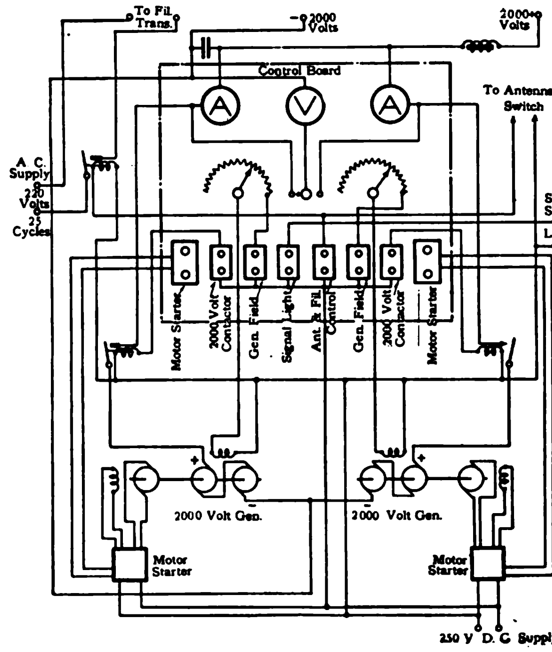


Fig. 6—Circuit Diagram of Power Equipment

In order to indicate the amount of modulation, a so-called modulation meter has been developed. This consists of a current transformer, the primary of which is connected in series with the direct-current supply to the oscillator tube plates and the secondary of which is connected to a thermo-ammeter. The transformer ratio is such that an audio frequency variation in the direct-current from zero to twice its normal value gives full scale deflection. An air-gap is provided in the transformer core to prevent saturation due to the direct-current component of the plate current. The meter has a current scale marked from 0 to 100 per cent modulation. When the announcer is speaking into the transmitter the modulation meter averages about 40 per cent with maximum

Continued on page 88

LETTERS TO THE EDITOR

Radio Fire Caused by Lightning

Sir:—On July 14th the following item appeared in the New York *Evening Journal:*

A fire caused by lightning striking the radio set of Charles Down, of No. 410 West Forty-fourth street, was said today to be the first of its kind.

The set was near the window of a room on the top floor of the apartment house. Down, who is an electrician, blamed the lightning arrester for the blaze.

While the small instrument worked successfully during the many electrical storms of last month, Down said yesterday's static was too much for it.

On the other hand, Dr. Alfred N. Goldsmith, Professor of Electrical Engineering at City College and director of its laboratory, did not think Down's theory plausible. He regarded the occurrence as "almost a phenomenon," and believed that a heavy bolt of lightning penetrated the porcelain-shelled arrester and struck the inside aerial.

Another explanation offered by Dr. Goldsmith was that Down's ground wire, which connected with a water pipe, was not properly adjusted.

When Down arrived at his apartment after firemen had extinguished the small blaze, he made a careful examination of the apparatus and found the outside aerial and the roof antenna in perfect condition.

On the ledge outside the window was the arrester and ground wire.

"Instead of jumping the gap to the ground," said Down, "the electricity went through the indoor aerial. The lightning seemed to be of greater voltage than at any other time since I installed the set and the static in the air was apparently heavier than the arrester could bear."

The rubber insulation covering the aerial from the arrester to the set was completely burned off, but no harm came to the ground wire. Recently adopted rules of the Board of Fire Underwriters make it permissible to connect grounds to the inside of a building instead of having them extended to the earth on the outside. Down's connected with a water pipe in his bath room.

Since the fire I have had this "arrester" tested by the New York Board of Fire Underwriters and they found that the arrester was full of water (from rain), which should help and not hinder the path of current, but regardless of this, on testing same it refused to pass current until the voltage reached 1240, whereas it should operate at 500 volts or less.

Arrester was outdoor type and was on window ledge with antenna and ground leads coming through casing of window in a ¾-in. porcelain tube, ground lead going to cold water pipe in bathroom (10 ft. long) and antenna to set with another ground wire from set to same water pipe but two separate ground clamps.

Underwriters' inspectors said it was put in in an approved manner.

The attached sketch gives an idea of the hook-up.

The leadin wire from antenna was burnt to a crisp but the ground wire was only burned for about 15 in. Current followed antenna leadin to set, passed through coupler to ground side and fused the shielding on panel, tearing several holes ranging from ⅛ in. to 1 in. in size, burned base board and discolored wiring and back of panel, proving the ground wire from arrester received no current to speak of. Otherwise why take the path of fine wire in set in preference to a nice No. 14 wire with a first-class ground at the end of 10 ft. Showing that everyone should use a single pole double throw switch as well as an arrester.

Damage to set and other apparatus on table was about $150; burned coupler, Atwater-Kent potentiometer, phones (not connected) two pair, four tubes A. P. and several other pieces of apparatus.

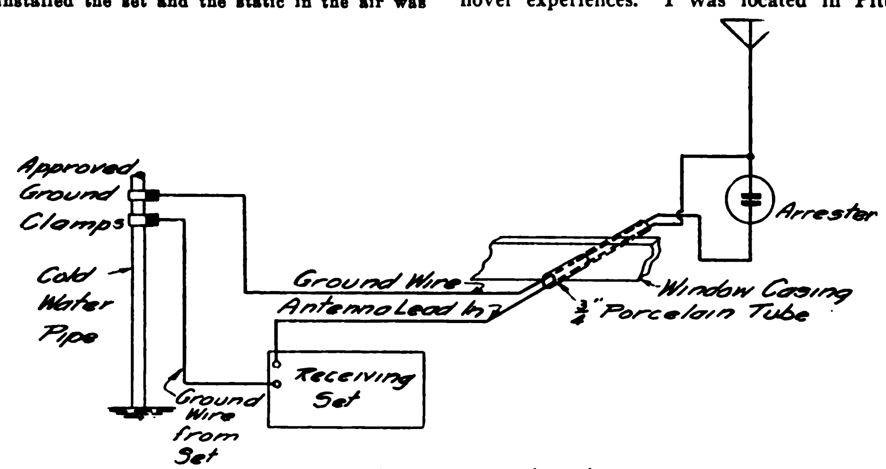
Set consists of two Atwater-Kent variometers and coupler, three step amplifier, Dunaphone loud speaker and regular short wave regenerative hook-up.

Trust this will keep some one else from having a similar experience, I am,

Very truly,

CHAS. DOWN.

410 West 44th Street,
New York City.



Hook-up of Arrester Causing Fire

Transmitting on a Crystal

Sir:—In regard to transmitting on a crystal, I have had some very interesting and novel experiences. I was located in Pittsburgh until a short time ago, when I moved to Wheeling, West Virginia. I did not bring my battery down, so I resolved to try a crystal detector. I used a honeycomb coil with series antenna condenser and found that I was able to hear Annapolis NSS at several periods during the day, and at other times I could hear NAA arc. The mineral was some I made in a school laboratory by grinding galena and iron pyrite, then compressing them together into pellets.

The fact that I heard the arc's natural wave and could hear no compensation or carrier waves was another fact that aroused my curiosity. I then began to log the time I received these stations and found that I could always hear them during the hours of transmission from KDKA, in Pittsburgh. I scarcely thought it possible that KDKA should have a harmonic at 16,000 meters and a lower one at 6000 meters, and even if that were possible I did not see how they could affect my crystal detector at a distance of 60 miles air line.

I had noticed that the people down here were getting the habit of using 5-watt tubes for detectors and putting 60 or 70 volt B batteries on them. There were two sets within four blocks of me that used 5-watt detectors and each one had an antenna over 200 ft. long. Then I smelled a rat. I took an ammeter to each station and found that on about 350 meters each station had an antenna current exceeding 1/10 ampere. The reason for my being heterodyned on several waves as doubtless because the two stations had such long antennas.

I then read Mr. Seefred's article in May RADIO and resolved to try it. I found it worked satisfactorily and that the voice, which I tried later, could be heard in my receivers, and also at both the second and third stations there was considerable distortion. When using an L25 honeycomb coil and the condenser, which is a C. V. 1500 De Forest, was set at 50, the wave being 210 meters both stations, in order to have their sets oscillating and at the same time get the voice, tuned their sets to 120 meters. We also fund that a telephone line about 1000 ft. long, which runs parallel with our antenna (all three are nearly parallel), would absorb considerable energy, which after a test we found to be about 5 milliamperes, and I believe that this, by re-radiating a small part of this energy, was heterodyning my receiver on higher wavelengths. All three of us are able to talk to one another any time in the day or night by simply tuning our sets to a set place and speaking in the transmitter.

A great deal of QRM has been caused around here lately by the 5-watt detector fad. I have found a very good way to stop this is to use one step of radio-frequency, which will not allow any energy from the detector to be radiated to the antenna.

I should like to hear some more from other fellows who have had some of the same experience with heterodyning and absorption.

Yours respectfully,

F. EUGENE MAGUIRE, Radio 8CH1.

329 So. Huron St.,
Wheeling, W. Va.

Effect of Mountains on Radio

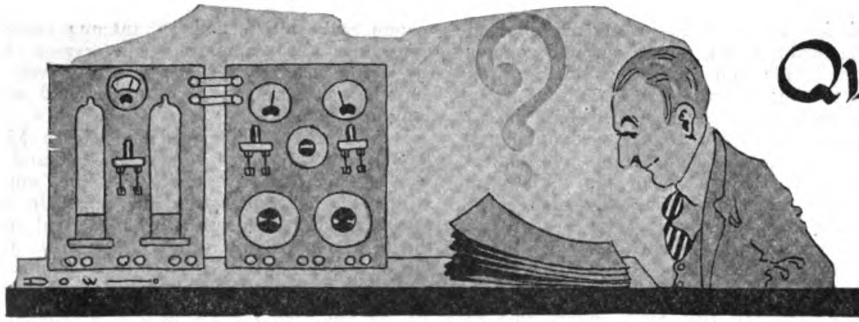
Sir:—Thinking some of the readers of RADIO might be interested in the effects of mountain ranges on radio transmission and reception, I will give the results of a few tests which I have made in that respect.

While located at Fullerton, Orange County, Calif., for years, we always had trouble receiving with any degree of loudness and sometimes hardly readable were the 1 kw. sets operating at Riverside, Calif., not 30 miles air line from us, there being a range of mountains lying at right angles between us; these same stations working east and north to limits around 1000 miles or better at times.

Another similar effect is experienced with San Diego amateur stations when receiving from Fullerton station. While not quite so weak as were Riverside station's signals, the San Diego signals were very weak when distance of 90 miles air line is considered, although these San Diego amateurs are able to reach out north and east with ease. In this case mountains lie across at right angles between San Diego and Fullerton, but Los Angeles is not so cut off, having more over water route air line.

At my Antelope Valley station, 8 miles east from Lancaster, Calif., I find very different results, though mountains lie on a line almost due east and west between my present station and Riverside, San Diego, Fullerton and Los Angeles. Here tests show just the reverse conditions and those same stations in Riverside and San Diego come in on a detector (vacuum tube) set with an unmistakable punch. While amateurs in Fullerton and Los Angeles, much closer, sound like they were a thousand miles away, so to speak, except that C. W. stations seem to kick through better than spark. In fact, very few spark sets can be heard from

Continued on page 82



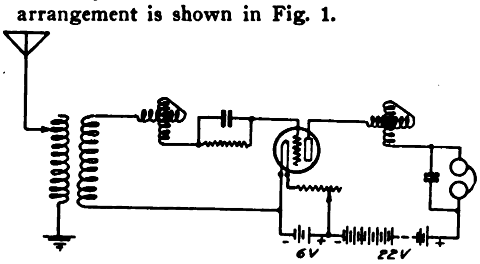
Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor

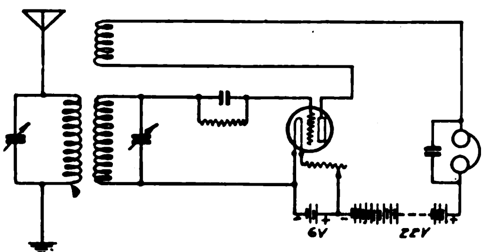
Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Ques. Please inform me the necessary equipment to be used with the Armstrong regenerative circuit. R. E. H., San Francisco, Calif.

Ans. The necessary equipment would be either a variocoupler and two variometers, with a detector tube and batteries, or three honeycomb coils, two air condensers and the necessary tube and batteries. The circuit arrangement is shown in Fig. 1.



VARIOMETER CIRCUIT



HONEYCOMB COIL CIRCUIT

Fig. 1

Ques. Where can I get the sheet aluminum for making the rectifier explained on page 80 of July RADIO? How long will it take to charge the battery? M. C. B., Wheatland, Calif.

Ans. Sheet aluminum for chemical rectifiers should be absolutely pure aluminum. Would suggest your trying one of the large chemical manufacturing concerns who have offices in San Francisco. The length of time it takes to charge your battery depends entirely upon the capacity of the battery, the charging rate, and the efficiency of the rectifier. If your battery is 40 ampere hour capacity, the rate is 2 amperes, and the rectifier fairly efficient, the battery should be fully charged in 30 hours.

Ques.—Would it be possible to use radio frequency amplification in connection with a single coil regenerative receiver using variometers? B. F. R., Montague, Calif.

Ans. Not efficiently, when you have only a single coil circuit, unless you completely change the arrangement of all the apparatus and add a considerable amount of new material.

Ques. Please advise if two steps of radio frequency can be added to the circuit of the tuner shown on page 21 of June RADIO. F. C. S., Cleveland, Ohio.

Ans. It would be impractical to add radio frequency amplifiers to this set without dismantling it and rearranging the apparatus, thereby destroying most of its present usefulness and appearance.

Ques. Can a variometer be constructed that will function on wavelengths up to 3000 meters? What book is there that will give the details of constructing radio instruments? W. V. H., Massachusetts.

Ans. A variometer that would work on 3000 meters would be very large and cumbersome, and would have a minimum inductance value far above that required for the shorter wavelengths. For such long waves, bank wound or honeycomb coils are necessary. Try the McGraw-Hill Book Company, of New York City, for a list of radio publications such as you desire.

Q. Please publish a circuit for a two stage amplifier with Remler cam switches instead of plugs and jacks. P. E. R., Los Angeles, Calif.; M. L. W., Eureka, Calif.

Ans. This circuit is shown in Fig. 2.

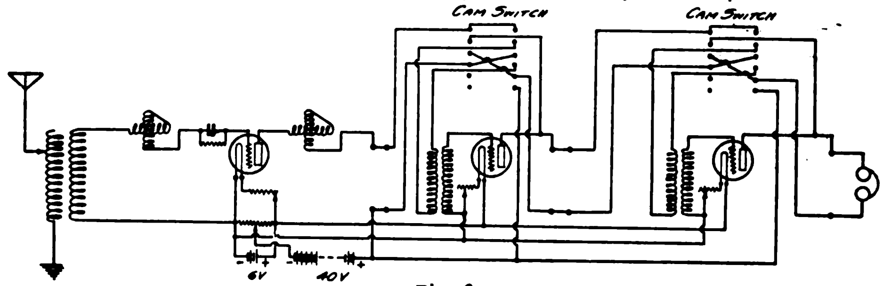


Fig. 2

Ques. Please publish a diagram showing how filament control jacks may be used to control the audio frequency amplifier in the enclosed hook-up. F. E. R., Nampa, Idaho.

Ans. If you require a circuit which has everything shown pictorially, I would advise you not to attempt such a complicated circuit as that which you request. A filament control circuit is shown diagramatically on page 29 of March RADIO.

Ques. Is this appliance which is supposed to utilize the electric wires as an antenna by screwing it into the socket practical? P. L., Toppenish, Wash.

Ans. Yes, provided that the article has been passed by the Board of Fire Underwriters. There are several types of this equipment on the market that are approved and are safe to use. The results obtained, however, are not as satisfactory as with a good antenna.

Ques. What size should the condenser shown in the set illustrated on page 24 of March RADIO be? R. J. C., Brunswick, Ga.

Ans. .0005 M. F., or about 23 plates.

Ques. Please publish a circuit for a three stage power amplifier employing 5 watt tubes, to be used in conjunction with a Magnavox. E. F., Los Angeles, Calif.

Ans. A complete description of such an amplifier is given by A. K. Aster on page 68 of March RADIO. If you have no copy of that issue, I will send you a circuit diagram.

Ques. Please tell me how to make the coupling ring and bank winding of Mr. R. C. Anderson's set shown in June RADIO. E. H. F., Woodlawn, Pa.

Ans. Would suggest that you write to Mr. Anderson at Long Beach, Calif., for a more detailed description of how to make this set.

Ques. I wish to put a station on a small yacht, and have it work with my amateur station at home, and with other amateurs, as may be convenient. What kind of licenses should I have to cover this? G. T. R., Eureka.

Ans. It is not possible for such licenses to be issued. If you wish to have a station on the yacht and one at home, they both must be licensed as "limited commercial," and they will not be permitted to handle any other correspondence unless in emergency, when they may be required to assist vessels in distress. They will not be permitted to operate with amateur stations, in any case. The operators of such stations must hold commercial second class licenses, or higher.

NEWS OF THE AMATEUR OPERATORS

6ARK, Ukiah, Calif., was recently struck by lightning. This started a fire, due to the melting of a kick-back preventer. A few leads were burned and a line transformer was damaged before the fire was extinguished.

Carlos S. Mundt, 6AJ, has moved from Concord, Calif., to 3715 Leighton Street, Oakland, Calif.

TRANSCONTINENTAL SPARK TRANSMISSION

Sir:—Wish to inform you that the spark signals of 60M, Los Angeles, have been heard on May 6, 1922, at 10:50 p. m. by 1BIY of Hartford, Conn., and by 1BDU of Winthrop, Mass. The reception has been verified by 60M, and any further information will gladly be furnished by and of the above mentioned stations.

Sincerely,

G. F. HUTCHINS, Radio 60M.

403 North Benton Way,
Los Angeles, Calif.

NEWS OF THE BROADCASTERS

KFAF: A NEW 500 WATT BROADCASTER

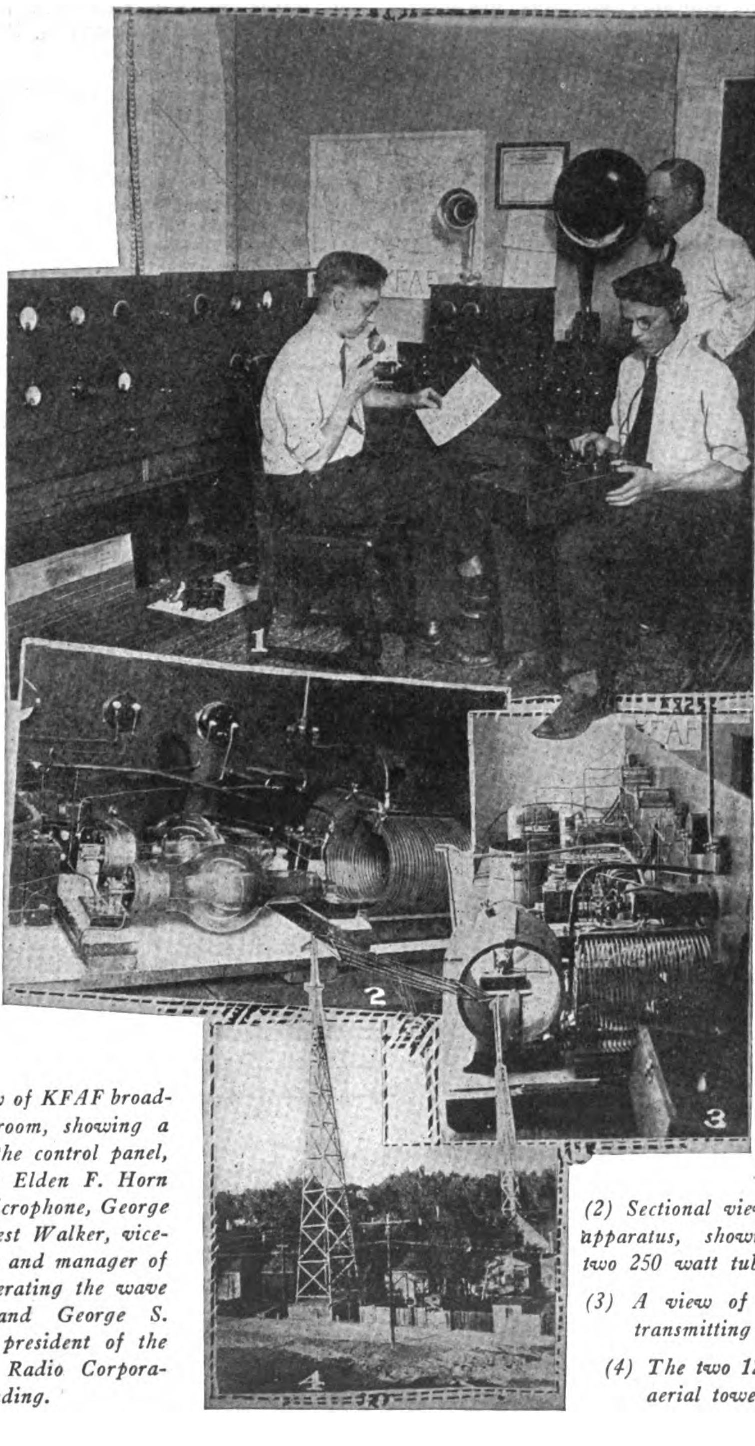
KFAF, the new Denver broadcast station installed and operated by the Western Radio Corporation, is now on the air with news and entertainment supplied through the co-operation of the Denver *Post.* It was installed and will be operated under the direction of Elden F. Horn, who supervised the construction of KYW, the Westinghouse station at Chicago, and was nationally known some years ago as 9AJA.

The station employs two 250 watt tubes as oscillators, one 50 watt tube as modulator and a second 50 watt tube as a high-frequency pilot oscillator, giving an output of 550 watts.

The aerial is a six-wire flat-top "T" supported on 24 ft. spreaders carried on two 120 ft. steel towers. Power is supplied by a 2000 volt generator direct-connected to a three phase motor.

The studio is draped with heavy fabric to absorb echoes and is provided with every convenience for the artists who will entertain Denver fans.

The station is also equipped with a two-step receiving set and a three-step radio frequency amplifier to pick up distant stations.



(1) View of KFAF broadcasting room, showing a part of the control panel, Engineer Elden F. Horn at the microphone, George De Forrest Walker, vice-president and manager of sales, operating the wave meter, and George S. Walker, president of the Western Radio Corporation, standing.

(2) Sectional view of the apparatus, showing the two 250 watt tubes.

(3) A view of the big transmitting set

(4) The two 120-foot aerial towers

LIST OF LIMITED COMMERCIAL BROADCASTING STATIONS LICENSED BETWEEN JUNE 24 AND JULY 22.

Call — Station

WGAJ—W. H. Gass, Shenandoah, Iowa.
WGAL—Lancaster Electric Supply & Const. Co., Lancaster, Pa.
WGAN—Cecil E. Lloyd, Pensacola, Fla.
WGAH—New Haven Elec. Co., New Haven, Conn.
WGAM—Orangeburg Radio Equipment Co., Orangeburg, S. C.
WGAT—American Legion, Department of Nebraska, Lincoln, Neb.
WGAU—Marcus G. Lumb, Wooster, Ohio.
WGAQ—W. G. Patterson, Shreveport, La.
WGAS—Ray-di-co Organization, Chicago, Ill.
WGAR—Southern American, Fort Smith, Ga.
WHAA—State University of Iowa, Iowa City, Ia.
WHAB—Clark W. Thompson, Galveston, Texas.
WGAZ—South Bend Tribune, South Bend, Ind.
WGAW—Northwestern Radio Co., Madison, Wisc.
WHAD—Marquette University, Milwaukee, Wisc.
WHAE—Automotive Elec. Service Co., Sioux City, Ia.
WHAC—Cole Brothers Elec. Co., Waterloo, Ia.
WHAF—Radio Elec. Co., Pittsburgh, Pa.
WGAW—Ernest C. Albright, Phila., Pa.
WGAV—B. H. Radio Co., Savannah, Ga.
KFAJ—University of Colorado, Boulder, Colo.
KFAR—O. K. Olsen, Hollywood, Calif.
KFBA—Ramey and Bryant, Lewiston, Idaho.
WHAG—University of Cincinnati, Ohio.
WHAH—J. T. Griffin, Joplin, Missouri.
WHAI—Radio Equipment & Mfg. Co., Davenport, Iowa.
WHAJ—Bleufield Daily Telegraph, West Virginia.
WHAK—Roberts Hardware Co., Clarksburg, W. Va.
WHAL—Phillips, Jeffrey and Derby, Lansing, Mich.
KFAN—Electric Shop, Moscow, Idaho.
KFAP—Standard Publishing Co., Butte, Mont.
KFAQ—City of San Jose, Calif.
WHAM—School of Music, Rochester University, New York.
WIAC—Galveston Tribune, Galveston, Texas (applied).
WHAO—F. A. Hill, Savannah, Ga.
WHAP—Dewey L. Otta, Decatur, Ill.
WHAN—Southwestern Radio Co., Wichita, Kansas.
KFBB—F. A. Buttrey & Co., Havre, Mont.
WHAS—Courier Journal & Louisville Times, Louisville, Ky.
WIAA—Waupaca Civic & Commerce Assn., Waupaca, Wisc.
WHAQ—Semmes Motor Co., Washington, D. C.
KFBD—Clarence V. Welch, Hanford, California.
WHAR—Paramount Radio & Elec. Co., Atlantic City, N. J.
KFAS—Reno Motor Supply Co., Reno, Nev.
WHAU—Corinth Radio Supply Co., Corinth, Miss.
WIAB—Joslyn Automobile Co., Rockford, Ill.
KFBC—W. K. Azbill, San Diego, Calif.
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.
WIAK—The Stockman Journal, Omaha, Nebr.

Continued on page 35

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

L. M. Clement, Pat. No. 1,415,992; May 16, 1922. Receiving Station.

The receiving circuit described is arranged to detect ordinary signals, whether damped modulated, continuous wave, or heterodyne, by a detector D. For this purpose switch 9 is in its upper position. One or two stages of amplification may be had through amplifiers A, A', by having switch 11 either in its upper position or in its lower position. When detecting continuous waves, the feed back coil 7 is made use of by throwing switch 8 on contact *b*, so as to provide a local source of heterodyning frequency. When it is desired to detect signals which are modulated a plurality of times, or heterodyned a plurality of times, switch 9 is thrown down, and in this way detector D' is placed in tandem with D. The input circuits of D and D' are tuned respectively to the frequencies making up the compound signal.

Pupin & Armstrong, Pat. No. 1,416,061; May 16, 1922. Radioreceiving System Having High Selectivity.

Continuous wave signals are detected by using a local source of oscillations 5 which together with the relay 4, produce heterodyne beats of low frequency below audibility, of say 100 cycles. By making this frequency low, the selectivity is greatly increased, due to the fact that the two values of received frequencies which produce this beat are closer together the less this beat frequency is. The transformer 6 sends this beat frequency through filter 7 to reduce the higher harmonies and after the signal passes through amplifiers 8 and 9, an induction motor type frequency changer 11, 14, is used to raise the frequency to audibility. A relay 15 and phone 16 thence serve to render it preceptible. The frequency changer 11, 14, produces two frequencies, equal to the sum and difference of the beat frequency and the frequency of rotation. By proper choice of frequencies it is possible to obtain distinctive harmonious musical intervals in phone 16, and the recognition of the signal is rendered easier.

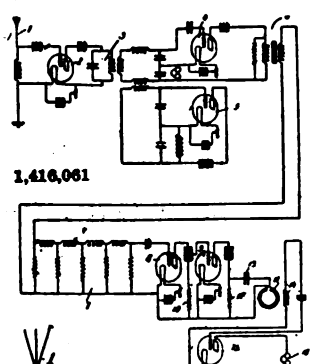
A. M. Curtis, Pat. No. 1,415,999; May 16, 1922. Static Reducer for Wireless Signals.

A crystal detector comprising a carborundum crystal with a metal feeler is so adjusted, by experiment, that the resistance of the detector to impulses of high voltage is equal for both half waves, but unequal for impulses of comparatively low voltage. In this way the crystal is a good rectifier for only the weak signal impulses; and the strong impulses, such as those due to static or interfering signals, are not appreciably rectified.

C. Bardeloni, Pat. No. 1,416,774; May 23, 1922. Device for Receiving Radiosignals.

A thermonic detector 24 is connected up in the usual way to an oscillating circuit 7, 8, tuned to the frequency of the signals to be received, in the antenna circuit 1-2-3-4-5-6. In order to eliminate static or other disturbances, a second oscillating circuit 10-11 is used, tuned to the disturbing oscillations or else to a value slightly different from that of the signals. This circuit is connected to a cold electrode 23 influencing the flow of current in the device 24, and by proper adjustment of the circuits, the potential of plate 23 can be made opposite always to that of grid 12, when due to

Continued on page 46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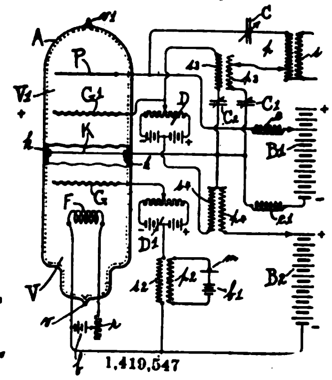
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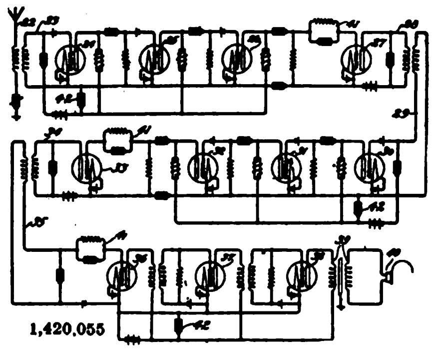
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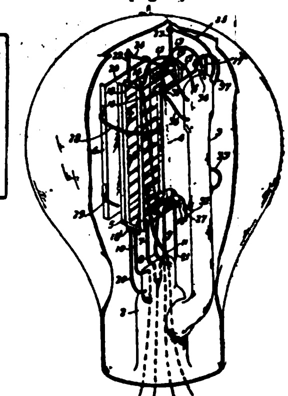
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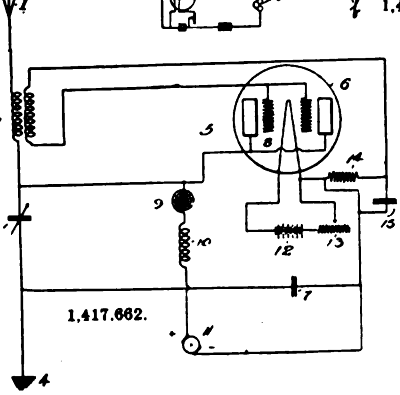
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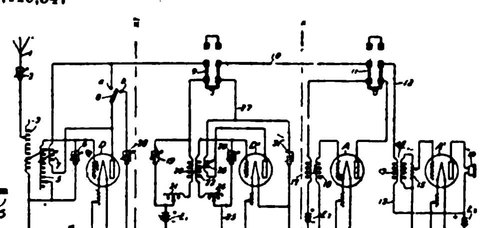
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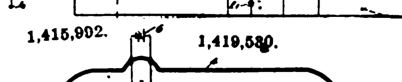
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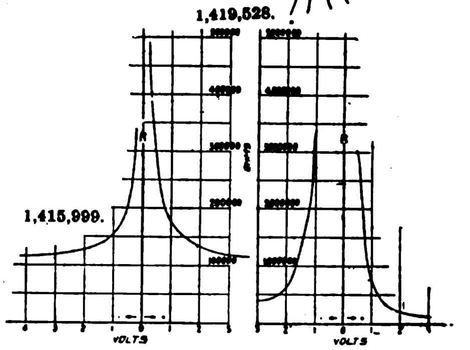
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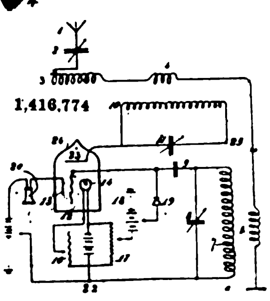
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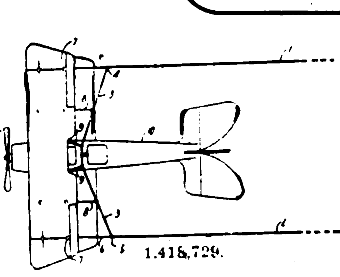
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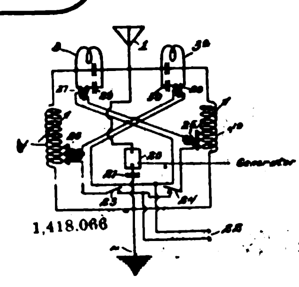
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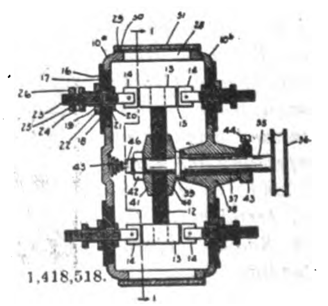
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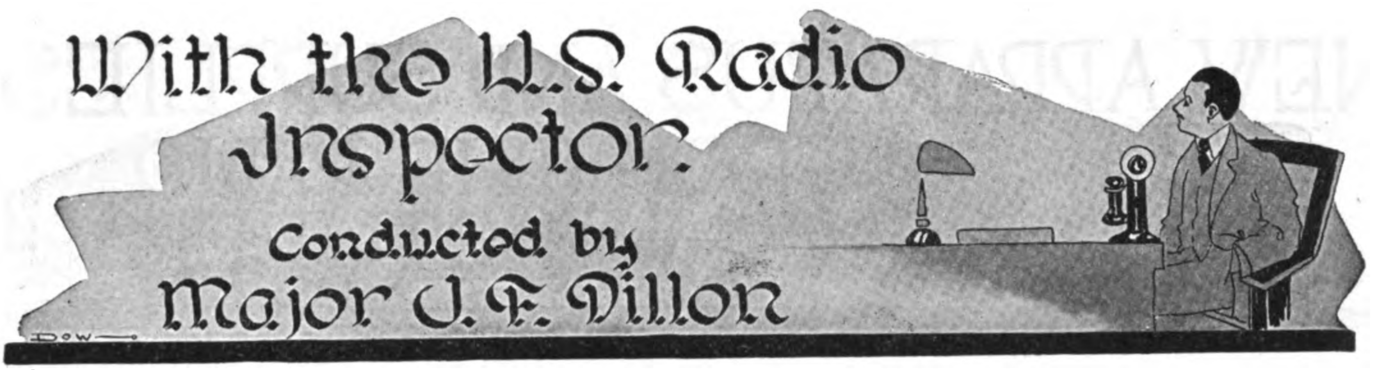


Ques. What is the lowest wavelength an amateur may work on? H. K., Los Angeles.

Ans. As it stands at present, there is no lower limit, as long as the station is adjusted to 200 meters or below. If the recommendations of the Conference are adopted, the lower limit will be 150 meters.

Ques. Why can't apparatus generally be worked on waves lower than 200 meters? Same.

Ans. This is due more to the faulty design of the antenna and tuning apparatus than to any inability of the actual wavelength or frequency limits, as such. It is understood that by very special means, and carefully adjusted circuits, wavelengths of a few meters have been obtained. There is no reason why 125 or 130 meters should not be easily obtained on amateur apparatus, if it were properly designed, although this would, doubtless, be restricted to tube sets.

Ques. I have had 11 months' experience on a commercial second grade license, and 10 months on a first grade license. I feel that I will have no trouble with the 25 word speed test. Am I eligible for examination for the first grade, first class exam.? J. U. I., Chicago.

Ans. The regulations say that service for a license of this grade must be under a *first* grade, and therefore, until you have had 18 months' experience on such license, you will not be eligible for the examination.

Ques. If an amateur who is unlicensed, but possesses a regenerative single coil circuit receiver, puts a key in his ground circuit and is able to transmit a few blocks with his receiving tube oscillating, is he working in violation of the law? Y. B., Reno.

Ans. Yes. The law does not specify the kind or type of apparatus that require licenses. All transmitters require such license, as they may interfere with the reception of signals from beyond the state; therefore the receiving set mentioned becomes liable to cause such interference and must be licensed, and, of course, must be operated by a licensed operator.

Ques. I am about 4 miles from the commercial station KFS in San Francisco, Calif., and whenever he sends he breaks up the concerts. I am unable to tune him out, and others complain of the same trouble. Can't something be done to have this station keep out, at least during the evening hours? J. H. G., San Francisco.

Ans. This station is operating on its lawful wavelength and decrement, and as the class of business handled is "general public service," i. e., correspondence with ships at sea, and cannot be interfered with for any reason, and especially for the concerts, as these are at best non-essential, while ship to shore communication is of vital importance. At the distance you are away from this station, it seems that a great deal of the interference could be eliminated by using extremely loose coupling, unless you are using a single coil type of receiver.

PROHIBITION OF BROADCAST CLASS PROPAGANDA

Several informal complaints have reached this office regarding a sermon broadcasted from a radio station in this district recently, in which the speaker is said to have maliciously attacked the exponents of other religious creeds, impugning their motives and otherwise reflecting upon their character and integrity.

This incident, if reported truly, is most regrettable, as the introduction of religious controversies is, in effect at least, an insidious perversion of the license privilege, as the provoking of sectarian strife and animosities, instead of supplying clean entertainment and instruction to the listening public, which is the real purpose for which the licenses are granted.

It is desirable to emphasize the fact that there is no intention or disposition on the part of this office to criticize the doctrine of any creed or to question the truth or logic of their contentions. It is insisted, however, that speakers refrain from broadcasting attacks upon other religious creeds or their proponents, as such a course will only create resentment and sectarian strife and inflict the same upon the innocent listening public, who are maintaining their receiving instruments for the purpose of entertainment and instruction and who, as a rule, have no interest in the fanatical denouncement of any denomination or sect.

In order that the public shall enjoy the maximum benefit from the operation of radio broadcasting stations, it is imperative that the transmission of all political, religious, labor or class propaganda which would tend to engender factional controversies and strife, be prohibited and that broadcasting be confined to legitimate entertainment and instruction on subjects that are of general interest to a majority of the radio public.

NEW RADIO PUBLICATIONS

A paper by R. T. Cox entitled "Standard Radio Wavemeter, Bureau of Standards Type R70B," describes a standard wavemeter constructed at the Bureau of Standards and used in the standardization of radio apparatus.

"An Electron Tube Amplifier for Amplifying Direct Current," a paper by H. A. Snow, describes an amplifier which has been developed at the Bureau for particular applications in electric signaling work and can be used in place of a polarized relay and also for various other purposes, including the recording of telegraphic and radio signals.

E. L. Hall and J. L. Preston have prepared a report entitled "High-Voltage Storage Battery for Use with Electron Tube Generators of Radio-Frequency Currents," describing a special type of storage battery developed at the Bureau. This battery employs a considerable number of small storage cells contained in small glass jars about 1½ inches square and about 4 inches high. The cells are assembled very compactly in trays which can supply 100 volts.

NEWS OF THE BROADCASTERS

Continued from page 33

KFAU—Independent School District, Boise City, Idaho.
WHAT—Yale Democrat & Yale Telephone Co., Yale, Okla.
KFAT—Dr. S. T. Donohue, Eugene, Ore.
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, Ohio.
WIAJ—Fox River Valley Radio Supply Co., Neenah, Wisc.
WIAI—Heers Stores Co., Springfield, Mo.
WIAH—Continental Radio Mfg. Co., Newton, Iowa.
WHAY—Huntington Press, Huntington, Ind.
WHAX—Holyoke Street Ry. Co., Holyoke, Mass.

The Northern Radio and Electric Co., 606 Pine Street, Seattle, which has been operating KFC in conjunction with the *Post-Intelligencer*, is now operating independently. The "P.-I." has turned over its facilities and all programs are being arranged by the Northern Radio and Electric Co., who will continue the service on even a higher standard of service than has been done in the past. This service will include news items furnished by the "P.-I."

A musical program will be given between 11 a. m. and 12 m. and 4:30 p. m. and 5:30 p. m., week days, over the new radio broadcasting station WBAY, which was recently erected on the Walker Street building of the American Telephone and Telegraph Company at New York City. A program will also be given on Thursday evenings from 7:30 to midnight, to be later announced.

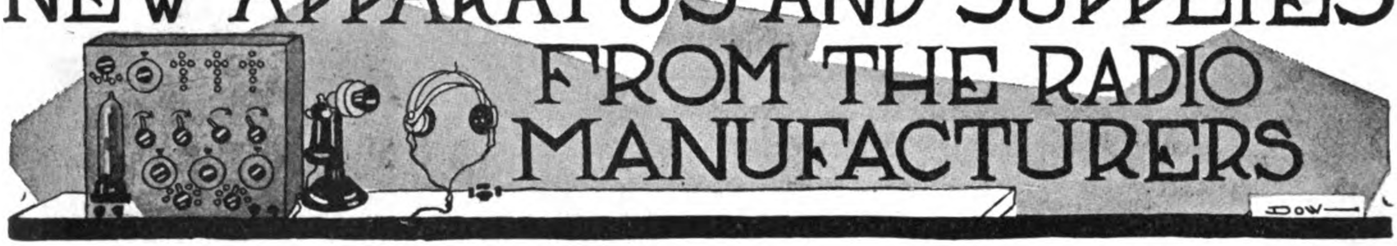
A. W. Drake, general commercial manager in charge of this station, says that there have been close to 100 applicants for the use of this station and he has taken steps to arrange with these applicants for the programs which they will provide.

While radio advertising has not as yet been prohibited by laws or regulation, it is considered, in the public interest, that applicants for the use of this station should provide programs of general interest.

Until the details of the scheduling of private programs can be arranged, WBAY will continue to furnish a miscellaneous musical selection.

The Oakland (Calif.) Tribune has taken over the time of KZM, the Hotel Oakland, by agreement with the Western Radio Institute, and will broadcast under that schedule pending the allocation of wavelengths or a rearrangement of the present schedule. KZM will broadcast once daily, between 6:45 and 7:00 on the time of KZY, the Atlantic-Pacific company, by arrangement with that concern. The Tribune's daily schedule, excepting Sunday, will be as follows: 7:15 to 7:30—General news summary, cable reports and sports. Tuesday, 7:30 to 8:15—Entertainment. Friday, 8:15 to 9:00—Entertainment. KLX will also broadcast occasionally in the afternoon, and as regularly as possible on the time of KZY.

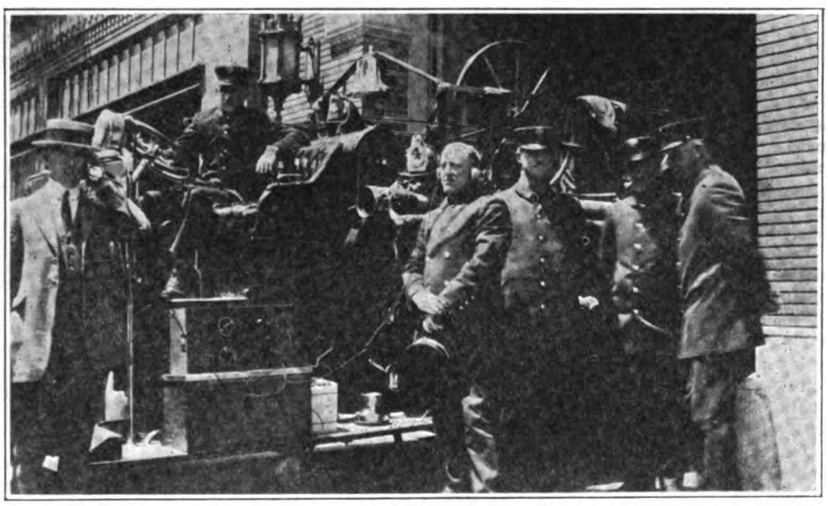
NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



A NEW RECEIVER WITHOUT GROUND OR AERIAL

"Impossible," you will say, but hearing is believing! The Atlantic-Pacific Radio Supplies Co. of San Francisco in the course of a series of tests with their "A. P. Special," using the Oard phantom no-ground circuit, has proved to the satisfaction of a number of radio fans, representatives of the U. S. Army and of the San Francisco Fire Department that broadcast concerts can be satisfactorily picked up at any time that music is on the air. This is the invention of Paul Oard, a California engineer.

All that is necessary to hear the concerts is the set, a six-volt storage battery and about 10 ft. of insulated copper wire laid along the ground or table. Furthermore, the same equipment works to perfection in an automobile running 40 miles an hour, with the 10 ft. wire stretched inside the auto top.



"A. P. Special" on Running Board of Fire Truck at San Francisco

This circuit, while based on an entirely new principle of radio reception, is extremely simple and free from complicated wiring. It is ultra-sensitive in comparison with circuits now in general use. When used with a very short antenna the results obtained approximate those of radio frequency, although audio frequency amplification only is made use of. Contrary to accepted theory and practice, this circuit will not function except at very short range with a ground connection. If a counterpoise is used it becomes less sensitive according to the size of the counterpoise. The nearer an actual ground connection is approximated, the weaker the signal strength. The circuit operates at its fullest efficiency on a single wire antenna not more than 50 ft. in length, placed in any convenient position, thus obviating the necessity of an out-of-door aerial. It is an interesting fact that an antenna of greater length than 50 ft. reduces the strength of signals.

The company is not yet ready to give out the details as to how this is accomplished but these facts will be available shortly. The set is portable, being mounted in a covered cabinet with carrying space for phones and extra tubes. The control is exceedingly simple.

During tests at Berkeley, Calif., the Avalon-Long Beach phone of the Pacific Telephone and Telegraph Co. was clearly heard. Other distant stations are picked up with care, and the nearby ones come in as loudly as with the usual regenerative set.

VACUUM TUBE PROTECTION

The high cost of vacuum tubes justifies the amateur in taking every precaution to prevent the filament's burning out—the usual cause of failure. Of several available protective methods, the simplest and cheapest is to attach a Radico safety fuse to the filament terminal. In case of too great a current supply from the B battery the fuse "blows" and thus saves the filament. These fuses are made by the Radio Equipment Co. of Boston, with carrying capacities of ½, ¾, 1, 1½, 2, 2½ and 3 amps., and are designed to fit the terminals of any standard tube used in any standard socket.

A NEW BINDING POST

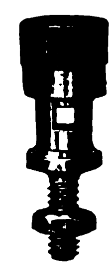
The H. H. Eby Manufacturing Company, 605 Arch Street, Philadelphia, have added another design to their line of metal binding posts. This new style is the same in all respects as the type they are now marketing, with the exception that instead of having a tapped base to take a standard machine screw, it has a solid threaded stem.

It is made in three sizes and is known to the trade by the code words SERGEANT "SS," BUDDY and MIDGET; the first ½" diameter with ½"x 10-32 stem, the second ⅜" diameter with ⅜"x 6-32 stem, and the latter 5/16" diameter with ⅜"x 4-36 stem. This design permits the posts to be mounted more quickly by simply screwing a hexagon nut on the stem.

THE BRISTOL AUDIOPHONE OR LOUD SPEAKER

The Bristol Company of Waterbury, Conn., has recently produced and placed on the market a loud speaker horn under the trade mark name "Audiophone" for receiving radio concerts, speeches, etc. While the Audiophone is a comparatively new development in the radio field, it is not an experiment, but the result of thirty years' experience in the development and manufacture of precision recording and indicating instruments, and six years' research work in sound reproduction. The Audiophone is the result of long and careful research work carried out at the research laboratories of The Bristol Company, to develop a loud speaker for use with the new Bristol talking moving pictures, which are soon to be placed before the public. The result of this research produced a loud speaker which gives a large volume of amplified sound, and yet faithfully reproduces the original.

The Bristol Audiophone



The Sergeant "SS" Binding Post

The Audiophone as shown in the illustration is of a compact and artistic design finished in bronze. The bell of the horn is 15 in. in diameter. The complete design of the bell, neck and electrical characteristics of the receiver box, together with materials used, are such as to produce a loud speaker remarkable for its rich, natural and clear tone. Songs, speeches, announcements, conversation and instrumental music are reproduced by it with a clearness and audibility which has not been the case with the majority of radio receivers.

It is rugged and simple in construction, thus insuring durability. It requires no separate storage battery for magnetizing current. In order to make the horn suitable for all types of radio amplifier circuits, a transformer is mounted in the base which provides the impedance about equal to that of the vacuum tube amplifier, into the plate circuit to which the horn is connected. When connected to a third stage of amplification operating on 100 volts or over, the volume of sound is great enough to be easily heard in a room seating five hundred people. For smaller rooms, such as in private houses, good results are obtained from the Audiophone when connected with a two stage amplifier.

RADIO MANUFACTURERS FORM NATIONAL ORGANIZATION

In order to develop the support broadcasting, in order to stabilize trade conditions, an association must be formed which is composed only of reputable members of the radio industry interested in the future development of radio. For this reason the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies has been formed to place the radio industry upon a sound basis, to study the public taste in the matter of broadcasting programs, and to support and promote broadcasting stations. This Radio Apparatus Section was organized on March 19, 1921, at a meeting held at the Hotel Pennsylvania, New York City. At the second annual meeting, which was held at Spring Lake, N. J., during the week of June 19th, the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies, definitely announced its program and the part that it intends to play in promoting the best interests of radio. At this meeting the object to be attained by the Radio Apparatus Section was proclaimed as follows:

"To advance and protect the interests of the manufacturers of radio apparatus; to promote the standardization of radio apparatus; to collect and disseminate information, and to promote co-operation among the members."

The membership of the Radio Apparatus Section is confined to bona fide and trustworthy manufacturers. That this ideal will be realized may be inferred from the names of the following members who constitute the Radio Apparatus Section at present:

Acme Apparatus Co., American Radio and Research Corporation, L. S. Brach Supply Co., C. Brandes, Inc., Burgess Battery Co., Clapp-Eastham Co., Cutler-Hammer Co., De Forest Radio Telephone and Telegraph Co., Dictograph Products Corp., Edwards & Co., Electrial Products Mfg. Co., General Insulate Co., A. C. Gilbert Co., Holtzer-Cabot Electric Co., Manhattan Electrical Supply Co., W. J. Murdock Co., Pacent Electric Co., Radio Corporation of America, Signal Electric Co., Stromberg-Carlson Telephone Mfg. Co., Telenduron Co., Western Electric Co., Westinghouse Electric and Mfg. Co.

Of equally high standing are the officers of the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies. Mr. M. C. Rypinski, who is now vice-president and sales manager of C. Brandes, Inc., is chairman of the Radio Apparatus Section. The Eastern vice-chairman is Mr. L. G. Pacent, president of the Pacent Electric Co., Inc. The Western vice-chairman is Mr. C. E. Hammond, secretary-treasurer of the Signal Electric Co. Mr. Charles Gilbert, president of the De Forest Co., is treasurer of the association. The secretary is Mr. Elmer Bucher, who is sales manager of the Radio Corporation of America.

The following standing committees have been created to fulfill the purposes indicated by their names: Committee on Publicity, Committee on Receiving Sets and Equipment, Committee on Aural Devices and Accessories, Committee on Standards, Committee on Support of Broadcasting, and the Executive Committee, which is composed of the chairman and treasurer of the Radio Section and of the chairmen of the standing committees.

This is the nucleus of an organization which will eventually include every important enterprise in the radio industry.

M. C. RYPINSKI JOINS C. BRANDES, INC.,

M. C. Rypinski, formerly radio sales manager of the Westinghouse Electric and Manufacturing Company, has associated himself with C. Brandes, Inc., 237 Lafayette Street, New York City, as vice-president and sales manager.

Mr. Rypinski was actively engaged in the erection of KDKA and other Westinghouse stations, and was also in a position to study at first hand the various commercial and

M. C. Rypinski, formerly radio sales manager Westinghouse Electric and Mfg. Co., now vice-president C. Brandes, Inc., and newly elected chairman Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies.

merchandising problems that naturally grew out of such a unique situation. In allying himself with C. Brandes, Inc., he is placing at the disposal of this organization, manufacturing radio phones, an experience in the radio field which has come to but few men. Occupying a position of great responsibility in the very center of the radio industry, Mr. Rypinski had occasion to familiarize himself with every phase of commercial radio as related to broadcasting.

VICTORY SELECTOR JACK

The Victory Radio-Electro Company of San Francisco and Chicago has a new selector jack which eliminates the use of the common radio plug and also the last jack in an amplifying set. By simply pressing a button the nuisance of jerking a plug in and out of the jacks and the dangling of long cords or wires in the front of the panel is entirely done away. On a detector and two stage amplifier for example, to get its entire range of selectivity it has heretofore been necessary to equip the set with three jacks and one plug. All this equipment can now be replaced by two Victory selector jacks giving simpler and more efficient operation. Incidentally, there are also fewer holes to drill on the panel. One is placed between the detector and first stage, and the other between the first and second stages, as indicated in the diagram, and the second or last stage is connected directly to the output binding posts where the phones or loud speaker is permanently connected. This jack can be used in any circuit where a standard radio jack is used without changing any connections.

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY R. ROPES, GEN. GRANT NATIONAL PARK, SIERRA NEVADA MOUNTAINS, CALIF.

Spark—6ar, 6dd, 6gt, 6gr, 6hc, 6iv, 6tc, 6tu, 6uq, 6vh, 6vk, 6zb, 6zy, 6aak, 6ajw, 6akt, 6ali, 6amk, 6amz, 6anq, 6asc, 6asx, 6atu, 6bin, 7mf, 7iw.

C. W.—Kmc (concert), klp (concert), kuy (voice), kzm (voice), 6ka, 6bcd, 6bjc, 6bzc.

BY 6AKW, ROUTE 1, LANCASTER, CALIF.

Due to the terrific static here on desert, I am not doing much transmitting, but with detector only I am able to receive fairly clear of static, so to speak, on average night, but find days much freer of it.

Will be in this winter with 100 watts A. C.—C. W.

Sparks heard June and July—6ex, 6zu, 6ajr, 6vx, 6gr, 6aau, 6kl, 6tu, 6qr, 6cc, 6avb, 6acr, 6xai, 6abw, 6hc, 6ib, 6hf, 6ala, 6ars, 6gx, 6hp, 6atp, 6bar, 6vk, 6qy, 6abu, 6qu, 6tj, 7zu, 7mf, 7nw, 7in, Canadian 9bd.

C. W.'s heard June and July—6nx, 6gy, 6alv, 6ni, 6awt, 6km, 6bhk, 6zf, 6ze, 6pj, 6bqc, 6abw, 6fh, 6uj, 7na, 9ayu.

On two step one night in July—9zaf, 9aog, 9es.

BY GEORGE AND CHARLES C. WHYSALL, MARION, OHIO. STATION 8CMI (ex 6TV).

1yb, 2fp, 2sz, 8ajd, 3awe, 8abb, 8arn, 3bfu, 8hj, Canadian 3ds and 8gx, 4gl, 4gh, 5da, 8ea, 8ev, (8bde), (8bbu), 8bo, (8ajx), (8un), (8wu), (8zo), 9aaw, 9afk, 9aiy, 9anp, 9agr, 9aly, 9dhz, 9dzy, 9dkk, 9fd, 9lf, 9tv, 9uh, 9wa, 9zn.

Fone stations — wwj, wcx, wgy, wgl, kdka.

Eighteen msgs. handled from May 28 to 29, 1922.

8CMI radiates 2.25 amperes into a single wire antenna 150 ft. long with one 5-watt tube. Effective resistance of antenna is 2.5 ohms at 200 meters.

BY G. E. MADDOX, BOX 958, KETCHIKAN, ALASKA

8hj, 4cb, 5xu, 5ax, 6zi, 6pl, 6zk, 6uq, 6aw, 6kq, 6ad, 6ab, 6mq, 6xga, 6pt, 6pd, 6jd, 6pr, 6pc, 6cn, 6hc, 6bx, 6bc, 6bd, 6ale, 7ib, 7dp, 7nn, 7nf, 7dh, 7mp, 7ax, 7qr, 7jd, 7zm, 7qt, 7gp, 7bd, 7bk, 7gj, 7zp, 7bc, 8pj, 8bum, 8ay, 8dj, 9dva, 9zac, 6xad.

BY 7TH, WALLA WALLA, WASH.

Spark—6gf, 6gi, 6hc, 6abu, 6acr, 6amz, 6ark, 7bk, 7ge, (7jw), 7nw, 7of, 7ra, 7to, 7uw, 7ve, (7vf), (7aby), (7ala), Canadian 9bd.

C. W.—6en, 6ff, 6ft, 6ka, 6awt, 6bsa, 7ia, 7lu, (7na).

Fones—7ia, 7rn, 7xf, 7zu.

All stations hearing my 10-watt C. W. please QSL Arthur W. Enigh.

Sir:—On the night of July 29th at 9:43 p. m., 120th meridian standard time, while tuning around in an endeavor to pick up a local broadcasting station I heard WSZ of the Atlanta Journal, Atlanta, Ga., signing off for evening.

His wavelength was about 370 meters.

At the time of reception I was laying on the Columbia River Bar awaiting arrival of vessel.

The aerial here is low and poorly insulated, having a high resistance.

I have written WSZ informing him of the reception and asking him to arrange tests in an endeavor to repeat the performance.

PHILIP I. MERRYMAN,
Tug "Oneonta," Sparks WPX.
Astoria, Ore.

BY 6AWP, EVERETT W. THATCHER, 407 W. FIRST ST., SANTA ANA, CALIF.

C. W.—(5za), 6aif, 6aiy, (6ak), (6akw), 6aot, (6asj), (6atp), (6aun), (6awt), 6bjd, (6bpu), 6bqf, 6bsa, 6df, 6ek, (6fh), 6gh, 6ib, 6ku, (6lu), 6nn, 6ov, 6pi, (6ti), (6tw), 6xas, 6xh, (6za), 6zaa, 6zac, 6zae, (6zaf), (6zf), 6zc, 6zi, (6zn), (6zt), 6zx, (6zz), (7dp), 7nf, 7na, 7ni, (7mf), (7oz), 7sc, 7xg, 7xf, (7zu), (9ayu), Canadian 9bd, 9wd, (9wu), (cl-8).

Spark—(6aak), 6aau, (6abu), (6aeh), 6agt, (6ahf), (6ajh), 6ajr, (6ald), 6amz, 6ar, 6as, (6atu), 6bdq, (6bju), (6bjy), 6bjv, 6cc, 6cs, 6gr, 6gx, 6hc, (6ic), 6iu, (6kc), (6vk), vx, 6zam, (6zb), 6zq, (6zu), 6zx, (6zz), 7kb, (7ly), (7mf), 7mp, 7nf, (7ot), 7tj, (7zu).

All hearing 6AWP C. W. please QSL.

Los Angeles, July 30, 1922.

Sir:—In August RADIO I notice a little item about reception of U. S. amateurs in South American waters. I would like to submit some of my own log from the voyage of the schooner "Vigilant," December 15 to June 15, in southern waters. I believe that I have logged stations farther than any so far reported. I used an Armstrong hookup with two steps of audio frequency amplification. The following are extracts from my notebook kept on that voyage:

Jan. 16, Lat. 1.20 S, Long. 120.00 W, 7:35 p. m.—CQ by 9pi plain, 6xac plain.

Jan. 18, Lat. missing, 7:20 p. m.—9xaq C. W. A. P. fone plain.

Jan. 20, Lat. 10.30 S, Long. 120 W, 8:10 p. m.—QST by 9bu. Called 5zl, 8gi. 8:25 p. m., CQ by 9x—. 8:26 p. m., CQ by 9xah, 60 cycle C. W. 9:50 p. m., CQ by 5xo Msg. 9:52 p. m., nmw. 9:54 p. m., 9dtm (probably 9xm).

Jan. 27, Lat. 21.00 S, Long. 121.22 W, 8:15 p. m.—Copied NPL arc on about 350 meters plain.

That is somewhat strange to me. He must radiate considerable on that chord. Hear C. W. from Catalina.

Feb. 17, Lat. 33.09 S, Long. 106.45 W, 6:10 p. m.—Modulated wave playing banjo piece. Music good but voice faint, unreadable. 7:40 p. m., Catalina alarm and voices. 8:15 p. m., 6baj, several other C. W. 8:30 p. m., 6baj. 8:31 p. m., 9zaa.

This is about the farthest south we went and is about 4900 nautical miles from San Francisco.

March 5, Lat. 30.48 S, Long. 90.50 W, 5:00 p. m. to 5:05 p. m.—Hear C. W. and voice, probably Catalina, very plain. Conversation said had a nice trip over, outside the three-mile limit, etc. Then said goodbye three times before party let him go. 5:05 p. m.—Now two girls talking but their voices do not carry so well.

March 7—I experimented with a loop 4 ft. in diameter. Results not very good, but copied COC over 300 miles. Then with the loop for an aerial and the aerial for a ground, heard both speech and C. W., but did not log them. The regular ground was disconnected.

Just a little about my receivers. The aerial is 65 ft. long with 145-ft. leadin. The ground was a copper plate on the keel and the conduct and water pipe system of the ship. The transmitter was a K. C., one-half kilowatt spark, and I made any distance up to 1750 miles with KPH and KFS. The power supply was a 110-volt Delco light, which I made do for both transmitting and A and B batteries in reception.

Sincerely yours,
L. V. DAVENPORT,
Operator KOZP.

8914 Wisconsin Place,
Los Angeles, California.

BY 7NW, HOQUIAM, WASH.

Spark—(6abx), 6abw, 6acr, 6ala, (6amk), 6ang, 6ark, (6avm), (6cc), (6dd), (6ex), 6ff, (6gf), (6ib), 6ic, 6tu, (7aea), 7bh, (7bk), 7bz, (7ey), 7fh, (7fi), (7ge), 7hf, (7iw), (7iy), (7ke), 7kz, 7mf, 7of, 7ow, (7to), (7tw), (7ve), 7vf, 7wg, 7zk, (3ec) Canadian, 5ct Canadian, (9bd) Canadian.

C. W.—6aat, 6abx, 6bcd, 6gr, 6ka, 6rm, 7aea, 7dd, 7lu, (7mf), 7na, (7oz), (7qw).

BY 6AVX, SAN DIEGO, CALIF.

Spark—6aak, 6aav, 6abu, 6aiu, 6aic, 6ajr, 6akg, 6ald, 6aqv, 6asc, 6up, 6avb, 6avd, 6avr, 6bem, 6bpz, 6ex, 6eb, 6gr, 6gt, 6ic, 6iv, 6od, 6oh, 6ol, 6tu, 6zu.

C. W.—5za, 6aag, 6ala, 6aqa, 6aqt, 6aqv, 6aub, 6awt, 6beg, 6bf, 6bgz, 6bqc, 6bqz, 6cu, 6du, 6ea, 6eb, 6ec, 6ef, 6en, 6ik, 6ka, 6ku, 6rr, 7na, 7sc, 9amb.

BY 6ASJ, 929 60TH ST., OAKLAND, CALIF.

Spark—(6ajh), (6apy), (6gr), (6ke), (7bb), (7to), (7vf).

C. W.—6aeh, (6agh), (6akw), (6alu), 6aqa, 6bcd, (6bes), (6bjt), (6bkb), (6bqc), 6cu, 6en, (6ft), (6gd), (6gx), (6jd), (6ka), (6ku), (6pi), 6xad, 6zac, 6zf, 6zg, 6zb, (6zs), 6zz, 7nf, (7na), 7qe, 7qw, (7sc), 7xg, 9amb.

6cu, Los Angeles, Calif., was reported by 9daz, Jefferson City, Mo., as being the "loudest station heard outside of nines." The distance is over 2000 miles air line. 6cu was using a ten-watt A. C. C. W. set and radiating 2.8 amperes. 9daz's receiver was a home-made regenerative set with detector and Murdock phones.

BY 6AHR, 659 CLAYTON ST., SAN FRANCISCO

Spark—6ak, 6cc, 6dd, 6eb, 6gi, 6gt, 6im, 6jh, 6kc, 6ke, 6lc, 6mi, 6od, 6ol, 6yy, 6zk, 6zu, 6aak, 6acr, 6acy, 6ada, 6aen, 6agk, 6ahp, 6ahq, 6ahz, 6aic, 6aje, 6ajh, 6akl, 6ala, 6ald, 6amf, 6ano, 6aoa, 6ars, 6atj, 6atr, 6bgd, 6bmv, 6bnu, 7mf, 7zt.

C. W.—6ea, 6eb, 6en, 6ft, 6jd, 6ka, 6lw, 6nm, 6pi, 6sg, 6zf, 6zz, 6aib, 6akw, 6alu, 6aqa, 6bes, 6bkb, 6bka, 6bkb, 6bla, 6xad, 7mf, 7zu, 9amb, 9ayu. My 8-watt C. W. been heard in Seattle, Wash., using 400 volts on plate, antenna current .5 amp.

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Hook up a 6-volt Willard *All-Rubber* Radio "A" Battery to your filament circuit, and two or more 24-volt *Threaded Rubber* Radio "B" Batteries to your plate circuit. Then note the difference in the way your set stays tuned—in the freedom from hissing and frying noises. These batteries give you results because they are *built for radio.*

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The 24-volt Threaded Rubber "B" Battery

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R-3
Magnavox Radio with 14-inch horn

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Price $45.00

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BY 6ARB, BERKELEY, CALIF.

C. W.—(6ea), (6eb), 6en, (6fh), 6ft, 6ka, 6ku, 6rr, 6zb, 6zf, 6zn, 6zx, 6zz, (6aeh), 6akw, (6agp), 6alu, (6awp), 6beg, 6bes, 6bjc, 6bkb, (6bmn), (6bqc), 6bqg, (6bqq), 6bfk, 6zac, (7dp), 7ic, (7mf), 7na, (7oz), (7qt), 7qw, 7rn, (7sc), 7zu, 8awl, (9amb), (cl8).

Spark—6ec, 6cr, 6ct, 6ov, 6zd, 6ajr, 6akl, 6ald, (6ara), 6ars, 6asc, 6atf, 6avr, 7bh, 7bk, 7jd, 7nw, 7mf, 7tj, 9bd Canadian. All those hearing 6arb pse. QSL to C. E. Duncan.

BY 6BQL, 575 21ST AVE., SAN FRANCISCO, CALIF.

Spark—6cc, 6dd, 6eb, 6fh, 6gt, 6ic, 6iv, 6kc, 6ke, 6mh, 6od, 6oh, 6ol, 6up, 6va, 6wg, 6zu, 6aak, 6abw, 6abx, 6aei, 6ahp, 6ajh, 6ajr, 6akl, 6ald, 6ali, 6aqv, 6aqx, 6ark, 6ars, 6asc, 6avb, 6avd, 6avm, 6avr, 6awx, 6bem, 6bmg, 6bpx, 7bk, 7fi, 7iy, 7kj, 7mf, 7nw, 7to, cl8, 9bd.

C. W.—5za, 6bf, 6ea, 6eb, 6ec, 6en, 6fh, 6ft, 6gy, 6jd, 6ka, 6ku, 6lo, 6oh, 6oy, 6rr, 6zb, 6zf, 6zg, 6zs, 6aat, 6aeh, 6alu, 6aoz, 6awp, 6bbc, 6beg, 6bes, 6bet, 6bhk, 6bjc, 6bjy, 6bkb, 6bmd, 6bmn, 6bqc, 6bqq, 6bqp, 6bts, 6xas, 7na, 7qw, 7sc, 7xg.

All stations hearing my C. W. signals over a hundred miles please QSL with card.

BY 4KL, ASHEVILLE, N. C.

1ii, 1xm, 1qp, 1cak, 2zk, 2aab, 2sp, 2wi, 2ayv, (3rf), (3ca), (3bhl), (3blf), 3km, 3qu, 3fs, (4gh), 4do, (4ds), 4by, (4mi), (5da), (5ku), 5za, 5aam, 5ho, 5fv, 5jb, 8ago, (8to), (8zg), (8and), 8awo, 8adm, 8agz, 8aii, 9akd, 9amd.

BY 7SY, GERARD DE BROCKERT, EUGENE, ORE.

6bk, 6cc, 6dp, 6fh, 6ku, 6lk, 6pj, 6tu, 6tw, 6xb, 6xf, 6xw, 6yr, 6zf, 6zg, 6zq, 6zr, 6zx, 6aak, 6aat, 6abx, 6acr, 6abw, 6abx, 6ajr, 6ale, 6alu, 6amk, 6ark, 6awh, 6beg, 6xam, 6xac, 6xad, kwg, klp, kij, kvq, kdn, kyj, kzy, kfu, kqw, agl, 7ad, 7ba, 7bj, 7bk, 7bz, 7cd, 7ck, 7cv, 7fc, 7fi, 7ge, 7jd, 7kj, 7ly, 7mp, 7mu, 7nl, 7nn, 7nw, 7nz, 7rn, 7sf, 7wg, 7xf, 7xh, 7ya, 7yg, 7yj, 7yl, 7zp, 7zt, kfc, kgw, kyg, cl8, kgb, kgy, 7iy, 7ku, 9ax, 9bd, 9pi, 9amb, dd5.

BY 6OD, SOUTH PASADENA, CALIF.

Spark—5if, 5of, (5za), (6ak), (6ar), (6as), 6bm, (6bw), 6cc, 6cp, 6cv, (6dp), (6ex), (6fh), 6fj, (6fk), (6gf), (6gr), (6gt), (6gx), (6hc), (6hp), (6ib), (6ic), (6im), (6iv), (6km), (6kx), (6lu), (6mz), (6ng), (6oc), (6oh), (6pj), (6po), (6pr), (6qk), (6qr), 6qy, (6to), (6tu), (6tv), (6vk), (6vx), (6wg), (6wz), (6xh), 6zd, 6ze, (6zi), (6zj), (6zk), (6zu), (6zx), (6zz), 6zam, (6aah), (6aak), (6aau), 6abm, (6abu), (6abw), (6abx), (6acr), 6acw, (6ada), (6aeh), (6afp), 6afy, (6agf), (6ahf), (6aif), 6ajd, (6ain), (6ajh), (6ajr), (6akl), (6ala), (6amk), 6ang, (6ani), (6aoe), (6aor), 6ape, (6aqu), 6ark, (6ars), (6arw), (6atu), (6aud), (6avb), (6avm), 6avx, 6bak, 6bcj, (6bgl), (6biu), (6bjv), 7bk, 7bh, 7bp, 7fi, (7fj), 7ga, 7gj, 7gq, 7hf, 7in, 7iy, 7jd, (7mf), (7ot), 7tj, 7xd, 7zj, 7zt.

C. W.—5za, (6ak), 6fh, (6gf), 6hc, (6jj), 6ku, 6oo, (6zi), 6zs, 6zx, 6zz, 6aat, 6aeh, 6asv, 6awt, (6atp), 6bjy, 6bmd, 7mf, 7xf, 9dn, 9wd, 9ayu, 9amb, 9bji, 9dva.

BY 6EA, 343 SO. FREMONT AVE., LOS ANGELES, CALIF.

C. W.—6fh, (6gf), (6gx), (6gy), 6lv, 6ni, 6nx, 6xc, 6zi, 6asj, 6atp, (6awt), 6bcd, 7lu, 7xg, 9amb.

Spark—6as, 6bw, 6cc, 6dp, (6ex), (6gr), 6hc, (6hp), 6ib, (6ic), 6kl, 6km, (6tu), 6uh, 6uo, 6vk, 6vx, (6xh), 6ze, (6abu), 6agf, 6ain, (6ajr), (6ala), (6amk), 6amz, 6aqu (Berkeley, Calif., now), 6ark, 6ars, 6atu, 6avb.

BY 6BQO, WM. SCHLAH, 1629 VINEYARD AVE., LOS ANGELES, CALIF.

C. W.—6ak, (6fh), 6gf, (6gy), 6gx, (6lo), 6lv, 6nx, 6oh, 6ti, (6zb), 6zs, 6aat, (6aeh), (6arb), (6asj), (6awt), (6bcd), (6bjy), 6bmd, (7na), 9amb.

Sparks—6ex, 6km, 6gr, 6zu, (6akl), (6ajh), 6ala, 6amk, 6aun.

Anyone hearing my C. W. pse. QSL.

BY 5KC, PLAQUEMINE, LA.

Spark—2fp, 3ao, 4as, 4bk, 4cg, 4ci, 4co, 4cs, (4cx), (4dh), 4gl, 4id, 4le, 4tg, 4zf, 5aa, 5ae, 5al, 5an, 5bi, 5bn, 5bq, 5bx, 5by, 5da, 5dw, 5ek, 5ed, 5er, 5ew, 5fa, 5fo, 5fv, 5gi, (5hk), 5hz, 5ic, (5ir), 5ji, (5jd), 5jr, 5kk, 5kp, 5la, (5lb), 5lo, 5mf, 5mt, 5my, 5nn, 5nc, 5nk, (5ns), 5pd, 5pe, 5py, (5px), (5qa), (5qt), 5qq, 5qs, 5ra, 5rj, 5rl, 5ro, (5sm), (5tg), 5tp, 5tu, 5uc, (5ue), 5ug, 5uj, 5we, 5wc, (5xa), (5xb), (5xi), (5xj), 5xl, 5xq, 5xt, (5xu), 5ya, 5yb, 5ye, 5yg, 5yk, (5yl), 5ym, 5yn, 5za, 5zb, 5zc, 5ze, (5zl), 5zn, 5zo, 5zr, (5zs), 5zt, 5zu, 5zv, 5zw, (5zx), (5zz), (5aat), (5aba), (5aby), (5zaa), (5zab), (5zac), (5zae), (5zaf), 5zai, (5zak), 5zan, 5zap, 5zar, 5zax, 8aa, 8aj, 8bk, 8vj, 8xi, 8xm, 8xv, 8ym, 8yu, 8zu, 8agz, 8afb, 8ard, 8axy, 8bbu, 8bfx, 8box, 8zac, 8zae, 9ac, 9ak, 9ap, 9ay, 9ca, 9dw, 9et, 9ev, 9ff, 9fk, 9fm, (9fu), 9fy, 9fs, 9gn,

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3. *Greatest Receiving Range,* because noiseless control detects weak radiophone waves, and by locating exact filament current, amplifies the waves to fullest extent.

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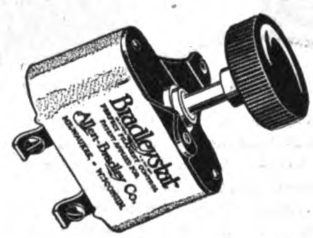

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Continued from page 44

9hi, 9hm, 9hr, 9ht, 9iv, 9jn, 9jq, 9jt, 9jx, 9ka, 9kf, 9ko, 9lo, 9mc, 9mw, 9nr, 9oa, 9ox, 9pe, 9pg, 9ps, 9qj, 9rr, (9ry), 9tq, 9tv, 9ug, 9uu, 9vl, (9wi), 9wj, (9wt), 9wu, 9xi, 9xj, 9xm, 9ya, 9yb, 9yc, 9yi, 9yk, 9ym, 9yo, 9yq, 9yr, 9zf, 9zh, 9zj, 9zn, 9zy, 9aap, 9aby, (9acb), 9aeg, 9aek, 9aey, 9aig, 9ajh, 9ama, 9amj, 9amk, 9amo, 9amr, 9ams, 9anf, (9anq), 9aoe, 9aoj, 9aou, (9apn), 9aps, (9aqe), 9aqm, 9arx, 9ast, 9atn, 9avd, 9ave, 9avh, 9avk, 9avp, 9avz, (9axu), 9ayk, 9ayw, 9aza, 9azf, 9azh, 9bbf, 9bfg, 9bid, 9blo, (9bsa), 9dbs. 9dcx, (9deh), 9dhz, 9dmj, (9dqq), (9dsd), 9dsm, 9dwj, 9dzi, 9dzy, 9jif, 9mxu, 9xae, (9yae), 9yak, 9zac, an5, nzo.

C. W.—1bcg, xfi, 2xi, 2zk, 2zl, 3aqr, 3blf, 3zy, 4bb, 4bf, 4bk, 4bq, 4by, 4dc, 4eb, 4ft, 4id, 4ii, 4iv, 4kc, 4lp, 4ya, 4xb, 5aj, 5an, 5ba, 5bn, 5bl, 5dd, 5do, 5dv, 5eu, 5fo, 5fv, (5hb), 5ho, 5hr, (5jb), 5jl, 5ku, (5la), (5lj), 5ma, 5nd, (5nn), 5nk, 5nz, 5oi, 5ou, (5pb), 5ra, 5rl, 5sp, 5tk, 5tu, 5uu, 5xb, 5xj, 5xm, 5xr, (5yg), 5yi, 5za, 5zg, 5aac, (5aba), 5acf, 5zad, 5zag, 6jd, 6zz, aa7, 7zu, 8bo, 8hj, 8hm, 8iv, 8pt, 8sp, 8uc, 8xb, 8xy, 8yz, 8zg, 8zz, 8abp, 8abv, 8aby, 8acf, 8aim, 8aqf, 8aqv, 8awv, 8azf, 8bau, 8bfx, 8box, 8brl, 8cfp, 8xak, 8zaw, 9ao, 9ar, 9as, 9dv, (9ei), 9fm, 9hk, 9hw, 9io, 9jd, 9jq, 9kp, 9lq, 9lz, (9nx), 9ps, 9sl, 9wa, 9wq, 9wu, (9uu), 9xi, 9xm, 9xr, 9ze, 9zg, 9zx, 9zy, 9aas, 9aav, 9aco, 9aix, 9aja, 9ajp, 9ajh, 9akb, 9akr, 9ala, 9amb, 9aog, 9avn, 9aua, 9ays, 9bbf, 9bik, 9biz, 9bjb, 9bkz, 9blo, 9bsg, 9dax, 9ddf, 9dgq, 9dkh, (9dky), 9dts, 9dtw, 9dun, 9dyn, 9dzo, (9dzq), 9vno.

Phones—6wv, 9vno, cm4, kdka, kyw, nof, wfc, wha, whb, wjz, wok, wpk, wrr, wrw, wsb, wwj, wbap.

All stations who have heard Radio Station 5kc please QSL. Use both spark and C. W.

BY 7SG, ABERDEEN, WASH.

Spark—6abu, 6abw, 6abx, 6aih, 6ajh, 6akt, 6ala, 6amk, 6amz, 6ang, 6ar, 6ark, 6avb, 6bb, 6bne, 6cc, 6fh, 6gf, 6gr, 6gt, 6hc, 6hp, 6ic, 6km, 6tc, 6tu, 6vx, 6zu, 7adr, 7aea, 7aeq, 7agi, 7bg, 7bk, 7bz, 7ck, 7ey, 7fi, 7fq, 7ge, 7ic, 7in, 7iy, 7jw, 7ke, 7mz, 7of, 7ot, 7pq, 7tj, 7to, 7tw, 7ve, 7vf, 7zp, 7za, cl8, Canadian 3ec, 9bd.

C. W.—6aat, 6aot, 6arb, 6asj, 6awp, 6awt, 6bmd, 6bmn, 6bql, 6bsa, 6ea, 6en, 6fh, 6ft, 6ik, 6ka, 6km, 6ku, 6zf, 6zg, 6zx, 7fr, 7lu, 7na C. W. and voice, 7oz, 7qb, 7qw, 7rn, 7zo, 7aea, bq3.

RECENT PATENTS

Continued from page 34

the disturbances. A by pass circuit including a rectifier 19 is also provided so that only the negative half waves of the signals influence the grid 13. When the plate 23 is positively charged it increases the flow of plate current, and when negatively charged it has no effect since it is not interposed between the electrodes. The result is that the negative half waves of the disturbances can have no effect because the potential of plate 23 nullifies any effect, and positive half waves are shunted through the rectifier 19.

L. DeForest, Pat. No. 1,417,662; May 30, 1922. Radiosignaling System.

An oscillating audion circuit is disclosed. There are two branches to the plate-filament circuit—one through condensers 3 and 7, and the other through conductors 9 and 10 and d. c. source 11. A so-called "tickler" circuit, which is the feature of the invention, is provided from the grid to the filament 8, and includes a coil coupled to the antenna coil 2, high leak resistance 14 and a condenser 15 across the resistance. It is claimed that such a circuit as disclosed is simple and efficient in operation.

T. R. Bunting, Pat. No. 1,418,066; May 30, 1922. Radiotransmitting System.

A duplex transmitting system is described, in which there are two paths, 3, 4, and 3a, 4a for the transmission of radiations. The arrangement is such that when radiations are sent from one branch, the constants of the other branch are so fixed that it is opaque to the transmitted signal.

E. F. Bell, Pat. No. 1,418,518; June 6, 1922. Quench Rotary Spark Gap.

A rotatable insulating disc 12 carries flat electrodes 13, arranged to be driven by shaft 35 past stationary posts 14. The sparks are formed between members 13 and 14. The entire mechanism is enclosed in an air tight

Continued on page 48

A Word About Price!

Something that everyone interested in Radio should know

THE Automatic Electric Head Set has been developed and completed to give a maximum loudness and clearness under all conditions.

Some of the outstanding features have been discussed in these pages. Price has been quoted at $10.00, with plug attached $11.50. This is a *fair* price. It covers development and manufacturing costs plus a reasonable profit.

On account of the widespread demand for Radio equipment, it is difficult to judge real values by the various prices you see quoted. High price may not necessarily mean commensurate quality. That is why it is safer to buy a product whose origin you *know*.

Automatic Electric Company has been making high class telephone apparatus for over thirty years. This perfected Radio Head Set is the result of years of experience and technical knowledge, backed by the reputation of this house. And it is our aim to give you the best Head Set ever produced, to fit all requirements.

Some of the Important Points of Superiority of the Automatic Electric Head Sets are:

Single pole construction —(a single powerful electro-magnet which takes effect at the exact center of the diaphragm).

The *soft iron magnetic path* assures minimum loss of strength and character to the diaphragm vibrations.

The *coil design* — a single coil wound on a cylindrical core. No sharp corners. The core of the coil is very small and the electric resistance per average turn is correspondingly low.

High resistance, as you know, sounds impressive but means practically nothing. The thing that counts most is PROPER effective impedance. This is governed chiefly by the number of turns of wire, amount of iron in the magnetic circuit, and its construction.

If your dealer sells high class Radio apparatus, he can tell you all about Automatic Electric Head Sets. Ask him. If he cannot supply you, order from us direct. Price is $10.00, postpaid—with plug attached $11.50.

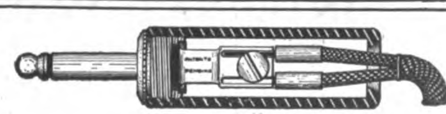
AUTOMATIC ELECTRIC LONG RANGE RADIO HEAD SETS

Automatic Electric Company

ENGINEERS, DESIGNERS & MANUFACTURERS OF THE AUTOMATIC TELEPHONE IN USE THE WORLD OVER

HOME OFFICE AND FACTORY: CHICAGO, U. S. A.

This is the high grade plug that comes attached, when desired, to *Automatic Electric Head Sets*. It will take care of any kind of cord terminals, will fit any kind of jack and will accommodate two head sets. With this plug attached to our head set you can be sure the head set is properly "poled."



Continued from page 46

case 10. The feature of the invention resides in the provision of the conical spring 45 bearing against the end of the driving shaft 35 for preventing this shaft from moving longitudionally and thus destroy the alinement of the contacts.

A. A. Oswald, Pat. No. 1,418,729; June 6, 1922. Portable Radiating System.

An antenna structure for an airplane is described, in which two wires 1, 2 are connected in parallel by wire 3, and form one side of the system. The other side of the system consists of the metallic body of the airplane. In order to reduce energy losses, the wires 1, 2, and 3 are spaced a considerable distance from the plane, as by means of the flexible cords 6 and 8, and the rigid strut 9. Such an antenna system has much better properties than a single wire, or a double wire in which one serves as the counterpoise for the other.

H. W. Weinhart, Pat. No. 1,419,528; June 13, 1922. Electron Discharge Device.

A three-electrode thermionic device is described having a pair of plates rigidly connected by wires 28 and 29, and a pair of grids supported by wires 24 and 25 at the top of a standard 3. These wires permit longitudinal movement of the grid. The filament 4 is supported at the top by resilient wires 12 and 13, which take up any expansion of the filament and insure that it be stretched always. These supports contribute to the reliability of the entire device.

W. Wilson, Pat. No. 1,419,530; June 13, 1922. Thermionically Active Substance.

A thermionic cathode for tubes is described, and a method of making it. The cathode wire is iron or nickel, successively coated with carbonates of barium and strontium. The resulting activity is stated to be comparable to that of a platinum filament similarly coated. In order to manufacture it, an iron or nickel wire 3 is enclosed in an evacuated vessel 4, in which is located coating material 2 near the wire. Simultaneous heating of the wire 3 and of the material 2 causes the sputterings of the material to adhere to the wire.

C. D. Ehret, Pat. No. 1,419,547; June 13, 1922. Electronic Apparatus.

A thermionic device is described, including a vessel, the upper portion V of which is entirely separated from the lower portion V by a thin plate K forming a cathode. The elements F, G, and K in the lower portion operate as an ordinary 3-electrode device. Due to the thinness of K, however, and to the fact that it is coated with electron discharging material, the impinging of electrons on the lower surface of K causes the upper surface to emit electrons and thereby cause current to flow through the primary p. A source *a* may vary the quantity of this current by varying the potential of grid G, with respect to cathode K, or the quantity may be varied by the microphone arrangement m, or both means may be utilized.

H, W. Nichols, Pat. No. 1,420,055; June 20, 1922. Selective Receiving System.

In order to prevent interference from a strong station having a frequency near that of the station from which it is desired to receive, detector tubes 3, 6 and 9 are arranged in tandem, so that they transmit even harmonics of the carrier wave. It has been found that such tubes produce even harmonics in the plate circuit, and this property is taken advantage of. Thus circuit 2 is tuned to fundamental frequency, while circuits 4 and 6 are tuned to the first even harmonic. Circuits 7 and 8 are tuned to the second even harmonic. The process may be carried on until sufficient selectivity is obtained.

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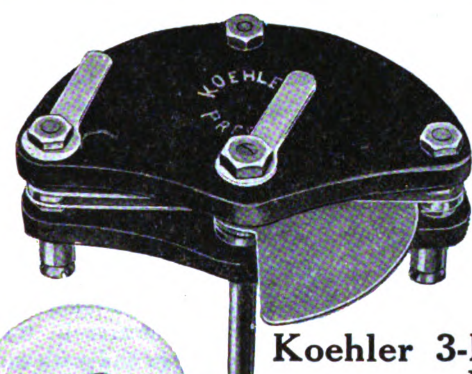

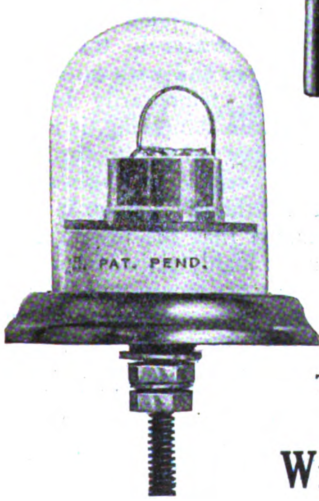

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Heavy aluminum plates, thick Bakelite ends, other parts of brass, nickel-plated .000075 MFD capacity. Accurately manufactured and carefully tested. Koehler Condensers have made good. Also made in other sizes.

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GREWOL Crystal Detectors

No trouble selling this fixed detector. Stays adjusted. Guaranteed tested crystal in dust-proof glass cup.

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Test our service with a trial order of these two standard sellers.

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Wholesale Only

Write for Attractive Discounts on Our Complete Line

Wholesale Radio Equipment Co.
24 WILLIAM STREET, NEWARK, N. J.

PROFESSIONAL RADIO OPERATOR

Continued from page 14

Francisco every spring in the Alaskan salmon-fishing fleets to operate the fishing companies' land stations up in the Bering Sea and Alaskan Peninsula canneries. Since each salmon cannery relies wholly upon its wireless equipment for communication with the other canneries and with the outside world (via the Alaskan naval radio stations), the radio stations are regarded as very important units, and the fishing companies are therefore generally at pains to get experienced operators.

As these cannery stations are isolated, the operators must be competent to maintain and repair their own equipment, as well as operate a gasoline or Diesel engine. The radio men are taken up to Alaska with the fishing-crews on old-time sailing ships, or sometimes on small steamers, departing from the Pacific coast in April and returning in September—except that in some of the fisheries on the Pacific side of the Alaskan Peninsula, the operators stay the year round. The salaries paid to the radio men in these stations range from $110 to $160 a month, with food served in the superintendent's mess, a comfortably furnished shack, and plenty of free coal. During four years of the time when the dishwasher wages prevailed at sea, I made this region my stronghold; and being therefore extremely well acquainted with it, I advise no one to go into the Bering Sea country who does not have a thirst after adventure and is willing to suffer hardships. It is a place, however, where money can be not only made, but kept.

THE RADIO OPERATOR'S FUTURE SALARY

WITH international affairs and world commerce in their present chaotic condition, and with universal industrial unrest, temporarily lulled by war wages, again fomenting, it is as difficult to forecast what the future will bring to us in regard to wages as in regard to other things—though it may be safely assumed that the more technical and the more highly skilled a profession becomes, the more secure will it be from unfavorable change. Viewing the radio situation from all angles—and barring another great war, which of course is improbable just now—I think that the prevailing shipboard operator's salary during the next six or eight years will be about eighty dollars a month, and the land-station operators' $135.

One thing is sure: the radio operators' wage will never again descend to the scullery-boy stipend of 1914. This is as nearly an impossibility as anything can be. Under present conditions, with an ethereal inferno of interference to contend with, and with careful radio compass work being constantly required,

Continued on page 52

Mt. Tamalpais, California, whose rugged slopes and lofty summit are plainly visible from the plant where Parkin Parts are made

SINCE 1914

Your dealer is glad to have you choose PARKIN *"Peak of Perfection"* Parts and Supplies—he knows he can stake his reputation on them. For PARKIN Parts are produced by *experienced* radio manufacturing—*PARKIN since 1914*. That is the dealer's assurance of dependability as well as your guarantee of perfect satisfaction. To be sure of getting *"Peak of Perfection"* quality, demand PARKIN every time you make a radio purchase. The price is no higher. Send us your dealer's name and we will send you FREE, postpaid, the PARKIN *"Radio Buyer's Guide"* (No. 6).

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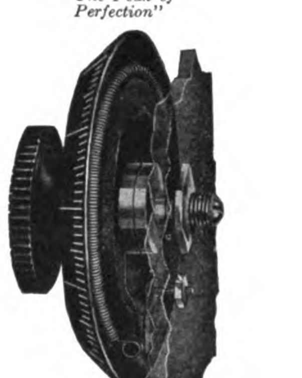
panel or table mounting—$1.00

—for maximum insulation. Moulded of genuine Bakelite, highly polished; contact fingers, binding posts, screws, and washers nickel plated. Base 2¼" by 2¾", marked for proper connections. Price includes screws for panel mounting, and holes drilled for table mounting. *Order No. 78—price $1.00.*

"The Peak of Perfection"



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PARKIN Dial Type RHEOSTAT

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The resistance element is mounted in a recessed groove in the back of a 3-inch moulded Bakelite dial, which saves you the cost of an extra part, gives you more cabinet space, and eliminates resistance heating from inside the cabinet. An off position is provided and a stop on the dial engages the stationary contact at the extreme positions. 360° rotation insures fine adjustment, and a brass bearing insures true running. Figures and graduations filled with brilliant white enamel. Brass parts nickel plated. Dial and knob both of die-moulded Bakelite. Resistance 5 ohms, carrying capacity 2 amperes. Only two panel holes required for mounting. Instructions with each instrument. Order *No. 77—price $1.75.*

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A dial whose easy action, smooth running and positive accuracy make tuning a real pleasure. A dial which we believe is worthy the name of PARKIN and the years of radio manufacturing behind it. A standard dial of moulded Bakelite highly polished. Graduated from 0° to 180°. The graduations read from right to left for clockwise rotation, and are filled with brilliant white enamel for easy reading. The knob is of moulded Bakelite. The brass bushing is moulded into the dial to insure easy action and true running. The set screw penetrates both the bushing and the knob. Drilled for either 3/16 or ¼ inch shaft. Order *No. 767—price 75c.*

"The Peak of Perfection"

PARKIN Fixed Receiving CONDENSER—70c

Regulation type for use with receiving circuits. The binding post screws are soldered to the unit, and with the unit moulded solidly into an unbreakable Bakelite base, making a sturdy and attractive one-piece instrument. *Order No. 58—price 70c.*

DEALERS and JOBBERS: *We want to hear from every radio dealer who has the foresight to realize that he must sell quality and give service to build a profitable business. If you are that kind of a dealer, write us, we have something for you. Ask for Catalog No. 6.*

Parkin Mfg. Co.

San Rafael, Calif.

Continued from page 50

radio operating has been placed beyond the abilities of the one-trip tourist and the "cheap" operator. But this is only one point.

The ship-owner, learning at last that there is no more occasion for renting a radio set than there would be in leasing the ship's engine or anchor-winch, is discarding leased wireless apparatus and buying his own. And then, since the set belongs to him, he expects his operator to maintain it for him; he expects the operator to make repairs and adjustments; and, in short, to handle the ship's radio department as the chief engineer manages his, and the chief steward his.

Even in the case of the leased wireless sets, of which, it is true, there are still a good many, especially on the Atlantic, the upkeep of the radio equipment is passing more and more into the hands of the operator. The Shipping Board, who are owners, not leasers, of their radio apparatus, furnish several hundred dollars' worth of spare parts and tools, and expect the operators to maintain their equipment.

This obviously requires a more competent and in turn a better paid operator than was formerly employed. Under the old regime of the leasing companies, the wireless operator was truly a mere thrower of switches and a key-puncher. A company inspector in every port made every trifling repair and adjustment; the finding of a pair of privately-owned head telephones anywhere in the wireless-room—even among the operator's private belongings—was the occasion of a severe reprimand; and the foolhardy brasspounder who, failing sufficiently to reverence the bit of dusty gravel in the crystal detector, dared to employ his own private piece of tried and true galena, if caught, was made to feel as if he were the perpetrator of some dastardly crime. Today, all is changed; so vastly changed, indeed, that it is sometimes hard to remember that the old order ever existed. The modern radio operator not only is allowed to be in full charge of his station, but is expected to be.

In view of all the foregoing, and considering the certain rehabilitation of the radio men's protective associations, which were almost wiped out during the 1921 strike, it may seem to some that the operators' salaries should increase rather than decrease; but in this I can hardly agree. If the reader does not agree with this, he will at least admit that the ship-owners are not going to pay anything more than they find necessary to obtain sufficiently good operators.

COMPENSATIONS FOR MODERATE SALARY

IF the shipboard radio operator's salary is modest, there are, at any rate, many compensating advantages. He has his meals with his fellow officers and the captain; and his accommodations are of the best. The food supplies put aboard ship are usually of excellent quality—though they are sometimes indeed hodge-podged by incompetent cooks who missed their calling as concrete-mixers. This is the exceptional case, however; and in general the meals, service, and accommodations furnished the radio operator aboard ship would cost him fully seventy-five dollars a month ashore.

On the freight and oil-carrying ships, or on any vessel carrying but one operator, the wireless man's duties are very light, his traffic being mostly confined to messages concerning the movement or operation of his ship. Although he may be at his apparatus at various hours of the day and night, he is not confined to his instruments by specified watches. Even in cases where watches are specified, they are not at all onerous.

When approaching land in foggy weather, necessitating frequent radio-compass bearings, or when putting through important messages at great distances and under difficulties in the form of interference, static, and inefficient coastal station service, the operator may be obliged to put in a good deal of time at his set; but in the general run of things, his number of actual working hours daily need not be more than from six to eight. The wireless operator necessarily does most of his work at night, being up usually until midnight or sometimes later; but then he can sleep luxuriously until nine or ten o'clock in the morning—which is a privilege denied at least to milk-wagon drivers.

It will be seen that the radio operator has a great deal of spare time on his hands; and this he can devote to reading and study. Many, however, instead of taking advantage of their splendid opportunity for self-improvement by such means, choose rather to idle away their leisure hours in card-playing and other things of no account; and some again are veritable Rip Van Winkles, with a narrow trail worn in the deck from their napkin-rings to their bunks. A good many ambitious young operators, on the other hand, are subscribing to correspondence school courses in electrical engineering and other high professions; and while it is granted that such work can not be mastered solely by correspondence school training, yet companioning with good books and a little earnest study will do wonders.

PASSENGER SHIPS LESS DESIRABLE

IN the foregoing, only the position of the operator on the freight and oil ship has been presented. In the case of the passenger liner, the wireless operator's working conditions are in some respects a great deal less pleasant. The large Shipping Board passenger ships carry three operators, but the great majority of the passenger steamers carry only two; and since a continuous watch is legally required on such vessels, this means that each operator must put in twelve hours at the apparatus every day, usually in two six-hour shifts.

On the smaller passenger ships, the watch is mostly a mere matter of listening in, and here it is still possible for the operator to do some study work; but on the great liners there is a constant and heavy message traffic to be handled, and a large wireless newspaper to be prepared, which leaves no leisure time. It is a peculiar fact, too, that despite the vastly greater amount of work that must be done on the passenger liner, the remuneration on these ships is in no case more than fifteen or twenty dollars a month above the salary of the operators on the freighters and oil-tankers, and as a general rule the rate of pay on both kinds of ships is exactly the same. The passenger-ship operator receives a commission on wireless newspaper sales; but then again he is compelled to buy expensive uniforms, which the tramp-steamer operator does not have to wear. The cash bonuses formerly paid to passenger-ship men for commercial traffic handled have long since been discontinued.

There is one privilege enjoyed by both the tramp-steamer and the passenger-ship operator that is common to no other member of the ship's complement; while his vessel is in port he has no duties whatever aboard. He is free to put on his other shirt and shove off ashore to follow his own individual bent, whether it be ice-cream sodas or flirtations in the park. Herein lies an immensely valuable educational advantage peculiar to the radio operator; his profession enables him to become intimately acquainted with foreign countries and peoples, which others spend thousands of dollars merely to visit.

RADIO FREQUENCY AMPLIFICATION

Continued from page 16

Where quality of reproduction must be retained at all costs, the answer seems to be multi-stage untuned amplification. This means a large outlay for tubes, for with most present tubes the amplification from a single stage is not great. There is the possibility of using the same tubes again for audio frequency amplification, which reduces the importance of this factor.

So, now, what to expect from radio frequency amplification?

With care, good apparatus and an expert knowledge of your hook-up, expect an increase in range worth going after, but not phenomenal. After you have made one step "perc," try another.

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RADIO FREQUENCY B AND P Transformer	$5.00 EACH	AUDIO FREQUENCY WESRAD Transformer

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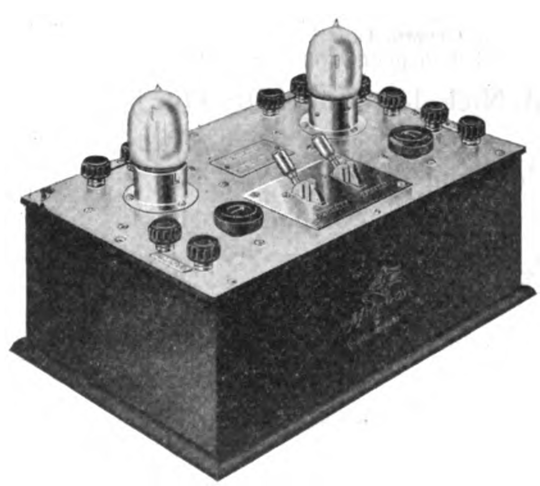

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THE CONSCIENCE SHOP

Continued from page 21

With the generator going steadily, he pressed the key and a large, peculiarly formed lamp bloomed forth with a soft light.

"That is the heart of the instrument —the auditron tube," Walter explained. "When I talk into the transmitter, the auditron tube converts the current into waves which my voice interrupts. These interruptions impinge upon the receiving instrument and are in turn reproduced into sounds. Now for the test!"

"Homer Madsen! HOMER MADSEN! HOMER MADSEN!" he said distinctly, each time with increasing loudness. There was a slight flurry of light particles in the lamp and that was all.

At the moment Walter turned on the auditron tube, Madsen, comfortably attired in his dressing gown and Chinese slippers, was following his nightly custom of dipping into a book before retiring. He was in the act of lighting a fresh cigar when, without warning, a voice spoke to him, coming, as far as he could determine, from nowhere at all.

"Homer Madsen! HOMER MADSEN! HOMER MADSEN!" it said distinctly.

Madsen jumped from his chair with a startled exclamation. The room was empty, save for himself. Through the half-opened door he could distinctly see the interior of his bathroom. The adjoining library was also unoccupied. The butler and other servants he knew were on the lower floor. Could it be that he was dreaming?

"I must have fallen asleep," he said to himself. He glanced at the clock; it was just 11. He had been home half an hour—more tired, probably than he realized. He would go to bed.

He had just removed his dressing-gown when out of thin space the voice spoke again.

"Homer Madsen!" it repeated.

Madsen halted. A cold chill crawled up his spine and into his hair. The cold perspiration began to start out all over his body. Slowly he turned his head and looked about the room. It was absolutely empty.

"Homer Madsen!" The voice was speaking again. There was a queer, incisive, metallic quality about it. "You are a crook. You have helped Marcus Waterford rob those who trusted in you and your company. You alone have been responsible for the juggling of the Development Oil stock. You must return that money. You will hear from me again!"

That was all. Motionless, hardly daring to breathe, Madsen heard the indictment through to the end. He stood frozen to the carpet, a figure of abysmal terror. He knew that he was awake,

Continued on page 58

"Northern Radio will supply it"

The above caption has become more than a trade expression. Every one who has ever placed an order with this house, regardless of how small, has realized the above statement. The slogan, "Northern Radio will supply it," has been broadcasted far and wide. We are not only living up to it—we are building our business around it.

Below we have listed a few of the many quality radio items upon which we can make immediate deliveries. Our stock is complete and is not devoted principally to any one manufacturer. Write or wire us your radio needs. Realize the pleasure as well as the profit of dealing with a house that can actually make deliveries.

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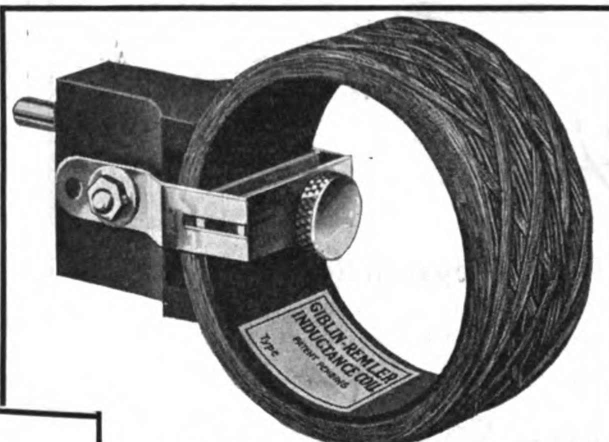
TYPE "C"
Loud Speaker Units

Price $7.75 each

Immediate Delivery



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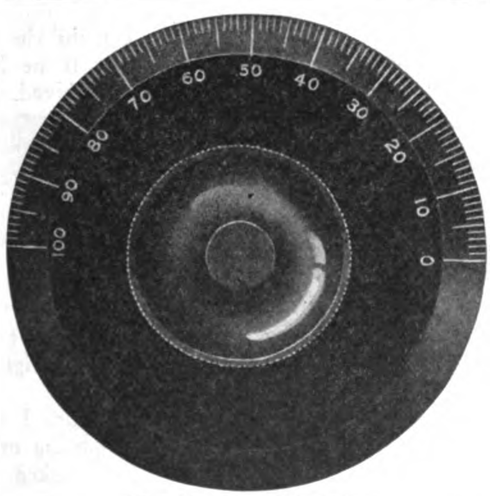
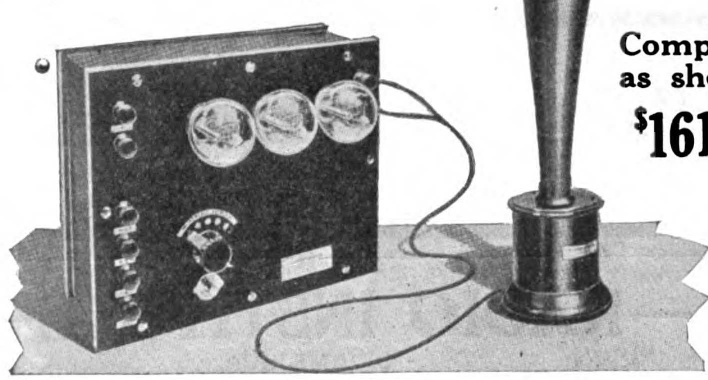
All sizes from 20 to 1500 turns



Remler Type No. 100
3-inch Bakelite Dial with Knob and Bushing
Price 75c

Western Electric 3 Step Power Amplifier. There is no distortion of signals and for true reproduction it has no equal.



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2512

Continued from page 56

and that a voice had spoken to him out of space. A voice that threatened him with—what? His eyes roved about the room. There was nothing to explain it—absolutely nothing.

In a sudden reflex of fear he rushed across the room, stumbling like a drunken man. He pressed the call-bell and continued to press upon it until he brought the butler tumbling upstairs with the other servants at his heels. They found Madsen in a towering rage in which fear mingled closely with the simulated anger.

"There is someone in this room—someone who has threatened me," he roared at them. "Find him—find him. Look around, can't you? Don't stand there like a bunch of dummies. What do I pay you for?"

Obediently, not understanding what it was all about, the butler and the others began to poke about the apartment, peering into the closets, behind doors, under the bed and chairs. Their efforts brought them nothing. They returned to where Madsen, with shaking hands, was pouring himself a drink from the cut-glass decanter, and reported that no one was to be found.

"Tell the chauffeur to get out my car," he snapped with sudden decision. "I'm going to the club."

Ten minutes later he hurried from the house, and snapping the order to his astonished driver, sped toward the city in defiance of all traffic regulations.

While this drama was being enacted at Madsen's home, Walter and Katie, in the offices in the Mainwaring building, were almost hugging each other in pure joy. Walter was certain the experiment had worked. But if he had needed any proof of it he received it a few minutes later when in answer to a telephonic question of the exchange operator at the Papyrus Club, he received the assurance that "Mr. Madsen has just come in, sir."

"I'd give a fortune to look at his face," said Walter, as he turned toward Katie with the information that they had succeeded in driving Madsen from home. Katie laughed in delighted assent.

"I think we had better—or, I had better—go now. There is nothing more to do tonight, is there?" she asked.

"No," Walter cheerily replied. "We've ruined Madsen's rest for one night. However, that's not the big thing. We have begun to drive the idea home. And Madsen is not the only man who has been startled when brought face to face with his conscience for the first time!"

HOMER MADSEN faced the following day with a strange admixture of emotions. For one thing, he had

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been rocked to the foundations of his being by the strange occurrences of the night before. Had anyone tried to convince him that a voice could speak out of thin air and threaten him with some mysterious punishment for some connection with a business transaction, he would have laughed at them. And yet there was within him the still small urge of that mysterious something which Rivers had called conscience, which told him that the voice was right.

The manipulation of the Development Oil Company's stock had been a wholly unnecessary market gamble. He knew it; so did Waterford. It was merely one of those things that are done from time to time without excuse, to add to the revenues of the men who had the power and knew how to do them. Yet, without hesitation he had given the word that had sent securities cascading downward, to the financial loss of thousands of minority stockholders.

Buried beneath the activities of his daily routine was the realization that such manipulations were fundamentally wrong. But Madsen had grown calloused. He had pushed that realization aside, and as the days went by, continued pushings aside had made the task easy. But now, that strange, inexplicable voice had brought realization of guilt back with startling emphasis.

Waterford dropped in later in the morning to find Madsen locked in his office and pacing the floor in a frenzy of worry.

"Hello, Homer," was Waterford's greeting. "What's the big idea? Something gone wrong?"

"Yes—everything," said Madsen. He dropped into his chair. Waterford noticed that his hands were shaking. Something inside of himself began to grow tense.

"Explain," said Waterford nervously. He had never seen Madsen in this state before.

Madsen did explain. Without any attempt to be graphic he told Waterford of what had happened in his bedroom the night before. At first Waterford was inclined to laugh at the whole thing. But when Madsen repeated the conversation about the Development Oil Company and the voice's threat to return again, he grew serious.

"Hum!" Waterford rubbed his chin and stared out of the window. "Why don't you call in an agency man?"

Madsen glanced up in surprise.

"By George!" he exclaimed. "That's an idea! I didn't want the police in on this. The agency would be better."

He picked up his telephone and called a number, explaining to the head of the agency that handled the bank's private affairs that he wanted a man for a special case.

Continued on page 62

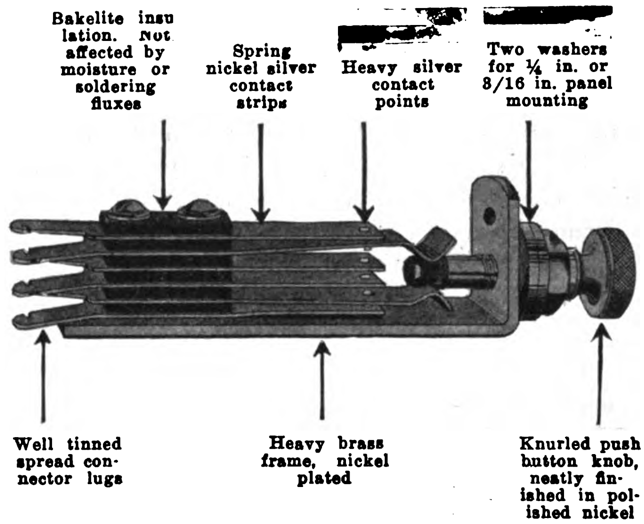
New Victory Selector Jack

Patent Applied For

Eliminates Cumbersome Parts

Simplicity and ease of operation outstanding features:

The new Victory Selector Jack marks an important advance in radio simplification. Its use entirely eliminates the common radio plug and also the last jack in amplifier sets, resulting in increased efficiency as well as simplification. Like all Victory Radio equipment, it is of best quality, handsomely finished.



Operation of Victory Selector Jack

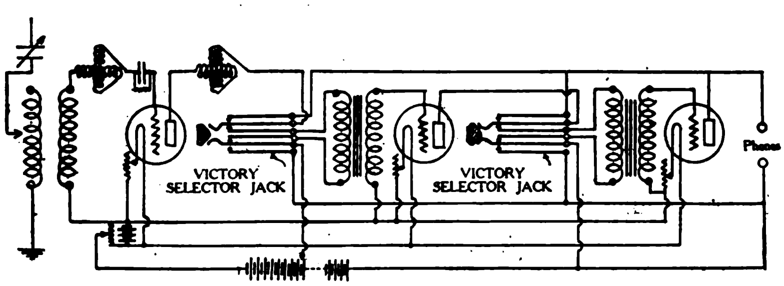
To obtain the range of selectivity of a set merely press the button! Nothing could be simpler! No cords or wires in front of panel to annoy! No plugs to jerk in and out! Fewer holes to drill in panel!

In diagram (below) of detector and two stage amplifier set, two Victory Selector Jacks replace the three jacks and one plug ordinarily used. One is placed between detector and first stage; the other between detector and second stages; last stage being connected to output binding posts, resulting in **Simplicity! A Saving of Expense! Improved Control! And Most Important—No Plugs to Buy.**

To listen in on the detector, press first button, automatically disconnecting everything beyond detector, then to select detector with first stage of amplification, press other button. Full output of set is obtained by leaving both buttons in "out" position.

Victory Selector Jack can be used in any circuit using standard radio jack, without changing connections. Victory Selector Jacks are also made for single or double automatic filament control.

Simplify your receiving set with Victory Selector Jacks!



PRICES

No. 300—Double Circuit	**$1.50**
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No. 302—Double Filament Control	**1.75**

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VICTORY RADIO-ELECTRO CO. · THE SEAL OF PERFECTION · V

Continued from page 60

"I can't figure what is back of this thing," Madsen remarked while they were awaiting the operative's arrival. "The big puzzle is how the voice trick was worked. For all you know there might have still been a person in that room. And that being the case, it occurred to me that—well, suppose he got close enough to take a shot at you if he felt like it. Do you get me?"

Madsen sprang to his feet.

"Confound you, Marcus," he said. "Why do you tell me those things? Isn't this situation bad enough without that sort of nonsense?"

Waterford shrugged his shoulders.

"I was only trying to help," he said.

"Well, you've helped a whole lot—I don't think!" growled Madsen petulantly.

Further conversation was interrupted by a knock and the entrance of the man. He proved to be a heavy-set, squat individual of the unimaginative type, by the name of Neal. Madsen looked him over approvingly. He was just the sort of a man to put on a case of this kind—one who would not be worried by mysterious voices and such things.

Drawing up a chair, Madsen motioned Neal to a seat and in a few crisp words explained what had happened.

"I want you to go out to my house and give it the 'once over' from top to bottom," he said. "There is some funny business about this somewhere. You and I both know that it is impossible for there to be a voice without some person to make it. Find that person. That is your job. And if you don't find him, stay there till I get home."

KATIE and Walter met by appointment in the latter's office shortly before 11 o'clock that night. As on the previous night, Katie had kept vigil over the Papyrus Club in the curtained machine until Madsen came out, following him only long enough to be sure that he was headed toward Cloyn Court. She found Walter in ebullient spirits.

"I saw Madsen today," he began without preliminary. "He is one worried old codger. Don't tell me that a hand-made conscience will not bother a man as well as the real article, once you get it tuned up right."

"I'll admit it is more merciless," Katie laughed.

She pointed to the clock. Walter nodded. It lacked two minutes of the appointed hour. He ran his fingers over the various switches, testing them out. Then he took a long breath.

"All right, Mr. Madsen," he said softly. "Here goes your second lesson in the art of being honest."

THE Naval Radio station at McNear's Point is one of the most important on the whole Atlantic Coast. It constitutes, in effect, one of the nation's most valued "listening posts." There are always trained operators at the instruments listening to the ceaseless drone of the whispering "waves" that oscillate perpetually across the spaces of the uncharted etheric ocean.

For this work "ZZR" was specially equipped. It never speaks to other stations, for it possesses no transmitting apparatus. Its duty is to hear and record silently and accurately the mysteries of the day and night. These are "logged," hour after hour, converted into official reports and dropped into the mail. To the assiduous alertness of this lonely shoreline post has been due much of the Government's understanding of European problems that would otherwise have remained inexplicable.

At 11 o'clock on the night of Walter River's second conversation with Homer Madsen over the air, Green, the night operator at "ZZR," was sitting with his feet cocked on the table amid the sensitive audions and amplifiers, the head-telephones of the set clamped over his ears. It was his customary attitude, for there were many lonely hours when commercial business chattered through, that he had little to do. Suddenly, into the murmur of it all there came a half perceptible stillness—a breathless "sound-pocket" with the queer indefinable dissonance of an empty room. To the operator it meant one of two things—an arc-station getting ready to work or a wireless telephone.

He gave the knob of his variable condenser a turn, cutting in the intersecting plates that shortened the wave-length down to an approximate zero. As the antenna reduced electrically he caught a faint sound—a voice speaking over the wave from some small radio station:

"Homer Madsen! Homer Madsen! Homer Madsen!" it said.

Green glanced at the calibration on his instruments and then up at a chart over his head. The scaling showed the wave-length to be shorter than the average amateur station—less than 100 meters, in fact. Probably a "non-antenna" set or one working from a small indoor aerial, he reasoned. He squinted thoughtfully at the dials before him and "petted" the glowing audions into further sensitiveness.

Homer Madsen! He racked his brain—oh, yes. The president of the Citizens Trust Company. Was he going in for radio? It seemed hardly credible. Yet why this faint call on the night?

A hollow rectangle of wire hung directly over the operator's head—the radio-compass of the Navy—a ship-finder that told to the smallest fraction of a degree the direction from which signals came. On an impulse the oper-

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ator cut the instrument into his circuit with a small switch, pivoting the rectangle on its own axis and watching the compass indicator that marked the direction.

"Homer Madsen!" came the voice again. Green turned the rectangle until the signals came quite clear and distinct, the pointer indicating a direction north-northeast of "ZZR" station. With his finger on the audion's control grid he sat tense and silent.

"You must return the money you have taken. It is now Wednesday night. If you have not taken steps to do this by Saturday morning the vaults of your bank will be blown open at midnight. I mean business. You will hear from me again tomorrow night at this hour. That will be your last warning."

After a moment's indecision the operator picked up his telephone and called the private number of the "Morning Blade." With the paper finally on the line he asked for Carter in the local room, a personal friend and the "star" man on the sheet. A second later he had Carter on the wire.

"This is Green out at 'ZZR,'" he said.

"Oh, yes," came Carter's voice crisply. "What's on your chest?"

The operator dropped his voice.

"Something odd," he said quickly. "You have been hounding me for a story for some time. I think I have one for you at last. As this is not a government matter I have no hesitancy about giving it to you. Listen!"

Rapidly he poured into the newspaperman's ears the conversation he had just heard, reading from a pad on which he had copied it down.

"I put on the compass," he explained, "and I got a N-NE reading. That places the transmitting station somewhere in your city, as I make it."

Carter gave an exclamation.

"Bully!" he said. "Looks like you picked up a live one this time. How far away do you figure that was?"

"As near as can be determined from the strength of the signals and the wave-length used, I would say about fifteen to eighteen miles. It would be impossible to work much farther with a radio wave-length that short."

"Good work," Carter replied quickly. "I am much obliged to you. I'll go right after it."

He banged up the receiver and rushed into the office of his city editor, to whom he explained what Green had told him. The latter came to life instantly.

"What is the best bet on this?" he asked.

"Martin Brady, chief of police," said Carter. "I figure that Madsen, if he knows about this, will beat it for Brady's house for a confidential interview. I know that bird and he always wants to work underground like a mole."

"All right," said his superior. "You slide for Brady's. I'll shoot Blain to the Madsen house and tell Hemhill on the police run to watch the Central Station. Have we got this exclusively?"

"As far as I know," said Carter.

"All right. Hump! I'm going to smash up the front page and hold for a makeover. You flip what you get on the wire and we'll bump the world with a headline that will make it sit up."

Carter was off on the instant, with Blain at his heels. Behind him he heard the speaking-tube whistle and the machinery of a special extra start to whirr.

WHILE all this was taking place much was transpiring in the apartment of Homer Madsen, banker. Madsen reached home from the Papyrus Club about 10:30. He was not in a pleasant frame of mind. The possibility that the voice would repeat its performance of the night before did not add to his peace of mind, however, he had resolved that he would not be deterred by it.

The detective was half asleep but managed to wake himself up and appear alert when Madsen came in. Together they went directly to the banker's apartment.

"If the voice is on the job it ought to start pretty quick," Madsen commented with a glance at his watch.

The detective was in the act of sitting down when without preliminary there came the same weird, hollow inhuman enunciation of the banker's name that had taken place the night before, apparently out of the very center of the room.

"Homer Madsen!" it said distinctly, three times.

The detective stared at the banker in amazement. Then he peered around the room. The voice continued, repeating the message as the operator at "ZZR" had copied it.

"My God!" exclaimed Madsen in sudden panic.

He began to back around the room, turning fearful eyes in all directions, his first terror clutching at him with icy fingers. The agency operative turned white and gripped the edge of the table. Then he pulled himself together and began to search through the apartment. After fifteen minutes of it, during which he thoroughly covered every available hiding place, he turned on the banker.

"I give it up," he said. "This is a police job."

"But, but——" protested Madsen.

The operative turned a cold and cheerless eye on him.

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"But nothing," he said. "I'm through. I'm a good guy on a mystery. But I ain't no spook hunter. Good night!"

He left Madsen standing on the rug in front of the fireplace and went out into the night.

The banker, after a moment's hesitation, jerked his overcoat from the chair over which he had thrown it, and called to the butler, who had been an interested spectator of the detective's departure.

"Get the machine," he ordered. "I'll have action on this some way."

WHEN the machine in which Carter of the "Morning Blade" had negotiated the residence of Chief Brady on record time, swung up to the curb in front of the police head's house, it found another car before it. Carter glanced at the monogram "H. M." on the door of the limousine and whistled softly to himself.

"Just in time," he muttered.

He ran quickly up the steps and touched the bell. A sleepy servant girl answered.

"Carter of the 'Blade' to see Chief Brady," he said quickly.

"The chief's busy," said the girl.

"I know it," said Carter. "We're all together—or will be in a minute."

The girl gave back and he stepped inside. The hum of voices and a crack of light drew him to the end of the hallway. He pushed open a door to find Chief Brady in a dressing-gown in close conference with a man whom he knew instantly for Madsen, the banker.

"Good morning, gentlemen," Carter greeted cheerfully.

Madsen paused with his arm upraised and glared at the intruder. The chief nodded in surprise.

"Carter of the 'Blade,' Mr. Madsen," he introduced.

The banker jumped to his feet.

"I do not wish to be interrupted," he snapped.

"Neither did the chief," retorted Carter without hesitation, throwing his hat on the table. "But when a bank is going to be blown open, the circumstance rather interrupts everything, doesn't it?"

The chief gave Carter a quick look. The banker's mouth opened.

"What the devil do you know about it?" he demanded.

"Lots—and nothing," replied Carter good-humoredly. Then he became serious. "To be accurate, we have the message whispered to you tonight, just as you got it. I figured that you would come here, and here you are. I have an edition going to press and I want a few facts, that's all."

Madsen glared at him in speechless wrath.

"But I want no publicity," he said.

"Sorry," said Carter, "but you haven't anything to do with it. The story is public property. The only thing to do now is to be graceful about it and give me the rest."

"Damned if I will," said Madsen. "I came here——"

"Sure—I know," said Carter easily. "You wanted some underground wires pulled. What that voice said about the Development Oil Company wasn't nice. But that can't be helped. You fellows juggle stock, don't you? Very well. You've got to stand the consequences."

"Where did you get your information about the—the message?" demanded Madsen.

"That is a question no newspaper ever answers," Carter replied. "However, I will say this: it came from a radio man. He put a compass on it. He says it comes from somewhere about the city here."

The chief studied Carter thoughtfully. He had been in office too long not to appreciate the value of a reporter's tip. Besides he was a careful, conscientious man who had won his position through hard, painstaking work.

"That puts it up to us, all right," he said slowly. "I wonder just how far that message goes."

The banker stared at him.

"What do you mean?"

"I mean I wonder how far somebody is going to go as regards blowing up your bank!"

"You think it is as serious as that?" Carter asked.

"I didn't at first. I was trying to convince Mr. Madsen that some crank had fixed matters up to annoy him. Now I am beginning to believe there is something to it."

"Oh, my Lord!" Madsen groaned, burying his face in his hands.

"Then," said Carter decisively, "the wider we tear this thing open, the safer the bank is going to be."

"How do you figure that?" the banker asked quickly, raising his head.

"Publicity will turn the city into eyes and ears," Carter explained. "Everybody will be on the lookout. Some one may get a valuable clue or remember a face or a remark. It turns the world into a detective force. Every man, woman and child will be at work on it by morning. Isn't that correct, chief?"

Chief Brady nodded. He had seen it work before.

"I think so, especially in this case," he said. "I think if I were you, I would tell Mr. Carter all the facts and let him go to it. You know it is one thing to catch a criminal after a crime and quite another to prevent him from perpetrating it in the first place. This latter is what we have to do."

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Madsen nodded. He saw the psychology of it. Without further remonstrance he repeated all he knew about the affair to the newspaperman.

Long after Carter and Madsen had departed the chief sat in his study and smoked thoughtfully. He knew something of Madsen's record as a financier and his reputation for ruthless market smashes that brought disaster on all sides. Such a man was bound to have many enemies and it was not surprising that some one had demanded a reckoning.

"The wonder is that it has not happened before," he told himself.

THE following morning Walter Rivers, proprietor and manager of the "Conscience Shop," came down the front steps of Mrs. Parker's place in an amiable frame of mind. His plans were working out nicely and it gave him a feeling of optimism as to the final outcome of the scheme. He bought a paper from a passing newsboy and on the instant the joy was blotted out of life.

"Banker Threatened!" read the headlines. "Mystery Voice Hurls Threat in Madsen Home!"

Walter read it through, vivid with the colorful exaggeration of a street edition. As he read his jaw set. So Madsen was going to fight! He had called in the police. He was prepared to "see it through to a finish," he had said. He refused to be blackmailed by anything of that kind! If "they" thought "they" could blow up the bank, "let 'em try it," he said.

Walter stuffed the paper in his pocket and strode up the street, his face grim. At the office he locked himself in his laboratory. Katie found him there later, enveloped in an apron, with the air filled with the odor of strange chemicals. To her request to be admitted Walter returned a terse "Not today!" Something in his manner made her drop any insistence. After a bit he came out, wiping his hands.

"Katie, girl," he said, and it was the first time he had ever addressed her so. "We are going to play with fire tonight. The situation has changed. Madsen has inducted the police into this and every move we make from now on is dangerous. As it stands today, there are thousands of trained detectives and eager citizens on our trail. Whatever we do from now on is under the chance of exposure, detection and arrest. Don't you think you had better get out of this mess before something happens?"

Katie shook her head.

"If it has become dangerous, Walter," she said, "why don't you pull out also? I have been afraid from the beginning——"

Continued on page 70

MU-RAD

BROADCASTING RECEIVERS

(Patents Pending)

TYPE MA-12

TYPE MA-12

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification and detector.
PRICE: With 2 telephone plugs, $128.00.

TYPE MA-13

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification, detector and two stages audio frequency amplification.
PRICE: With 2 telephone plugs, $160.00.

TYPE MA-13

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IN appearance these sets exemplify the art of the finest woodworkers, machinists and laboratorians. Their details of design and construction conform to the highest engineering standards. Complete instruction book is furnished with each set and each is tagged with our guarantee against defects. Bulletin No. 13 on request.

DEALERS: WRITE

MU-RAD LABORATORIES, Inc.

800 Fifth Avenue, Asbury Park, N. J.

Continued from page 68

"Because there is something yet to be done," the young engineer said quickly. "There is a wrong to be rectified. That can only be done by Madsen himself. Until his conscience tells him what is right to do, I have got to keep driving the lesson home. Sooner or later he will understand this himself. Then the lessons will be over. Until then——"

Katie smiled—a very brave little smile.

"I guess I'll—stick too," she said simply.

Walter's eyes glowed.

"Katie," he said with a catch in his voice, "you're a—a brick!"

He sat down beside her and outlined in detail what that night's work would comprehend. When he had finished they parted for the day, Katie expressing the intention of spending it for the most part in the open air. Walter returned to his laboratory and for the rest of the hours that followed until sundown the office of Walter Rivers, engineer and contractor, remained empty and deserted.

At 10:45 that evening the telephone bell rang insistently in Walter's office. Walter, who had been pacing the floor like a caged animal with a thousand fears for Katie's safety whipping him into a nervous frenzy, jumped for it. It was Katie herself on the wire, quite all "right" and a bit excited.

"Is everything all set?" Walter asked quickly.

"Yes," she said breathlessly. "Mr. Madsen and three men—one of them grey-haired and heavy-looking — just went into the house. The heavy man I think was the chief, at least he looks like the picture you showed me. The other two I have never seen before, but they looked like policemen in citizens' clothes."

"Central office men," Walter replied.

She hung up the telephone and Walter with a glance at the clock, sat down beside the wireless telephone and opened the switch to the generator.

At that precise moment the banker with Chief Brady and two central office men was standing beside the library table in his apartments. He was explaining in detail just what had happened on the previous nights.

"It was right here, I think," he said, pointing to his chair. "I recall placing it so that I could get the best light from the lamp——"

"Good evening, gentlemen!"

The words boomed into the room like the report of a cannon. The little group jumped. Madsen's face went white and he staggered back against the table.

"My God! There it is now!" He blurted out the words in a quavering voice.

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Federal
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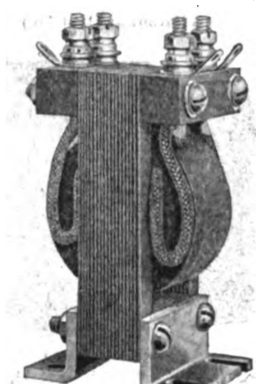
THE WORLD'S STANDARD



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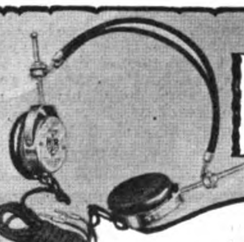

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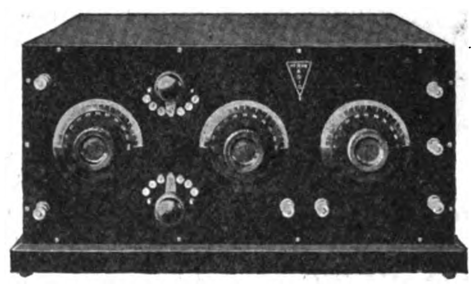

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Continued from page 70

The detectives looked at each other, at Madsen, the chief. The latter was in the act of raising a cigar to his mouth. His arm halted half-way and he stood in an attitude of close attention.

"This is your last warning, Homer Madsen! As I told you last night, your bank will be shattered Saturday night if you do not take steps to rectify the wrong you have done the stockholders of the Development Oil Company. Nothing can prevent it—not even Chief Brady or the central office men beside you. I mean business!"

The words ceased. Madsen, a picture of abject terror, stared at the chief with twitching face. The detectives shifted uneasily and peered around the room, seeking the source of the sound. Chief Brady pulled at his moustache and scowled at the walls, the ceiling. Abruptly he pivoted on his men.

"Get busy," he said. "Let's find this thing *now*. There is nothing supernatural here. There is an instrument of some kind working around here. The thing to do is locate it."

His words broke the tension. The men went to work with a will. They were of a different type from the agency man and plunged into the task at hand with a thoroughness that aroused Madsen's admiration, frightened as he was. They tore away tapestries, moved furniture, pulled up rugs and carpets and within a few minutes turned the place into complete disorder. Finally one of them knelt on the hearth of the fireplace and turned his flashlight up the chimney. He called out:

"There is something here!" he said.

Instantly Chief Brady was by his side with the other detective. Crouched in the broad open fireplace, they turned their lights up the broad-mouthed flue. In the augmented radiance they made out something that glittered with myriad knobs and switches.

"At last!" breathed the chief. "Get me a pole, somebody."

One of the men ran down to the lower part of the house to return presently with a curtain pole. This he thrust up the chimney several times. Finally he broke one of the wires that suspended the instrument in place. The next instant there was a snap and a loud crash as a complicated mechanism of coils, switches and metal parts burst asunder at their feet and scattered numberless parts over the hearth and across the floor. The chief stood up with a smile.

"Well, Mr. Madsen," he said with a chuckle, "there is your mysterious voice. The remnants of a once good wireless telephone with a loud-speaking attachment!"

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BIG SUPPLY LATEST APPARATUS ON HAND READY FOR PROMPT DELIVERY

FOUR HOUR MAIL ORDER SERVICE

WE ASSURE YOU OF THE MOST PROMPT SERVICE

Our Radio Mail Order Service is gaining much popularity on account of the **FAST SERVICE**. We ship your order within four hours of its receipt. After you tire of waiting days—or maybe weeks—for your supplies, try Warner Brothers' Radio Mail Order Service and you will use no other. Following are a few items that we have in stock:

VARIABLE CONDENSERS

.0003 17 Plates K & C Type	$3.00
.0005 23 Plates K & C Type	3.50
.001 43 Plates K & C Type	5.00
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.001 43 Plate Warner	4.00
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R3 Magnavox Radio Type	$45.00
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36 inches long	

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CROSLEY Porcelain	.60
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UV-712 Radio Corporation	$7.00
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226W FEDERAL	7.00
A2 ACME, semi-mounted	5.00
Thordarson	4.00
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VARIOMETERS

REMLER 505 Moulded Bakelite	$6.50
OUR OWN TYPE	4.50
ATWATER KENT	8.00

JACKS AND PLUGS

FEDERAL 1421 Open Circuit Jack	$ .70
FEDERAL 1422 Single Circuit Jack	.85
FEDERAL 1423 Double Circuit Jack	1.00
FEDERAL 1435 Automatic Filament Control Jack	1.20
FEDERAL 1438 Automatic Filament Control Jack	1.30
WESTERN ELECTRIC Plugs	1.30
FEDERAL Plugs	2.00
PACENT UNIVERSAL	1.25
NEW FEDERAL Universal Plug	1.75
FEDERAL PLEIPHONES	14.00

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DEFOREST, new type	1.20
PARAGON	1.50
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KLOSNER	1.50
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MURAD T-11, 160 to 500 meters	$6.00
MURAD T-11A	6.50
MURAD T-11B	7.00
RADIO ENGR. CO.	6.00
UV1714	6.50
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Philadelphia 6 V. 60 A. H.	16.00

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REMLER 503 Vario-Coupler	$5.40
REMLER 505 Coupler on Unit Panel	12.75
OUR OWN TYPE	3.50
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PHONES

Federal, 2200 Ohms	$8.00
Federal, 3200 Ohms	10.50
Cory	8.00
Western Electric, 2200 Ohms	12.00
Dictograph, 3000 Ohms	12.00
Manhattan, 2000 Ohms	6.00
Manhattan, 3000 Ohms	7.00
Brandes, Superior	8.00
Lincoln, 3000 Ohms	8.00
Frost, 2000 Ohms	5.00
Frost, 3000 Ohms	6.00

Now that you have read the list, get that order into the mails without delay. If there is something that you want and don't see it listed here, write us anyway and we will get it for you. Our two stores save still more time in getting your apparatus in a hurry. Enjoy the pleasure of real service for a change. Send us your orders.

WARNER BROTHERS

TWO STORES

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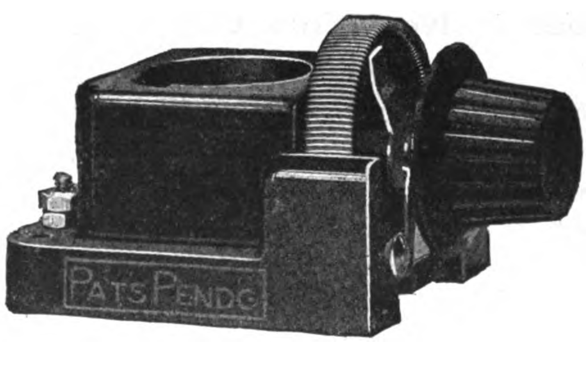
KING Rheo-Socket

Another RADIO SURPRISE

Price $3, f. o. b. New York City

Compact, increased efficiency, shorter connections, less wiring—brings in stations you never heard before. Make this a part of your up-to-date set.



A high grade article in Red Bakelite with Phosphor-Bronze Contacts and Alloy Resistance Wire.

For Base or Table Mounting

KING AM-PLI-TONE

82 CHURCH STREET **NEW YORK**

Mfrs. of the Famous KING AM-PLI-TONE

Jobbers, wire or write for proposition

Continued from page 72

Madsen sank down in amazement—collapsed in a chair, a dazed look on his face. The detectives gathered up the parts and spread them out on the library table on a couch cover. There seemed an endless number of them.

"I guess this ends this part of the trail," said the chief. "Now for the man that did it!"

Madsen shook his head.

"There is something more important than that—his threat," said Madsen. "Do you think he will carry that out?"

Chief Brady half shut his eyes and considered.

"After seeing this I am inclined to believe he is very likely to have a try at it!" he said.

YOUNG Rivers closed his office for the week-end. With a small leather sack in his hand he went over to Madsen's bank, the Citizens Trust Company, where he carried a small account, and joined the long line of late hour depositors that reached from the entrance to the receiving teller's window.

It amused him, in the next few minutes, to notice that several heavy, red-faced men passed and repassed the spot where he stood subjecting all in the line to close scrutiny. He was surprised to find that he was not the least bit nervous over the circumstance, although he would have disliked to have been questioned or examined by any of them at that particular moment.

The line crawled along like a patient snake until it came Walter's turn at the window. The teller, a pleasant-faced young man with adept hands and an eye-shade, gave him a friendly nod and called him by name.

"I see you were not scared out," he remarked with a nod toward a newspaper which a man was reading avidly nearby.

"Not with my little acount," Walter laughed.

He opened the leather case and took out several rolls of money and some checks. The teller took Walter's bank-book, made the necessary entries, stamped in the date and passed it back. The money and checks he threw in receptacles behind him.

From the bank corridor an elevator went to the upper floor. Walter took one of the cages and stepped off on the upper level. There were few persons about. Walter walked rapidly along the hallway until he came to a door marked "stairway." He turned the knob and stepped out on the roof. The building overtopped most of its neighbors and those that were higher were too far away for anyone looking from the windows to determine what he did.

From his little satchel he took a small instrument to which he attached

Continued on page 76

RHAMSTINE*

Announces a

RADIO FREQUENCY TRANSFORMER

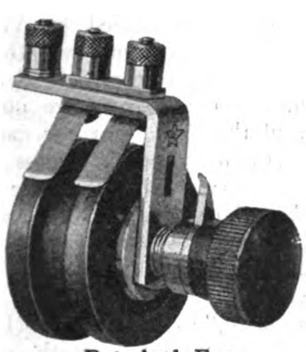
Pat. Apd. For

$4.50
Postage 10c

Once more Rhamstine* has satisfied a definite radio requirement. The Rhamstine* Radio Frequency Transformer is now available to the many thousands of radio enthusiasts who have been waiting for a guaranteed product, made to a fixed standard in quality, and sold at a reasonable price. The Type 1R.F. Transformer complete with special base mounting sells at $4.50. While it has a range of 200 to 500 meters it is especially well-suited for the wave-lengths of the present broad-casting services.

Consistently good engineering has been followed in its design and by comparison it is the most attractive transformer in appearance that has ever been offered.

Complete circuit diagram is sent with each unit.



Pat. Apd. For

$1.75
Postage 6c

RHAMSTINE*

Carbon Element

POTENTIOMETER

Another new product from the Rhamstine* Shops is the carbon element Potentiometer shown herewith.

By using a carbon potentiometer in the circuit of a radio frequency set best results are obtained. The Rhamstine* Potentiometer is made for panel mounting, is compact and attractively finished. The price is $1.75. Immediate deliveries.

Manufactured by

J. THOS. RHAMSTINE*

2152 E. Larned Street **Detroit, Michigan**

*** Maker of Radio Products**

Continued from page 74

a wire which he carried across the roof and looped to a corner of a ventilator pipe, fifty feet distant. Beside the instrument he hung a second wire to which he fastened a small round object which resembled a large metal lemon. The object was familiar in the trenches as a hand grenade and the instrument to which it was attached was a portable wireless receiving instrument.

Walter hung the grenade so that it would swing clear of the roof and safe from casual observance. Stepping back, he surveyed his work. Satisfied that the stage was set, he smiled grimly and went back down the stairway to the upper floor corridor. No one saw him close the door behind him, and the elevator operator, when he stepped into the down cage, merely favored him with a casual glance.

As Walter left the bank a watchman was hanging a "Bank Closed" sign in the front doors. He glanced back at it and mentally ran over the bank processes for the next few hours. Within a few minutes the clerks would settle down to their regular Saturday afternoon grind. The coin would be taken from the various cages, placed in racks and carted into the vaults on small, rubber-wheeled wagons. At 4 o'clock the huge vault would be closed. The time-lock clock would throw the tumblers on the four doors fifteen minutes later by automatic action, locking them until 8 o'clock the following Monday morning.

That afternoon Madsen called on Chief Brady, accompanied by Waterford. Together they went over the police arrangements for the night defense.

"When the police lines are out tonight," said the chief, "no one can get through without a personal pass from me. We will establish a deadline from 11 o'clock tonight until tomorrow morning at 1 o'clock. Nothing moves within that district during those hours. The rest is waiting."

"I suppose so," said Madsen. "I have doubled our own guards with agency men that can be depended upon. That is all I can do."

"That is all," said the chief. "To wait and hope for the best."

Madsen arose.

"I shall be at the Papyrus Club," he said. "There is nothing I can do at the bank."

"I agree with you," the chief replied. "I am really glad you are going to stay away. It will be better all around."

By 11:55 the whole downtown district of the city was tense with electrical expectancy. A revolver shot would have produced a panic. Afternoon extras had fanned popular excitement until the streets leading toward the financial center were thronged with hundreds of persons who normally would have been in bed at that hour. The district immediately surrounding the bank was roped off and a "deadline" established by scores of uniformed and plain-clothes detectives. Inside the restricted area machines, filled with detectives, cruised slowly up and down the streets.

On the roofs of buildings adjoining the Citizens Trust Company police armed with rifles paced to and fro in ready expectancy. Armed men loitered in doorways or peered occasionally from alleys in the middle of adjacent blocks. Directly across the street from the bank a shotgun squad stood well back in the shadows of a big office building, where from an advantageous position they could sweep the opposite side of the street with their deadly weapons if the occasion demanded.

Chief Brady made a personal inspection of the district during the last minutes of the evening. After assuring himself that everything that was mortally possible to police efficiency had been done to effect the safety of the bank, he took up his station a short distance from the bank to await results. The last minute of the hour shortened to seconds and these in turn to incalculable fractions. For a short fragment of time the minute and hour hands of the clock overlapped.

Suddenly there came a short, sharp jar, followed by the roar of an explosion. The sound of the detonation echoed and re-echoed down the long canyon of tall buildings. A puff of white smoke poured from the top of the building.

Into the silence that followed a police whistle shrilled sharply.

From every quarter the police closed in. Singly and in squads they plunged toward the spot—from doorways, alleys and around the corners of buildings. They came on the run, jerking at their revolvers. Here and there a uniformed man grabbed at a moving plain-clothesman, seen dimly in the half-light, thrust a revolver in his stomach and dragged him under a light. A coat would be thrown back to disclose a star—and they would run on together, cursing.

Madsen was sitting with his watch in his hand at the Papyrus Club when the detonation came. His watch was a minute slow, so that he was caught unexpectedly. With the jar he arose unsteadily, a queer, twisted expression on his face, and staggered toward the telephone exchange. The operator saw him coming and plugged in a call for the bank. Waterford slid down in his chair, letting the glass in his hand smash upon the marble floor.

"My God!" he muttered thickly. "They've done it!"

Madsen began clawing wildly at the receiver in the booth. The bank did

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not answer. Finally he gave it up and stumbled out, leaving the receiver dangling on the cord.

"Get me a taxi!" he commanded hoarsely.

At No. 52 Tenant Street Katie was sobbing on Walter's shoulder, unnerved, hysterical. The young engineer sat white-faced and haggard, a strange fire burning in the depths of his eyes.

"The last lesson!" he said grimly to himself. "I wonder——"

SUNDAY morning!

Homer Madsen, president of the Citizens Trust Company, and Marcus Waterford, president of the Development Oil Company, faced each other across a table in the latter's office with drawn, haggard faces. Beside them lay the oil company's stock books.

"Did you get Ruggles & Company on the telephone?" Madsen asked, looking up.

"He'll start shoving that stock up bright and early Monday morning," said Waterford wearily. "I hope that is satisfactory."

Madsen shook his head.

"We can only hope," he said. "Heaven knows I'd like to know what is expected of me."

Waterford lighted a cigar with hands that shook unsteadily.

"What does the chief think?" he asked.

"He says a bomb went off on the roof—probably clockwork, and that it was evidently intended to scare."

"All right, all right," Waterford replied impatiently. "I don't care how it was done. It was done, wasn't it? That's enough for me."

He pulled the books toward him and opened to the memorandum of transfers. Madsen stared out of the window.

"You know, Marcus," he said, "we *did* slump that stock at an awful rate, didn't we?"

Waterford scowled at him, fatly.

"I told you to let it alone, didn't I?" he demanded with sudden heat. "No, you wouldn't do it. Well, look what happened. If you had——"

The telephone bell jangled suddenly. The eyes of the two men met. Waterford grew a sickly yellow.

"Who the devil knows we are here?" he asked.

"Answer it and find out!" Madsen commanded.

Waterford shook his head and backed away from the table.

"Not me," he said.

Madsen picked up the receiver.

"Hello!"

"Hello, Madsen!"

Madsen felt the hair on the back of his neck stand up. It was The Voice—the one that had spoken to him out of

Continued on page 80

Continued from page 78

nowhere on three successive nights in his apartment—the voice he feared more than any one thing that had ever come into his life. He braced himself against the table.

"Hello, Madsen!" the Voice went on. "Have you made up your mind yet?"

The banker steadied his nerves.

"Merciful heavens—yes!" he gurgled.

The Voice chuckled.

"All right, Madsen," it said. "If you keep your word you have nothing more to fear."

Things in the room swam dizzily for Madsen. Waterford's drawn, concentrated face seemed to dissolve in a mist. After a bit he came back to himself.

"You mean that?" he asked faintly.

"Absolutely."

The banker took a long breath. Then he gave a short laugh.

"You win," he said. "The stock goes back to normal Monday. If it's not too personal, I'd like to know where you learned your trade?"

A long, hearty laugh—a rather pleasant, well-bred laugh—came over the telephone wire.

"In the Conscience Shop!" was the answer, as a distant receiver clicked into place.

"Well, I'm damned!" said Madsen as the other's meaning reached him.

A block away from the Development Oil Company's office Walter Rivers stepped out of a telephone booth, a whimsical smile on his face. Katie Ferguson was waiting for him with a tender, wonder-light burning in her eyes.

"Is it finished, Walter?" she asked softly.

"Practically," he replied. "Madsen has agreed to run the stock back to its original valuation on Monday. That will rehabilitate the investors. There still remains one problem——"

Katie's face grew serious.

"And that is?" she asked.

"My own."

"Yours?"

"Yes—you see, my stock has all been cornered by one little speculator who, like Madsen, is without a conscience—"

He broke off and glanced down at her. Katie flashed him a dazzling smile and slipped one small hand through his arm.

"Perhaps that stock will go up too—on Monday!" she said, her eyes very bright.

The End.

This is station K.S.&S.Co.

Broadcasting

Better Radio Equipment

First—A Short Talk on Kellogg Head Set Superiority

Kellogg head sets are the lightest on the market which is a prime requisite for comfort in any Radio receiving. They are built of highest quality material and their design is based on 25 years' engineering experience in telephone receiver construction. Kellogg head sets are supplied under the following codes and resistances: No. 69A, 2400 ohms, including head band and 6 foot cord; No. 69C, 2000 ohms, including head band and 5 foot cord; No. 74A, 1000 ohms single receiver with head band and 5 foot cord. Kellogg head sets are adapted for use by campers with portable receivers.

Second—A Brief Description of Kellogg Jacks and Plugs

Kellogg Radio jacks likewise are a standard product, once installed in your set, will give service and last indefinitely. Hundreds of thousands of Kellogg jacks and plugs in telephone work are in service the world over. They are designed for all standard Radio practice with the following codes: No. 501 is a four-conductor, two break type; No. 502 is a two-conductor open circuit type; No. 503 is a three-conductor, single break type; No. 504 is a four conductor, single make contact type; No. 505 is a six-conductor, one make, two break type.

Third—Why You Should Use Kellogg Grid Leaks and Condensers

Because first of all, they are accurate—no variation, regardless of atmospheric conditions, insuring uniform receiving.

Fourth—The Reliability of Kellogg Transmitters

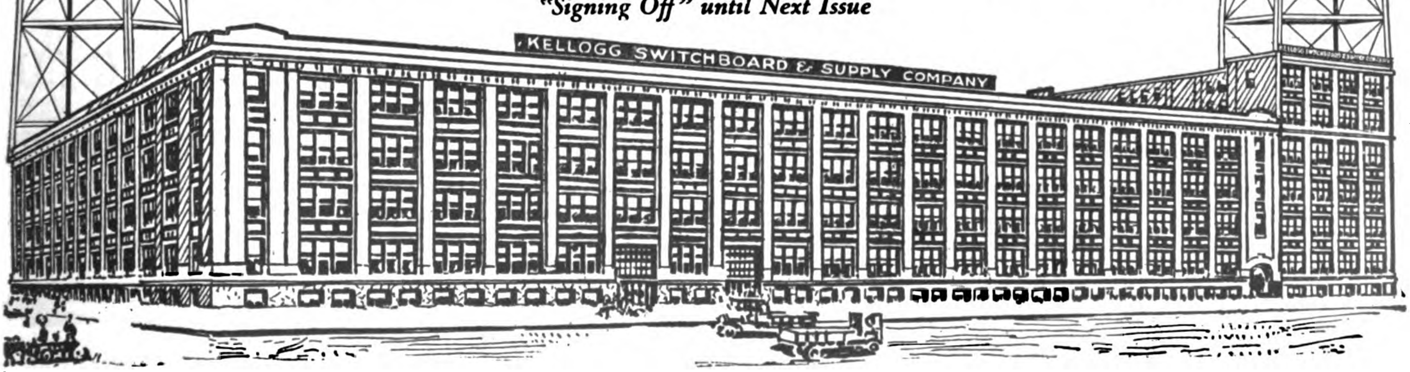
Kellogg Company transmitter or microphone is proving exceptionally reliable in Radio work. Today there are over three million Kellogg telephone transmitters in service, and their record is unsurpassed.

Fifth—Kellogg tube sockets are built of Kellogg Bakelite, and a standard product easily installed.

Write us today for our Kellogg Radio bulletin, completely listing our supplies, which include insulators, batteries, arresters, etc.; and investigate the latest Kellogg Radio products, every one of which is designed and built on the basis that—Use, is the Test.

Kellogg Switchboard & Supply Co., Chicago

"Signing Off" until Next Issue



For 25 Years Manufacturers of High Grade Standard Telephone Equipment

LETTERS TO THE EDITOR

Continued from page 31

Los Angeles and vicinity and broadcasting stations are weaker than they should be for this distance of 74 or less miles air line, Denver stations coming up much stronger, and I presume, using no more power than Los Angeles broadcasting stations.

Why the Riverside and San Diego fellows come up stronger here I do not see, unless for Cajon Pass to east of me allowing an etheral air strata on a level to this elevation, while high mountains rise in continuity between here and Fullerton and Los Angeles.

With my transmitting, tests show, I am able to get out north and east with comparative ease with my 15-watt I. C. W., having reached Canada on north and Fort Worth, Texas, east, but am not getting through to stations in Fullerton, San Diego, Los Angeles and Riverside with much kick. In fact, very unsatisfactorily for the distances of 60-120 miles air line.

I might add that my reception from north, east, northeast and southeast are all good here in Antelope Valley.

Anyone having any data on similar tests in this district, I should be pleased to learn your results.

LEE ROY POTTER.

Route No. 1,
Lancaster, Calif.

LOW POWERED CIRCUIT

Continued from page 11

which is liable to decrease the life of, or totally destroy the filaments.

15. In operating vacuum tube transmitters, always heat the filaments to the proper brilliancy first, then cut in the plate supply voltage. When shutting down a tube transmitter cut out the plate supply voltage first.

16. When employing the Heising system of modulation, wherein control is obtained by variations in the grid potential of the modulator tubes, a C battery must be used. If the plates of the modulator tubes become red, the grid potential may not be sufficiently negative and more C battery should be used.

STATION 3BV

Continued from page 19

lead-in. It has an average height of 40 ft.

This station has been in operation, with the exception of the war period, since 1912, when licenses were a novelty. On the night of June 1 of this year I heard 6XAD very plainly. I have a letter from Major Mott confirming the signals. I hear 5ZA fairly regularly in the winter time, and occasionally in the summer when static permits. The old 9ZN spark used to roll in here in the wee hours. This station is located 25 miles northwest of Philadelphia, Pa.

GETTING RESULTS WITH SUPER-REGENERATION

Continued from page 15

condensers in parallel, or the Dubilier Model 577, furnished in the .0025 mf. value, will serve the purpose.

The filter, to prevent the 15,000 cycles from interfering with the operation of the audio frequency amplifier, is shown in the dotted lines and consists of two 12,000 ohm non-inductively wound resistances, a condenser of about .005 mf., and a 1 henry choke coil. Western Electric No. 38-B Lavite resistances are the best 12,000 ohm resistances on the market, and one of the ordinary choke coils used in transmitting sets will do for the 1 henry choke. A Radio Corporation Model UP-415 was used in the writer's installation.

The audio frequency transformer should be a Radio Corporation Model UV-712, where Western Electric "E" tubes are used, since it is the only transformer sold to the general public that has a primary impedance that is anywhere near the plate impedance of the "E" tube. If the ordinary tungsten filament receiving tubes are used, other types of transformers may be employed, but it is important when using "E" tubes to have a transformer that has a relatively low primary impedance.

After setting up the circuit and making certain that the tickler coil of the super-regenerator tube is poled properly, and that the external oscillator is functioning, the signals may be tuned by varying condenser C-1 until the signals are audible. Then vary condenser C-2 until the signals are of greatest intensity, and then retune C-1 for maximum strength. Considerable trouble will be experienced by beginners in determining the proper adjustment of C-2 and the relative position of the tickler with respect to the primary inductance, but results will come in due time if the experimenter has the ability to stick to it and not give up at failure to get results the first time.

If a loop is not desired an antenna may be used, as is shown in the lower left-hand corner of the diagram, in dotted lines. The advantage of using the loop is increased selectivity and freedom from static and other interference, but it may be well for the experimenter to try the circuit with the antenna first, before using the loop, in case he is not familiar with the operation of the latter.

After duly considering the merits of the new circuit and comparing its operation with that of both the ordinary regenerative receiver and the so-called Super-Heterodyne type, the writer has come to the conclusion that where reception of broadcasting only is desired, and the receiving station is located in the midst of a group of broadcasting stations, as is the case in nearly every

large city, a super-regenerative circuit is not necessary. It has already been proved that a loud speaker can be operated satisfactorily from the ordinary detector and two stage amplifier, where the broadcasting station is not more than 25 miles away. Such a set will consume 3 amperes of filament current at six volts and the plate battery of 40 to 80 volts will last a considerable length of time. If a super-regenerator using Radiotron or Cunningham 5 watt tubes is employed, the filament current will be 7.5 amperes at 10 volts, or about three times the power consumed by the ordinary receiver. The plate battery would have to be much larger and should be either of the storage type or of large dry cells. Hence, where expense must be considered the ordinary regenerative receiver wins on all counts.

For the amateur who is some distance from the broadcasting centers the new circuit is a great benefit and will doubtless come into general use in the rural districts of the country. For amateur C. W. telegraphy the new circuit will prove of immense value, as it will permit of greater selectivity, the use of a loop, the ability to receive well on the very short wavelengths (since the efficiency of the new circuit increases as the wavelength decreases), and increased signal strength.

However, the Armstrong Super-Heterodyne, or double detection and amplification at a relatively low frequency by a number of amplifiers still remains the most sensitive of radio receiving circuits and will probably come into more general use with the advent of better tubes and more efficient apparatus. As the Super-Heterodyne is rather expensive to construct, it has been stated that the latter is the Rolls-Royce of the radio world, and the Super-Regenerator the Ford, which gets there just the same. The reader is asked to draw his own conclusion after trying out the new circuit.

KDKA

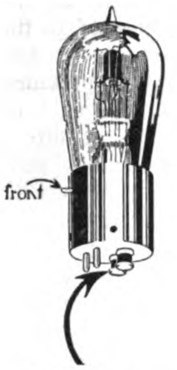
Continued from page 30

between 70 and 80 per cent. Piano solos average about 30 per cent, violin solos, 20 to 30 per cent, and vocal numbers, 40 to 50 per cent, with maximum of 100 per cent. Of course, the modulation meter indicates only the average volume of sound. While the meter may read only 30 per cent in case of piano music, the individual notes at the instant of striking may reach 80 to 90 per cent. Allowing for the kind of sound being transmitted, that is, piano, speaking voice, solo, etc., the modulation meter provides a convenient means of finding the correct distance to place the artist from the pick-up transmitter and accounts to a large extent for the uniform volume of sound received from KDKA. The instruments at the top of the transmitter panel, Fig. 2, are from left to right: filament volt meter, ground current meter, plate ammeter, modulation meter and plate volt meter. The antenna current meter is mounted on the wall with a series condenser and discharge resistance and is not shown in the picture.

The antenna at KDKA consists of 6 wires, 190 feet in length on 20-foot spreaders. This antenna is supported 210 feet above the ground by a brick smoke stack at one end and by a 100-foot pipe mast on a nine-story building at the other end. The operating room

and studio are located on the ninth floor of this building. Fig. 5 shows the mast end of the antenna with the operating room directly below. A counterpoise which is a duplicate of the antenna in construction is placed 110 feet beneath the antenna. This brings the counterpoise about 15 feet below the transmitting set. The down lead from the antenna and the counterpoise lead are made up of eight strands of No. 14 copper wire equally spaced around 1.5-in. diameter wooden spacers. The natural period of this aerial system is approximately 412 meters. A series condenser of 0.0005 mf. capacity is used in series with the antenna and sufficient loading inductance added to obtain the desired wavelength of 360 meters. The series condenser is shunted by a radio frequency choke coil of 10 millihenries inductance in series with a one megohm resistance, to drain off any static charge that might accumulate on the antenna when insulated from ground by the series condenser. The high frequency resistance of the antenna system at 360 meters wavelength is approximately 12 ohms, a large percentage of which is radiation resistance. The antenna current at 500 watts is 6.5 amperes; at one kilowatt it is 9 amperes.

The power equipment consists of two 2-kw. motor generator sets with 250-volt direct-current motors, the sets employing two armature windings and two commutators permanently connected in series. Normally, the motor generator sets are used with the generators paralleled. Either set may be used alone with the radio set at reduced power. There is also a third motor generator



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Slipping directly on the filament terminals of any standard bulb used in any standard socket, the

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makes it impossible for any excessive amperage, even an accidental short, to "burn out" the filament. Positively does not affect the efficiency of your set.

The Radeco Safety Fuse is equally good for the protection of meters and other delicate Radio instruments.

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Order by Mail **4 for $1** ***Buy from Your Dealer***

Send money with order and state what tube fuses are wanted for

We carry a complete stock of standard Radio sets and parts at standard prices. Order from any standard catalog.

RADIO EQUIPMENT CO.

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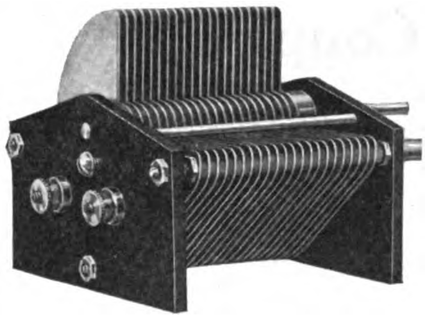
Oldest Exclusive Radio Store in New England

Pen Brand Variable Condensers



Pen Brand 43 Plate Variable Condenser

Will Meet Your Requirements Regardless of What Circuit You Use.

For Telephone reception, a 3 plate vernier in parallel with a 23 or 43 plate variable is the only REAL vernier.

PEN BRAND PRODUCTS have enjoyed the reputation of being the STANDARD for three years, and are Quality instruments.

MANUFACTURERS

We are in position to supply you with U and T punchings for transformer iron cores, also brackets. If you are contemplating manufacturing transformers, write us, stating your requirements, and let us quote you.

3 plate	Vernier	Approx.	.00005	mf	$2.10
7 plate	Variable	Approx.	.0001	mf	2.25
11 plate	Variable	Approx.	.0002	mf	2.60
17 plate	Variable	Approx.	.0003	mf	3.00
23 plate	Variable	Approx.	.0005	mf	3.60
33 plate	Variable	Approx.	.00075	mf	4.20
43 plate	Variable	Approx.	.001	mf	4.70
63 plate	Variable	Approx.	.0015	mf	7.20

Attractive discounts to dealers and jobbers. Write for folder on PEN BRAND PRODUCTS

THE RADIO TELEPHONE SHOP

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A CLASSIFIED ADVERTISING SECTION READ BY 60,000 BUYERS

The rate per word is five cents, net. Remittance must accompany all advertisements. Include name and address when counting words.

ADS FOR THE OCTOBER ISSUE MUST REACH US BY SEPTEMBER FIRST

RECEIVING APPARATUS

FOR RELIABLE BROADCAST RECEPTION buy a "Master Radio Broadcast Receiver." Write at once for complete circular. Master Engineering Company, Omaha, Nebr.

VARIABLE CONDENSERS. Buy them direct—save money. 23 plate, $2.25; 43 plate, $2.85. We pay the postage. Electrical Equipment Co., 113 N. Broad Street, Trenton, N. J.

FOR SALE—New Honeycomb Set: detector, two step, tubes, coils, phones and B battery, in one cabinet, $100. Write M. A. Hicks, 230 No. Eugene Street, Stockton, Calif.

FOR SALE—Reinartz C. W. Receiver, Detector and 3 step Amplifier. Hear 2ZL, 3FS, 4GL, 8AGZ, and 15 concert stations all over 400 miles distant, on detector alone. $80.00 without tubes. John Titcomb, Nogales, Ariz.

Switch Levers, $0.50; Binding Posts, $0.10; Switch Taps, $0.03. Remler, Murdock and Crosley radio apparatus on hand. Send stamp for list. Griewisch Radio Supplies, 801 So. Oakland, Green Bay, Wis.

RADIO. Our $15.00 (tube) detector sets selling like hot cakes. Big opportunity. Write today. Simplicity Radiophone Factories (6), Cincinnati, Ohio.

FOR SALE—2 Remler Variometers and 180° Coupler, mounted on new formica panel, complete, $20.00. Also 200 watt C. W. Power Transformer, new and completely mounted, $12.00. C. W. Park, Riverbank, Calif.

Variable Condenser parts: Plates, .03; Rotary washers, .10 doz.; Stationary, .05; Shafts for any number plates, .25; Supporting Rods, .05; Condensite top and bottom, .25. Gravenstede, 84 Hancock Ave., Jersey City, N. J.

BARGAINS. Variometers, $3.00; Variocouplers, $3.00; Two Variometers and Variocoupler, $8.00. Wound with silk wire. Unmounted tuning coils, beautifully finished, 95c. Dials only 55c while they last. Remit coin or money order. K. J. Morrison, P. O. Box 1396, Pittsburgh, Pa.

FOR SALE—Short Wave Regenerative Receiver, $15.00. E. Gassmann, R. R. B. Box 498, Fresno, Calif.

FOR SALE—New York Coil Variable Condensers, 11 plates, $2.50; 23 plates, $3.00; 43 plates, $3.75; Variometer, $5.00; Variocoupler, $5.00; Amplifying Transformer, $5.00; 3" Bakelite Dials, 95c; Switch Levers, 40c; Switch Points, per dozen, 20c; Switch stops, per dozen, 40c; large Rubber Binding Posts, 9c; Metal Binding Posts, 9c; Crystal Cups, 9c. Add postage. Wholesale and Retail. W. E. Roehl, 614½ Fannin, Houston, Tex.

200—20,000 Meter Receiver, including Radio-tron Detector, $35.00. Box 205, Williamsport, Pa.

MISCELLANEOUS

AUDION RENEWALS—Tungsten filament Detectors renewed $3.00. Tungsten filament Amplifiers renewed $3.25. Tungsten filament 5 watt Transmitters renewed $5.00. We do not accept tubular Audiotrons, RAC-3 or other multibase tubes for renewal. W.E., V.T.1 with Oxide coated filaments renewed for $4.00. If in doubt write us, enclosing 2c stamp. Ten years experience, results guaranteed, safe delivery assured. TERMS, CASH WITH ORDER OR C. O. D., PLUS COLLECTION CHARGES. Trimount Laboratory, Milford, Mass. (Superseding all price lists prior to Aug. 1st, 1922.)

LIGHTNING. Wonderful new Electrolyte charges discharged batteries instantly. Eliminates old Sulphuric Acid method entirely. World has waited half a century for this invention. One gallon retails $10.00; free to agents. LIGHTNING CO., St. Paul, Minn.

FOR SALE—New set "Hawkins Electrical Guides," $7.50. Will trade for fones. Cessford Kerr, 627 N-2 E, Provo, Utah.

PERSONAL — Graphologist reads character from handwriting. Enclose 25c and sample of writing for trial. R. A. Williams, Box 63, Tucson, Arizona.

set with a 220-volt 25-cycle motor, which can be connected to the radio set in case of failure of the direct-current supply. This set is provided with an exciter to supply the field of the high voltage generator. A filter consisting of a 50-henry inductance and 32-microfarad condenser reduces the generator hum to a negligible amount. The panel beneath the speech amplifier on the right in Fig. 1 controls the power equipment. Here are mounted generator field switches and rheostats, generator paralleling switches, generator voltmeter and ammeters, voltmeter switch, antenna switch control and studio signal light button to show the announcer in the studio when the transmitting set is in operation.

The engineer in charge of the station tests all filament and plate batteries before each program. He next starts the transmitting set and checks the wavelength by means of a wave meter. He then lights the signal light in the studio, notifying the announcer that the transmitter is in operation. The announcer turns on the studio amplifier which lights a signal light in the operating room, notifying the engineer that the audio circuits are in operation. The engineer then watches the modulation meter and adjusts the amplification of the speech amplifier to give the desired amount of modulation. A loud speaking receiver in the operating room serves as a check on the quality of the transmission. When programs from local churches or from the downtown studio are to be transmitted, the telephone line is tested before the program. Orders and any special arrangements are made over a supplementary order wire or phone line between the radio station and place of the performance.

RADIO MINE EQUIPMENT

The Bureau of Mines is considering the problem of equipping mines with radio apparatus for use in the event of accident. The stringing of wired telephone is impossible, but officials state that it would be fairly simple to equip certain distant rooms or chambers with crystal receiving sets, so that rescue parties could communicate with imprisoned miners. The real problem, they say, is to find a simple and portable transmitting set by which the miners could communicate with the mouth of the mine or the outside world in the event of being injured in or imprisoned after an accident. There is no room for a large transmitting set, they point out, and the danger of a transmitting spark igniting gases or coal dust complicates the problem, although a tube set might be used if the necessary power could be supplied for its operation without lengthy power wires which would be in danger of being cut constantly, just as telephone lines would be cut or broken by the mining operations.

Buy Fada Equipment From Your Dealer

Fada Inductance Switch, 50c

FADA

Fada Equipment Assures the Joy of Radio Reception

Don't fool around any longer with apparatus that is theoretically imperfect and miss all the good things that are broadcasted every day for your benefit. End all that trouble and worry by making your own receiver complete with FADA parts or demand FADA equipment when buying complete assembled sets.
Our aim, first and last, is user satisfaction. We design and build FADA products to give the greatest possible results.

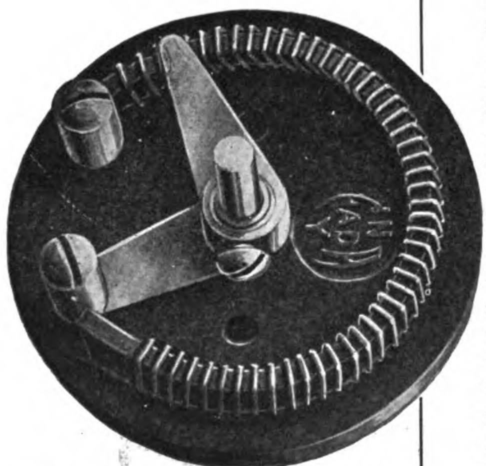
If you would go through our plant and observe the care with which the proper materials are selected, the scientific exactness with which each piece is made, the precision in assembly and testing, the constant supervision of each step in the process of manufacture—you would realize that there could be no better equipment made. You would ever after, look for the FADA trademark when you buy.

The FADA Inductance Switch is a delight to use. It moves easily over the contact points and gives perfect electrical contact. It's so easy to fasten to your panel and the cost most reasonable.

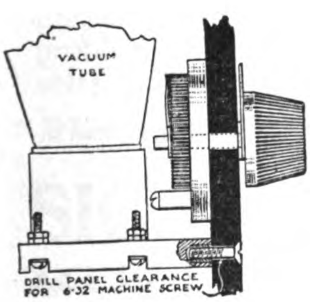
The FADA Rheostat is mechanically and electrically perfect in design and free from the usual rheostat troubles. The wire is evenly wound so the contact lever passes smoothly over each turn of the resistor. The knob is secure on its shaft and "fits the fingers."
The FADA Detector has a supersensitive crystal. You marvel that such a small piece of crystal can capture words and music from the air. It always does its work faithfully, constantly receiving messages from miles around.

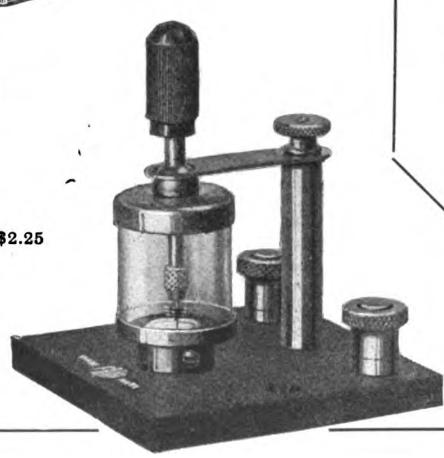
F. A. D. ANDREA

1581-F Jerome Ave.
New York City



Fada Panel Mounting Rheostat, $1.00





Fada Crystal Detector, $2.25

FADA **The Mark of Scientifically Exact Radio Equipment** FADA

It Is Time to Think of Service

It is time to look further than the mere equipment when you buy radio supplies, whether you're in Radio for profit or pleasure.

SIGNAL

When you see this name "SIGNAL" on wireless and radio equipment, you may confidently expect real radio service on your problems.

SIGNAL Radio Apparatus is built entirely in SIGNAL factories, from improved designs, by our own radio engineers, working in our own laboratories.

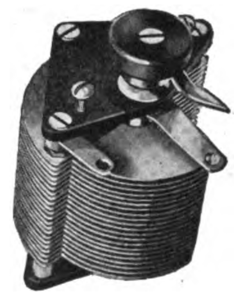
Bear in mind that SIGNAL Equipment is not, nor will it ever be **"side-line" material.**

Back of every SIGNAL Product is a reputable company, with a record of years of successful development in Radio.

As a part of the Service offered beginners, advanced amateurs and serious experimenters on Radio, we maintain a complete engineering service department, upon which our friends are at liberty to call, at any time, regarding their Radio problems, and to aid them in getting the best results at all times from their apparatus.

When you specify "SIGNAL" you specify "SERVICE"

SIGNAL BACK MOUNTED VARIABLE CONDENSER



One of the SIGNAL line, produced to meet the demand for a condenser for panel mounting. Comes in three models, so built as to permit mounting on panels from $\frac{1}{8}$ to $\frac{3}{8}$" in thickness. Machine screws are furnished for fastening the instrument to the panel; it is only necessary to drill three holes. Each instrument furnished with metal scale calibrated to 180 deg. Knob and pointer are removable. Construction is very rigid, the material in the aluminum plates being .026". The bearing plates are 3/16" black Formica.

SIGNAL ELECTRIC MANUFACTURING COMPANY

Menominee, Michigan

709 Mission St., San Francisco

This request-coupon makes it easy to secure all "SIGNAL" latest Wireless Bulletins, without any obligation. Simply fill out and mail now.

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RADIO

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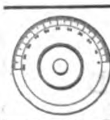
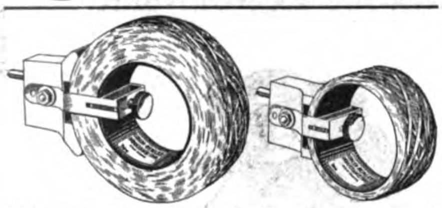
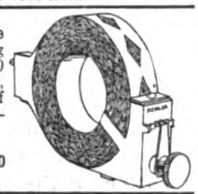
Keep this issue of Radio—Order direct from this page as you need new apparatus. Write your name and address plainly giving article number and inclose money order or bank draft. Send currency by registered letter only. Postage is covered in prices listed. Send your order direct to our San Francisco office. We guarantee safe delivery. 48 hour service or your money back.



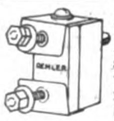
R532—Remler Bakelite Dial—With knob and bushing. A true running, Molded Bakelite Dial. 3" diameter, 3/16" thick, with 3/8" beveling tapering to 1/32 of an inch at edge of dial. Specify 3/16" or 1/4" shaft.
Price....................75c



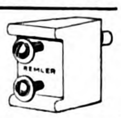
Giblin-Remler Inductance Coils—The result of years of research and study by Thomas P. Giblin who originated Honeycomb and Duo-Lateral Coils. They have MORE INDUCTANCE—LESS DISTRIBUTED CAPACITY—LOWER HIGH FREQUENCY RESISTANCE than any other coil of same number of turns on the market.
R533—35M turns—Price, mounted....................$1.50
R534—50M turns—Price, mounted.................... 1.60
R535—75M turns—Price, mounted.................... 1.65
All sizes from 20 to 1500 turns



R536—Remler Q. S. A. Inductance Unit—Four taps provided giving wave length range of from 1,000 to 15,000 meters. Dimensions, over all 6½"x4"x1". Coil is of standard honeycomb type. Bakelite coil plug and fiberoid strap.
Q. S. A. 850 Remler Inductance Coil Unit..........$6.00

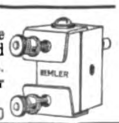


R537—Remler Bakelite Coupling Plug—Used whenever a variable coupling is desired. Brackets spring brass, nickel plated. Studs and hexagon nuts provided for mounting and terminals. Drilling centers ¾". Cross drilled for Remler Extension Handle.
Price....................90c

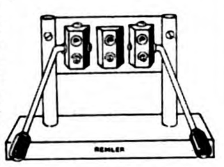


R538—Remler Bakelite Panel Plug. The Brass Terminals are tapped and provided with two nickel plated screws to serve both for mounting and connections.
Price....................60c

R539—Remler Bakelite Coil Plug—Provided with two N. P. metal clamps and screws for securing fiberoid straps. Terminals of brass and extend through plugs for making soldered contact to coil leads.
Price....................70c



R540—Remler Bakelite Coupling Plug—Same as **R539** but provided with No. 85 polished nickel binding posts instead of hexagon nuts. Drilling centers ¾". Cross drilled for Remler Extension Handle.
Price....................$1.00



R541—Remler 3 Coil Mounting—Specially designed for Giblin-Remler Inductance Coils but is equipped with standard coil plugs and permits the use of any standard inductance coil. Panel of highly polished black bakelite 4½"x1⅛"x3/16". Panel Supported by two black enameled brass rods ½" in diameter. 3⅝" high.
Price....................$6.50

R543—Remler Bearing Type Rotary Lever Switch—1" radius lever. Knurled insulating knob. Ideal for coupler control switches.
Price....................60c

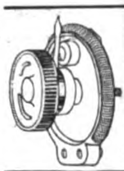
R544—Remler Plain Type Rotary Lever Switch—Knurled insulating knob. Polished N. P. washer 3/16" collar, ½" in diameter.
Price....................40c

R545—Remler Plain Type Rotary Lever Switch—Knurled insulating knob. Polished N. P. Washer ¼" collar, ½" in diameter.
Price....................40c

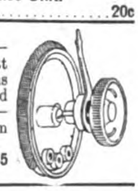
R546—Remler Plain Type Rotary Switch—1½" radius with Remler Polished Bakelite Knob 1⅜" diameter. Polished N. P. washer 3/16"x¾".
Price....................50c

R547—Remler Bearing Type Rotary Lever Switch—Finest switch manufactured. When MOUNTING IT NEED NOT BE DISASSEMBLED AS THE LOCK NUT CLEARS THE SPRING. Radius 1½" Remler Bakelite Knob 1⅜" diameter.
Price....................$1.00

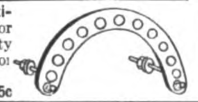
R548—Remler Plain Type Rotary Lever Switch—1" radius, 1⅜" Bakelite Knob, bearing washer ¼"x¾".
Price....................50c



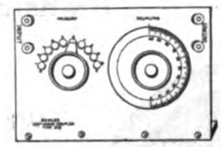
R549—Remler Junior Rheostat—Designed for filament control of 4 or 6 volt detector and amplifier tubes—extremely easy to mount—resistance unit readily renewed, very economical, smooth running. 2¼" in diameter, ½" maximum thickness when mounted.
Price....................$1.00
R550—Renewal Resistance Unit.
Price....................20c



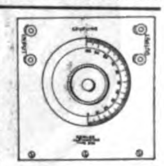
R551—Remler Heavy Duty Rheostat—Designed for filament control of 5 watt power tube control and the simultaneous control of three amplifier tubes. Designed for panel mounting—smooth running—perfect contact. 3" diameter, 1" maximum thickness when mounted.
Price....................$1.75



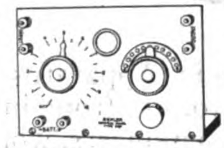
R561—Remler A-Battery Potentiometer—A battery potentiometer for plate voltage control. A necessity for efficient operation of any detector tube.
Price....................75c



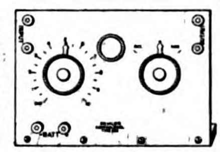
R554—Remler Panel Mounted 180° Vario-Coupler—The Remler 180° Panel Mounted Vario-Coupler is a necessary part of every efficient receiving set. Panel of highly polished black bakelite 5" x 7¼" x 3/16". Lettering recessed and filled with white enamel. Base of hard non-warpable wood 7 3/16" x 3 1/16" x ⅜".
Price....................$12.00



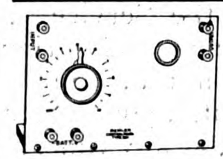
R555—Remler Panel Mounted Variometer—Wiring of this panel arranged to eliminate body capacity effects when used for tuning a secondary circuit. Panel of highly polished black bakelite 5"x5"x3/16". Lettering recessed filled with white enamel. Base of hard, non-warpable wood 5"x3 1/16" x⅜".
Price....................$9.75



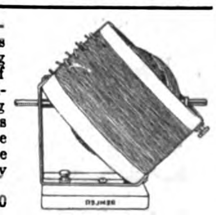
R556—Remler Detector Panel with A-Battery Potentiometer for Plate Voltage Control—Designed to give maximum efficiency. Panel layout and wiring make it especially suited for use with Remler Vario-Coupler and Variometer panels. Short leads—tight connections—correct alignment of wiring. Panel polished black bakelite 7½"x 5"x3/16". Base 7½"x3½"x⅜". Price....................$8.50



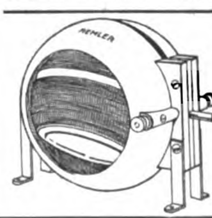
R557—Remler Amplifier Control Panel with Rotary Cam Switch—For long distance work—clear reception of broadcasting—operation of loud speakers, an amplifier is a necessity. Rotary Cam Switch is exclusive feature of this panel; does work of two jacks and plug. Panel 7½"x 5"x3/16". Six Remler nickel plated binding posts. Base 7½"x3½"x⅜". **Price without transformer.......$9.00**



R558—Remler Amplifier Panel Without Transformer—Designed to give maximum efficiency—necessary for long distance work—operation of loud speakers, etc. Panel highly polished black bakelite 7½"x5"x3/16". Remler Rheostat, Tube Socket, six binding posts. Base 7½"x3½"x⅜".
Price without transformer....................$6.00



R559—Remler 180° Vario-Coupler—This Variocoupler has two original features. Mounting of rotor allows 180° instead of 90° rotation. There is practically no inductive coupling between primary and windings of a vario-meter used in same set. 5¼" high, including base 5⅛" wide. Can be readily mounted on table or panel.
Price....................$5.40



R560—Remler Molded Bakelite Variometer—In electrical and mechanical design—in accurate construction—in uniform appearance, these Remler Variometers are without equal. Wave length range 100 to 600 meters. Stator 4½" diam. Rotor 3⅞" diameter. For panel or table mounting.
Price....................$6.50

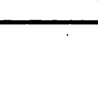
R542—Remler Bakelite Socket—For Panel or Table Mounting. Molded in one piece, insures perfect alignment. Base 2⅛" x 2¾". Overall height 1½".
Price....................$1.00

Radio Mail Co.

48 hour Service or your Money Back

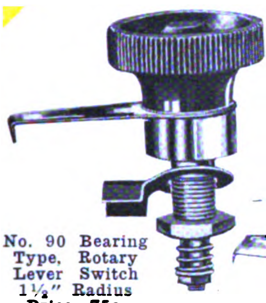
681 MARKET STREET SAN FRANCISCO, CALIF.

R563—Remler ¼" One Piece Slider—Stamped from one piece of spring brass completely in compound die. Lever is 1" and length of slider ¾".
Price....................25c

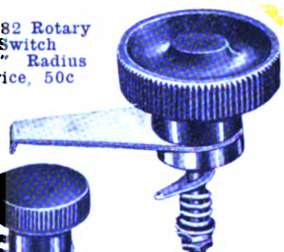


REMLER

Cunningham



No. 90 Bearing Type, Rotary Lever Switch 1½" Radius Price, 75c

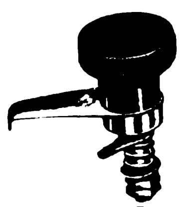


No. 82 Rotary Switch 1½" Radius Price, 50c

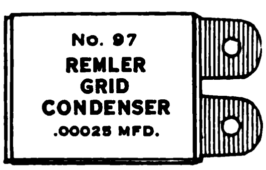
No. 91 Bearing Type Rotary Lever Switch 1" Radius Lever Price, 60c

No. 94 Rotary Switch 1/4" Collar 1" Radius Price, 40c

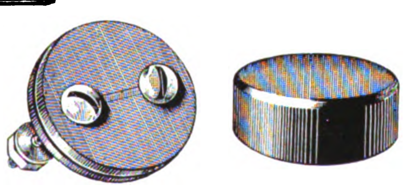
No. 95 Rotary Lever Switch 1" Radius Price, 50c



No. 83 Rotary Lever Switch 3/16" Collar 1" Radius Price, 40c



No. 97 Fixed Grid Condenser Price, 20c



No. 96 Variable Grid Leak Price, 40c

Type No. 100
3-inch Bakelite Dial with Knob and Bushing 75c

On this page are shown the popular line of Remler switches, the Remler Fixed Grid Condenser, the Remler Variable Grid Leak and the famous Remler Dial.

This represents but a small fraction of the Quality Radio Apparatus that has put Remler in the leading position it holds today. This small fraction, however, is built with the same care, accuracy and precision that has made the entire Remler line universally known as Quality Radio Apparatus.

It is becoming more and more apparent that Remler Apparatus is preferred in the building of sets because of its uniformity of construction—the well balanced proportion of each item giving an accurate and a pleasing appearance to the finished set.

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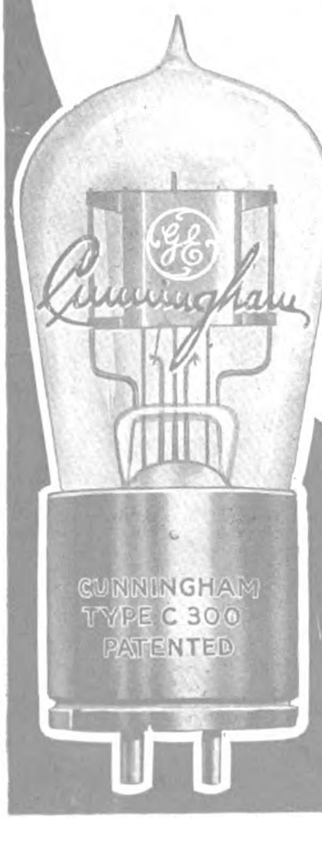

TYPE C-300	TYPE C-301
GAS CONTENT DETECTOR	HIGH VACUUM AMPLIFIER
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RADIO

Established 1917 as Pacific Radio News

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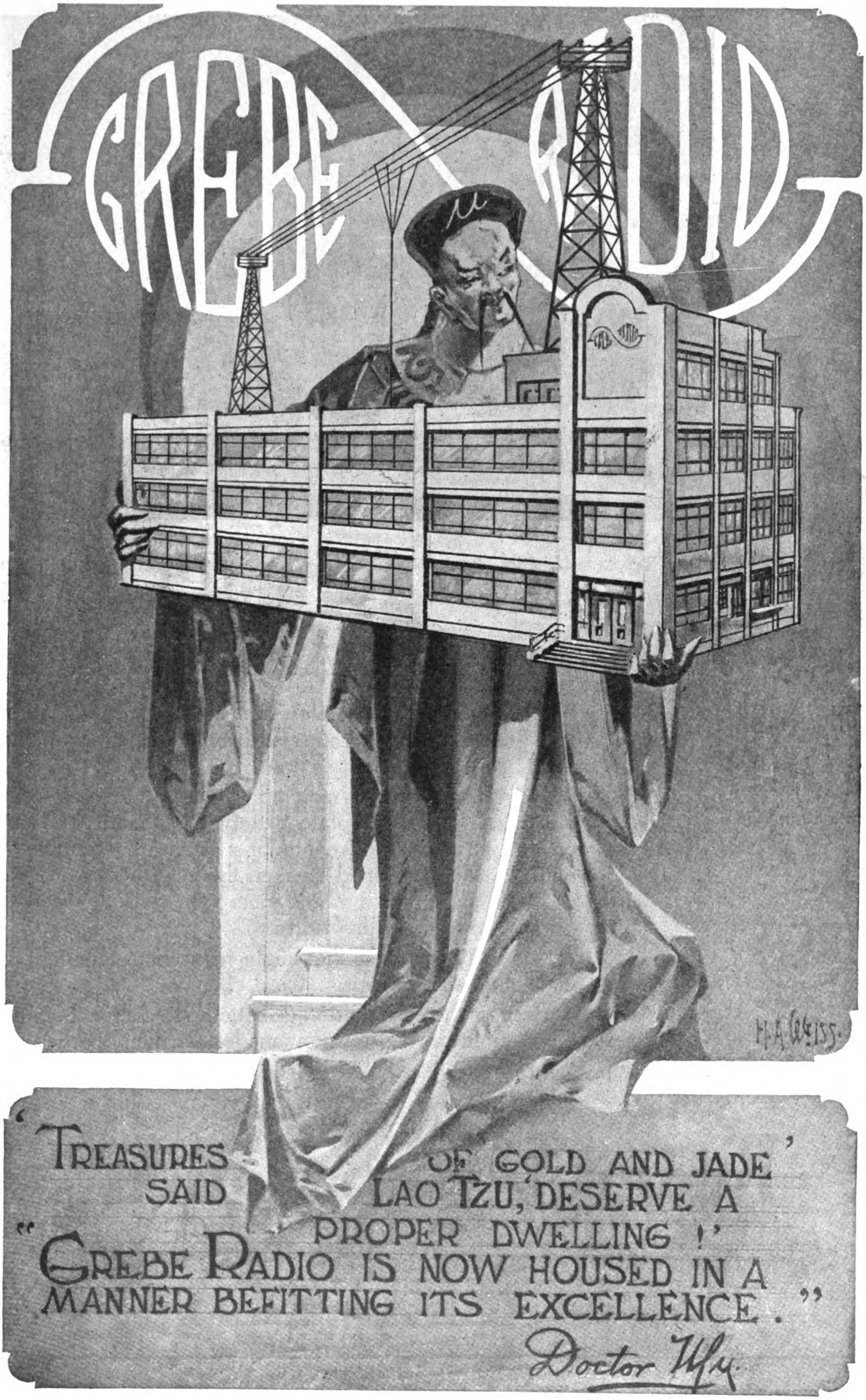
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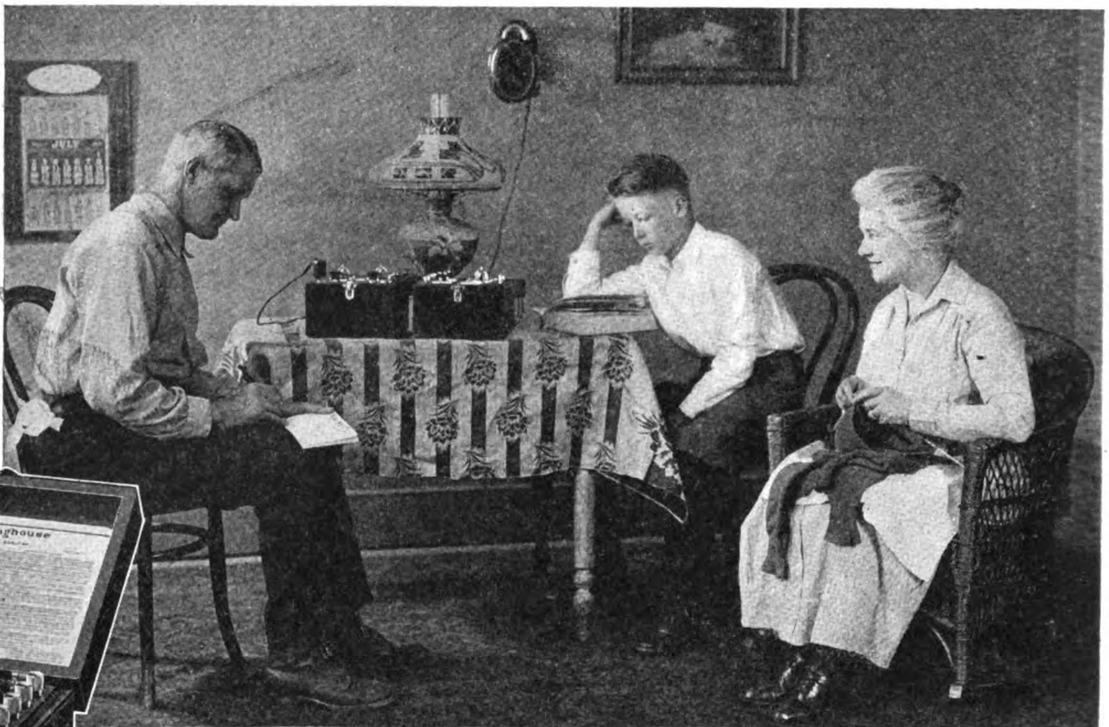

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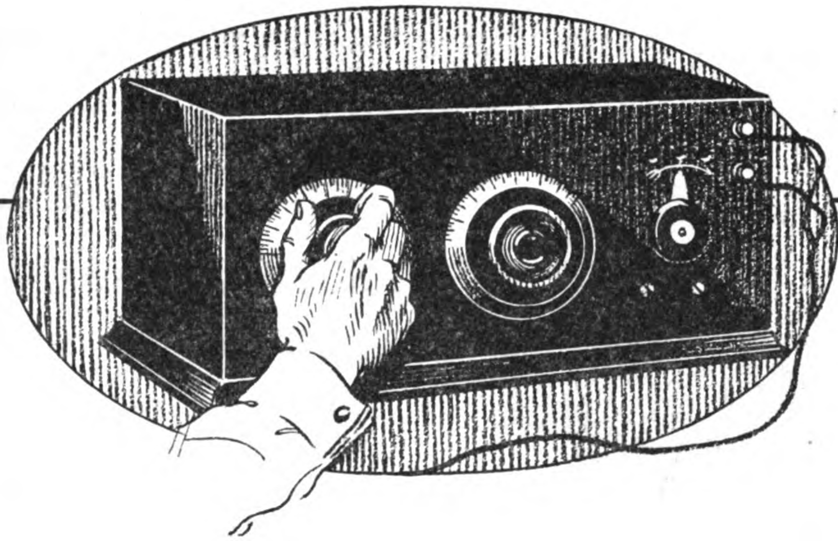

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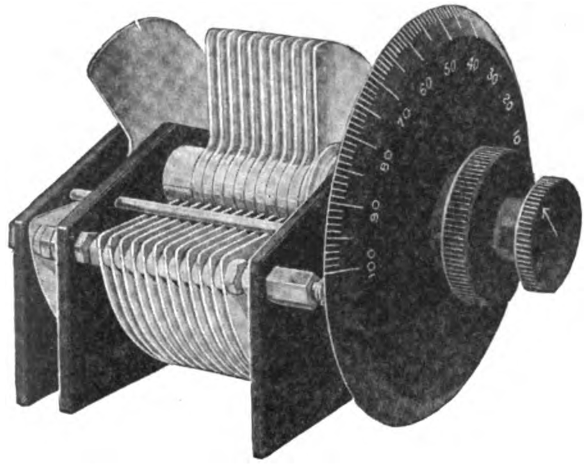
IMPORTANT ANNOUNCEMENT



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23 plate, with dial	$6.00
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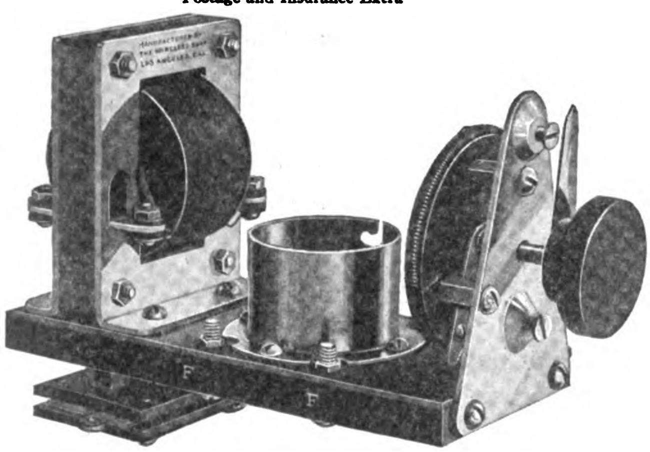

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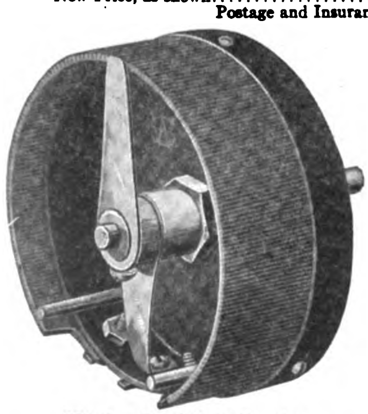

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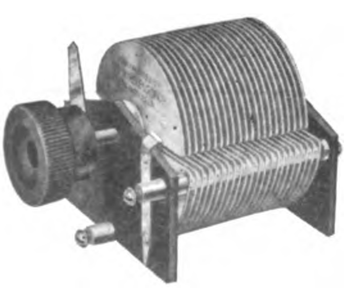

"Wireless Shop" Quality Variable Condensers
New Prices

No. 20	$1.60
No. 70	1.90
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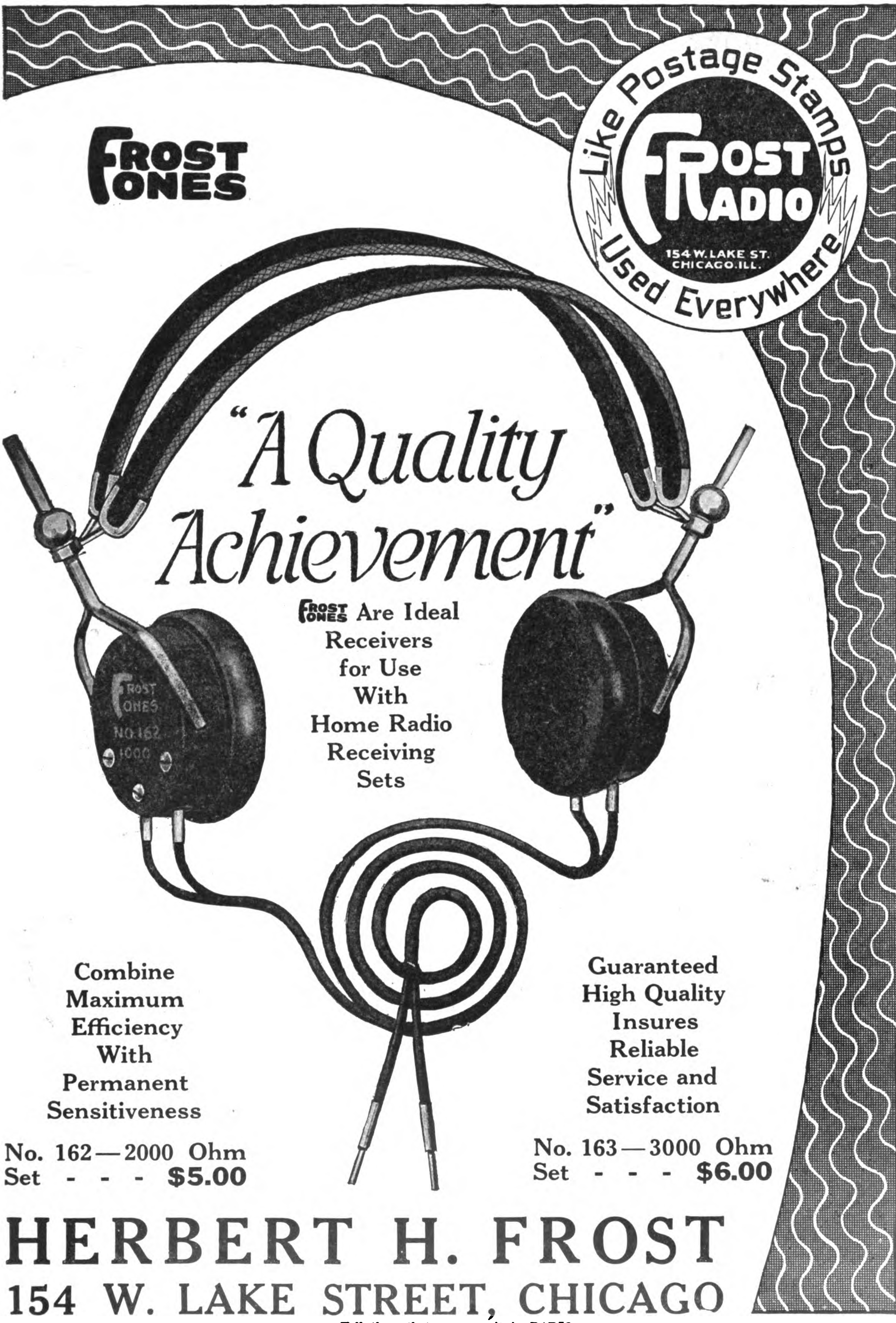
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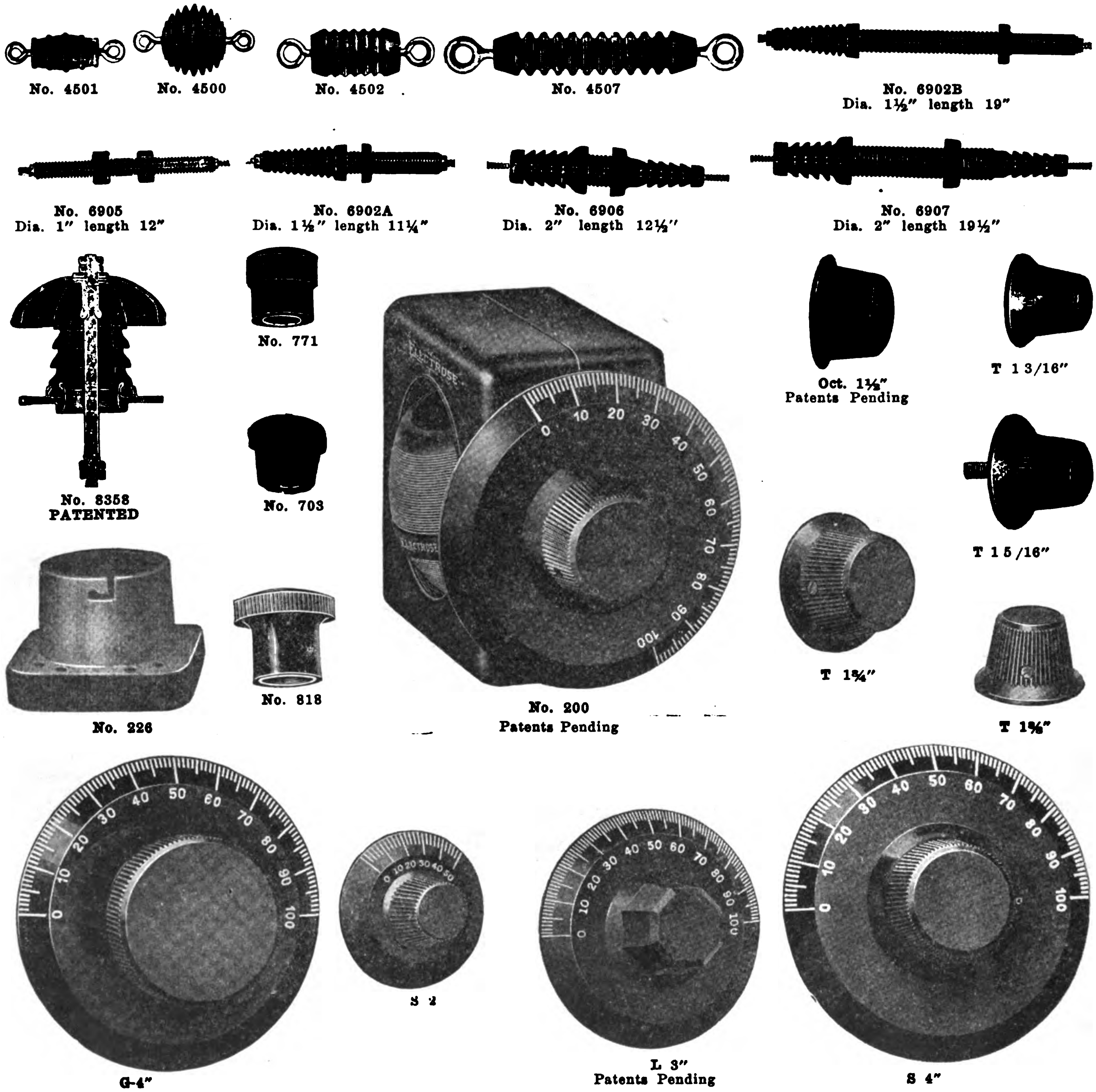

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Globe Commercial Co., San Francisco, Cal., Factory Representatives on the Coast

Tell them that you saw it in RADIO

October, 1922 RADIO Vol. 4 No. 10

Radiotorial Comment

HERE is a proposal well worth the consideration of every amateur owning a spark transmitter which is interfering with the reception of radio broadcasts. In order to reduce such interference a number of dealers have tentatively proposed to supply the equipment for a tube transmitter at wholesale cost if the amateur will dismantle his spark set and agree to keep it off the air. At present this plan is proposed only for Sixth District stations and is subject to general acceptance by the amateurs. If it proves satisfactory locally it will probably be applied nationally. With the manifold advantages of C. W. transmission and the probability of eventual prohibition of spark sets this offer is most opportune. Readers are invited to write their opinion of the idea to the Editor.

THE relative rights and privileges of those who transmit by radio is a universal bone of contention. Now that the practical limit of wavelength appropriation has been reached, the "air" is no longer as free as it used to be. So recent are the demands for its use that neither legislation nor court decisions are available to settle disputed points.

The first squatters on this part of the public domain were the amateur operators. But they were soon crowded off into the far confines of the reservation by the Army, the Navy, the ships, and the commercial radio companies. The former two classes have appropriated unto themselves large tracts of the air which they are not adequately using and, in addition, some of them are poaching on the amateurs' preserves with lower harmonics.

The latest settlers in the promised land are the broadcasters, who have been forced to take what is left, although their service to the general public is at least equal to that given by any other class. It is recognized that there should be no interference with such important services as ship communication, but, nevertheless, the present 360, 400 and 485 meter wavelengths are insufficient to care for the public interest in broadcast news and entertainment.

The whole situation is much like that prevailing among the early miners after the gold rush to California in 1849. Coming to a land where there was no established law and order, they protected themselves by the adoption of local customs, which later were incorporated into the law. Strangely enough, these customs, especially those regarding the use of water, are peculiarly applicable to the use of the "air." In fact, the men who will eventually be delegated to formulate a radio code might well pattern their rules upon the established water laws. While the analogy is far from perfect, still, it is suggestive of what radio needs.

As the western pioneers soon found that the old English law of riparian rights did not meet their needs, they developed the doctrine of appropriation, which is now an integral part of the law of almost all of the western states. Its basic principle is that water is regarded as the property of the public.

Priority is the governing factor in appropriation. "The first in time is the first in right." This is modified, however, by the recognition of the rights of a subsequent claimant who proposes to put the water to a higher use and a greater development than the first appropriator. As the public is the real owner of the water, the right to use it is granted to the one who gives the best public service.

Water rights, like other real property, may be lost by abandonment, which "simply adds to the unappropriated public waters and the benefits therefrom are not intended to accrue to a particular person." "The popular notion of the exclusive ownership of water finds no authorization of the books."

The right to the use of public waters is granted for a definite time, after which the title reverts to the public if proper compensation is made for the equipment utilizing the water. An annual license fee is charged for the use of the water. The water rights cannot be capitalized.

Without going into further details, it is evident that these principles are well adapted to the regulation of radio broadcasting. In fact, these very ideas, because of their common sense and their common justice, have been used by the Department of Commerce in deciding disputes about the use of the medium whereby radio communication is maintained.

No one should question the decision that the "air" is public property, that the needs of the Government are paramount in the use of the public domain, and that there is no basis of claim for private ownership. The priority rule as modified by the greatest service to the greatest number also seems just, as likewise does the rule for forfeiture by abandonment. In order to protect the broadcasters' investment in a station, it will be wise to grant a license for a definite tenure, not revocable at the whim of a Government official, provided, of course, that adequate service is being given the public. A license fee also seems desirable if similar charges are made for other classes of service.

There are many other questions, such as the equitable allocation of hours and the determination of wavelengths in the proposed bands, for which little precedent is provided in the law of water. Such questions as are peculiar to radio are being settled amicably by mutual agreement among local broadcasters. The best of these local customs will undoubtedly survive in the ultimate law which will enable those on the air to live together in peace and harmony.

The C. W. Manual

Final Installment

By J. B. Dow, Lieutenant, U. S. N.

Notes Concerning Mechanical Processes

1. Following is a list of tools and equipment that every experimenter should possess: Small electric soldering iron and accessories; three inch bench vise; small breast drill and set of drills, size 0 to 60; tap wrench and taps of common sizes; jeweler's saw frame and supply of saws; combination square; pliers, including flat nose side cutters, long nose side cutters, diagonal cutters, gas pipe, and round; an assortment of screw drivers; small calipers; eight inch scale; drill gauge; thread gauge; assortment of files; small hammer; center punch; countersink tool; scriber; dividers; hack saw, and an assortment of machine screws. Wood working tools are also necessary if the experimenter does his own cabinet making.

2. Large holes are easily cut in bakelite or similar substances by using a boring bar in a drill press and boring half way thru from each side. In this connection a small centering hole must first be drilled for lining up the tool.

3. A jeweler's saw is one of the handiest tools that the experimenter could possess, yet one is rarely ever found in the average constructor's workshop. To those who are unfamiliar with such a tool, it is simply a very fine hack saw which finds an almost unlimited number of applications.

4. A metal cutting band saw is much preferred to a circular saw for cutting bakelite and similar substances.

5. Black crystalizing enamel is used to produce the beautiful checked finish oftentimes found on metal parts of radio

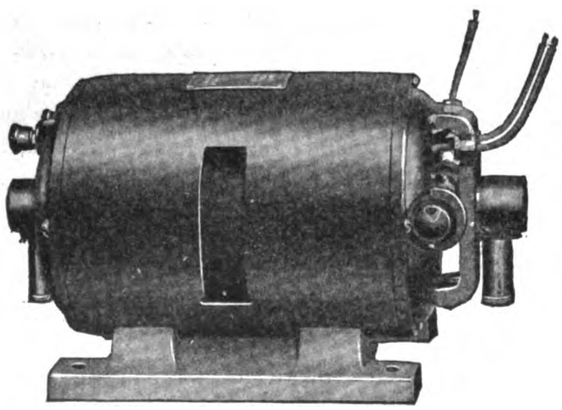


Fig. 70. Two Bearing Single Unit Motor Generator

apparatus. This is easily applied with a camel hair brush and checks in the process of drying.

5. The modern tendency in the construction of vacuum tube transmitters is to use Litz for conductors of high frequency currents of any appreciable magnitude and this excellent tendency is somewhat thwarted by the difficulties usually experienced in soldering same. Litz composed of individual wires smaller than No. 32 does not ordinarily warrant usage in view of the difficulties encountered in soldering. Where the wires are larger than this, the enamel may be removed quite easily by heating to redness in a clean flame such as is given by hydrogen gas or alcohol, and plunging the heated section in alcohol, repeating the process once or twice. This procedure breaks down the enamel in such a manner as to make it easily removable by immersing in hot solder and scraping lightly. The enamel comes off quite easily and floats to the surface of the solder. The application of a very small quantity of good anti-corrosive soldering paste will then cause the solder to run in, making a solid mass when cool. The greatest difficulty that will be experienced will be in obtaining a clean flame such as is given by hydrogen gas.

Notes Upon the Selection of Apparatus

1. Litz inductances are far superior to edgewise wound copper strip inductances or to inductances wound with copper tubing as regards high frequency resistance. The latter type, however, has a slight, though unappreciable, advantage

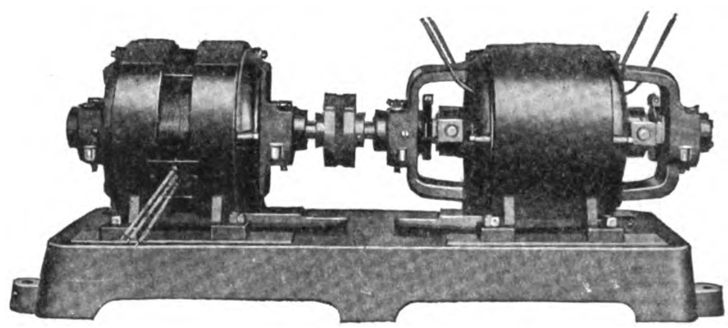


Fig. 71. Double Commutator Generator

over the second type. Inductances wound with solid round conductor are inferior to other types and this inferiority increases as the size increases beyond a certain limit for a given current flow. It likewise increases as the size decreases below a certain limit for a given current flow.

2. Generally speaking, a modulation transformer having a primary to secondary turn ratio of 1 to 30 will be found most satisfactory.

3. Small motor generators having outputs under 200 watts are most desirable in the form of two bearing single unit machines. A unit of this type is shown in Fig. 70. Larger sets for generating voltages under 1500 are most satisfactory in the form of two unit four bearing machines. Where the output voltage is in excess of 750 volts the generator should be of the double commutator type. Such a

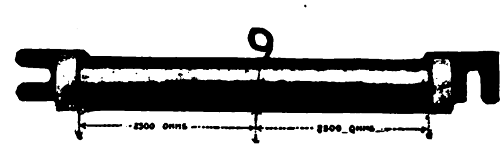


Fig. 72. A Rugged Grid Leak Resistance

machine as manufactured by the Electric Specialty Co. is shown in Fig. 71. For producing voltages in excess of 1500, two such generators connected in series and having their frames insulated from each other and from the motor which may be most conveniently mounted between them, are recommended.

4. Fig. 72 shows a type of grid leak resistance manufactured by the Radio Corporation of America. This device is meeting with great favor because of its ruggedness and facility for mounting.

5. Though not mentioned heretofore, a motor driven chopper is an ideal device for modulating the output of C. W. transmitters for non-oscillating tube or detector reception. A device of this kind may be inserted either in the grid, or oscillating circuit.

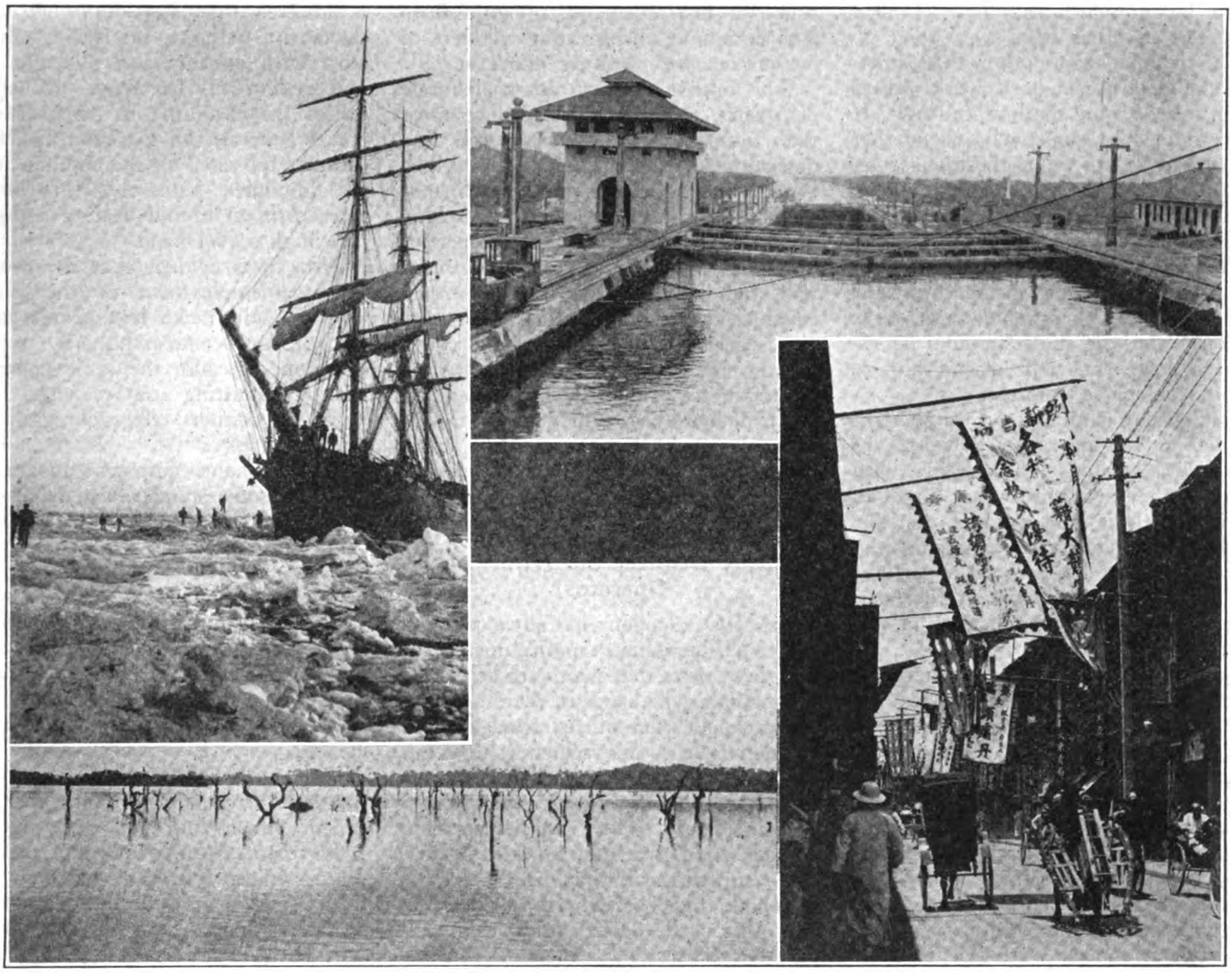
The Professional Radio Operator

By Volney G. Mathison

Photographs by the Author

The Radio Operator's Future

MANY complain that there is no future in commercial radio operating. To learn radio, they say, obtain a license and become an operator, is well—but what then? What can the wireless operator look forward to? What can he, as an operator, aspire to become? For what will his commercial radio experience qualify him?



The trail of a radio operator may lead from the cruel ice-pack of the Bering Sea to the strange sights and smells of the Far East, and even to the sun-burnt tropics, where man has cleft two continents with a Panama Canal and drowned an ancient forest with Gatun Lake.

Commercial radio operating, it is true, cannot be regarded as an end in itself; it does not rate high enough. In the operating field there is little reward for experience. The salaries are fixed, unvarying, with no regard as to whether the operator is a beginner with the ink hardly dry on his license, or a straight-gap pioneer with enough certificates to paper the walls of his wireless shack. The experienced operator's only important advantages are somewhat steadier employment and prior claims for the most desirable ships. As has already been pointed out, the older radio men have a monopoly on the shore berths, but there is not at present room in the land radio field for every shellback; and, even so, once settled down in a shore station, the operator is liable to become a fixture, with no great prospects for betterment financially or otherwise in his condition through the passing years.

In conformity with the demands of truth, this, the unfavorable aspect of the radio operator's future has been touched upon. But to look into the matter, as many do, no further than this, is to draw a somewhat erroneous conclusion; erroneous because we have considered only the field; we have not considered the man.

I happen to be acquainted with an old fellow tending generators in a small street railway power plant, who knows how to keep the most wonderfully soft polish on his commutators that I have ever seen; for he has been polishing them right in that same power station since 1894. Dynamos, boilers, machinery have come and gone, but the old tender is still there, and considering present prices, he is not getting much more pay now than he got twenty-eight years ago. Again, I have a friend who wore the phones six years, then he became foreman in the shop of a small concern manufacturing radio equipment; soon he was in full charge; and now he is half owner of a factory completely equipped with expensive automatic machinery and employing nearly a hundred men—one of the largest manufacturers of amateur radio apparatus in the United States today. Deprived of his ability and forced to compete with it instead, the old concern has gone out of business. This former radio operator started with no capital; he had no extraordinarily good luck; but he had ambition and the kind of brain back of it that makes success inevitable.

This is all very fine, but we cannot all build wireless apparatus, some one may rejoin—there are already so many apparatus-maker magnates that, like the moonshiners, they almost have to carry badges in order to avoid canvassing one another. True, perhaps, but I have cited merely one example of many that I could present. A number of former radio operators are engaged in important radio construction work, both at home and in foreign countries; others are at the manager's desk and higher among the commercial wireless companies; while to a very great many more radio operating has been a rung or two in the ladder which they have climbed to success in other lines.

The popular assumption that ambition and determined hard work always bring success is a shallow fallacy. It is maintained by some, who argue that not every one can be at the top—somebody must hew the wood and draw the water—that it were better therefore for writers generally to leave off harping on this worn-out theme and turn their efforts upon present social injustices, that these may be uprooted and every worker, even the most humble, be assured a wage that will permit him to live in reasonable comfort.

While there is much food for thought in this, in the present article we are necessarily confined to dealing with things as they are, not as they ought to be; and so it is here asserted that the youth who has really something in him will find that he has as good opportunities for advancing himself in the commercial radio operating field as in any other.

No, he has vastly more, for what field of endeavor is there on earth that has even comparably such possibilities and such titanic development yet to undergo as has radio? Other branches of electricity are well established; they have already traveled far on the road to ultimate perfection; applications have already been made in almost every conceivable place and manner; while radio —why, radio has just begun!

Ten years ago we were glad to cover a hundred miles on a kilowatt of transmitter input, and in long distance high power work ten kilowatts for each hundred miles was found hardly sufficient. During the few short years that radio has been put to commercial use, six or seven distinct types of equipment have been "the latest," only to be doomed to disuse in a few months by the advent of something tremendously better. A great amount of highly improved shipboard radio apparatus was built during the war, and, compared with earlier equipment, this apparatus of four years ago appeared to have approached very near to perfection. Some even went so far as to say that the end of improvement had been about reached. What a short-sighted view!

Our highest class quenched-spark sets do well to cover two thousand miles over water at night—ideal conditions—on a full two kilowatts input; and now transmission over prairie and mountain-range from California to New York is being accomplished on four five-watt vacuum tubes. Not long ago an operator on a ship two thousand miles out in the Pacific successfully copied on a one-step amplifier a lad in eastern Oregon sending on a single five-watt tube. Who dare say that the end of radio development has been reached, or that it is even in sight? Who knows what mightier potentialities lie in this vacuum tube, an instrument justly entitled to a place among the greatest wonders of modern science—and yet brand new!

The upshot of this rather elaborate discussion is this: the radio operator with ability and live energy will find opportunities opening before him which are to be grasped in no other line of electrical work today. And in reaching at these opportunities, the prospective operator, indeed the veriest beginner, will find himself able to stand on an equal footing with the oldest and most experienced man now in the radio game, because the future is destined beyond any doubt to bring the entire abandonment of both arc and spark wireless. We all, expert and novice alike, must learn a new radio—vacuum tube radio. Who cannot read the signs of the times?

Will the Radio Telephone Eventually Displace the Wireless Operator?

RADIO telephony has advanced with such incredible rapidity during the last three years that many are beginning to speculate whether this, the most marvelous application of the three-element vacuum tube so far achieved, may not eventually replace the wireless telegraph —and the operator.

Coincidently with the development of the "hard" vacuum tube, or rather, as a result of this development, the radio telephone has evolved from early arc and other crude devices to at least comparative perfection. Musical concerts and speech transmitted on a fifty-watt radiophone have been received with ample audibility and remarkably good modulation over a distance of 2500 miles; and this is only the beginning. The "radio link" between Los Angeles and Catalina Island has connected the Bell telephone system to the local telephone lines on the little island out in the Pacific, and so perfectly has the feat been accomplished that the subscriber at his ordinary city phone can hardly believe that his voice is being relayed by radio across thirty miles of ocean. This is virtually the first application commercially of the wireless telephone so far attempted. It is almost comparable to Marconi's wireless telegraph operations of 1900; and if the radio telephone is destined to undergo, in turn, the vast development that has already taken place in the field of the wireless telegraph since its first commercial utilization—but who will venture to carry out the comparison?

In the marine radio field it is possible that the wireless telephone will supplant the telegraph on a few ships. The employment of the radiophone on shipboard will be facilitated through the ultimate universal adoption of the vacuum tube transmitter. This last is inevitable. The spark transmitter of whatever type will eventually by strict legislation be barred off the air. Where a hundred tube sets can work simultaneously without interfering in the least with one another, a single spark can destroy all harmony. When the use of the vacuum tube transmitter becomes general, the spark outfit will no more be tolerated on the air than would an unmuffled automobile in the city streets, or an urchin beating a dishpan in a high school band.

Now it is evident that the eventual universal employment of the vacuum tube set will make it a simple matter to introduce commercially the wireless telephone, because the same apparatus, both transmitting and receiving, can be used for either telegraphing or telephoning.

A radiophone equipment aboard ship, tuned to some standardized telephoning wave, will be able to call the desired shore station, which will answer likewise on "phone." Certain hours for wireless telephone work may be assigned in order to simplify ship and shore and ship to ship communication; and a vessel out of reach of the coastal stations might relay through an intermediate ship. In this way traffic could be cleared.

Nor will the availability of radio-compass bearings be in any wise curtailed. Each ship will carry its own radio-compass equipment; and the navigating officer will take his own bearings upon continuously transmitting coastal stations. No knowledge of code will be necessary to recognize the different coastal transmitters, since these will be automatically operated by motor-driven contacting devices adjusted to give certain prearranged combinations of long dashes and dots (analogous to lighthouse flash signals) sent so slowly as to be easily recognizable by anyone. If this seems a far-fetched idea, it may surprise the reader to learn that the installation of such automatic radio transmitters in the more important lighthouses is actually being planned. These "radio beacons" will, of course, be operated only in foggy weather, and being purely automatic, could be cared for by the light-keepers. This will be

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The Electronic Theory of Matter

First and Second Text Assignments in Correspondence Course on Elementary Radio Conducted by University of California Extension Division

By Ellery W. Stone

THE transmission of intelligence by means of radiotelegraphy or radiotelephony is essentially an electrical phenomenon. Hence, in order that the student may have the proper grounding for this course, we shall consider, in the first assignment, the fundamentals of electricity, the electronic theory of matter, and definitions of the more common electrical terms.

At the outset you may be interested to know that the electronic theory is probably the most comprehensive, the most amazing, of the various theories and hypotheses which have been advanced, and accepted, in all science. For the electronic theory explains the structure of all matter; it explains the foundation on which all life, active and inanimate, is based. Too much importance, therefore, cannot be attached to this theory and the student is urged to acquire a thorough understanding of it before passing on to the later assignments of this course.

Briefly, the electronic theory sets forth that matter—that is to say, everything material and physical in life, all solids, liquids and gases—is simply condensed energy. This energy is electrical energy.

Whether or not you have studied chemistry, you probably know that all solids, liquids and gases are divided into three classes—elements, compounds and mechanical mixtures. Zinc and copper are elements because no matter how much either of them may be disintegrated through heat or other agencies, it cannot be so separated or decomposed as to produce any substance other than itself. Brass, on the other hand, is a compound, and through heat and other means may be dissociated into the two elements of which it is composed—copper and zinc. Water, also, is a compound, composed of the elements hydrogen and oxygen. If suitable proportions of sulphur and oxygen, already combined into a compound, are added to the hydrogen and oxygen which together compose water, we shall have another compound—sulphuric acid. But if oil, let us say, which is a compound of the elements hydrogen, oxygen, and carbon, is mixed with water, a new compound will not result. These two compounds will not combine to form a third compound, oil will not dissolve in water—we say—and while we may keep both compounds in the same container, may even shake them vigorously, they will not blend together to form a new compound. The result of this combination is called a mechanical mixture, each of the two compounds, oil and water, retaining its own identity and characteristics even though in physical contact.

In disintegrating an element down to the most minute portion of it which can exist, we arrive at the *atom*. In breaking up a compound, which is composed of two or more elements, into the smallest part of it which can exist and still retain the compound's characteristics, we obtain the *molecule*. A molecule of any compound is thus seen to be composed of two or more atoms of the various elements of which the compound is formed.

As may be imagined, the greatest interest in the field of advanced chemistry centers around the atom. Recently it has been found possible to break up the atom—not into combinations of new elements, because the atom itself, as we have seen, is the most minute particle of any one element which can exist and still retain all of the characteristic features of that particular element—but into the electrical charges, called *electrons,* of which the atom is composed.

What is the electron itself? That is something which no one knows. It is the nearest approach to the infinite to which the scientist comes. He is able to measure the amount of its electrical charge; he knows that there is a positive electron always associated with some indefinable mass 1845 times heavier than that associated with the negative electron. Both positive and negative electrons, however, have the same degree or quantity of electrical charge, except that they are of opposite polarity or sign—that is to say, the charge of the heavier electron, if we may speak of its weight, is positive, while that of the other is negative.

It is a fundamental law of electricity and magnetism that like charges repel each other and unlike charges attract. Thus, if two positively charged electrons, or two negative ones, happen to be near each other for an instant, their like charges cause them to repel each other and they fly apart. On the other hand, a positive electron has the greatest attraction or affinity for a negative one, and if two of these dissimilar electrons are near enough together to exert their influence on each other, and if there are no other electrons in the vicinity and no other adjacent electrical or magnetic force which might affect their normal behavior, their unlike charges will cause them to fly together and unite.

Bear in mind that the electron, whether positive or negative, is simply an electrical charge. It is not associated with anything tangible, any element, of which we have knowledge. It is believed by some scientists to be associated with a magnetic strain in the *ether,* that mysterious, all-pervading medium which is said to fill all space and which serves to conduct or transmit the great family of electrical waves—the wireless or radio waves, heat, light, and ultra-violet rays, such as the X-ray and the emanations from radium and other radio-active substances. In the next assignment we shall consider this great family of electrical waves in more detail.

What complicates our understanding of the true identity of the electron is the fact that since the publication of the Einstein Theory of Relativity, the opinion has grown among scientists that it is no longer necessary to have our conception of the ether at all. This being the case, one can understand why the theory that the electron is a magnetic strain in the now dubious ether does not mean very much.

However, because it has been scientifically proved, the student must be asked to accept on faith the theory that the basis of all matter is the electron—an infinitesimally small, weightless electrical charge.

In the study of chemistry we find that the hydrogen atom is the lightest of all the atoms of the different elements. This hydrogen atom is now definitely known to be composed of a single positive and a single negative electron. It is believed that the negative electron revolves in a circular path or orbit around the positive one, but this is not definitely known.

The atoms of the heavier elements are indicated simply by adding to the hydrogen combination of one positive and one negative electron additional negative electrons, together, always, with an equal number of positive ones. This is really one of the most amazing phenomena of all science—that out of the electron, simply by building up various combinations of these minute positive and negative electrical charges, always an equal number of each, should emerge the atoms of all the elements.

Now, since the atom is composed of an equal number of positive and negative electrons, it follows that the resultant atom itself is not characterized by any electrical charge or activity. The number of positive electronic charges is exactly balanced, neutralized or cancelled by the equal number of negative electrons, since the *degree*—not the kind—of electrical charge is the same with both positive and negative electrons. The resultant electrical charge of the atom is thus seen to be nil, or zero.

It has been conclusively proved that the atom consists of a relatively heavy nucleus of positive electrons—it is only in the hydrogen atom that we have but one positive electron together with its single negative neighbor—surrounded by a ring, or by rings, as we approach the heavier elements, of negative electrons. Fig. 1 represents what may be considered as a hydrogen atom, consisting

Fig. 1—Representation of Hydrogen Atom

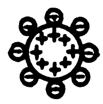

Fig. 2—Representation of Atom of Heavier Element

of the "heavy" positive electron to which is clinging, or around which is revolving its companion negative electron. (The plus sign, +, represents the positive electron, and the minus sign, —, the negative electron.) Fig. 2 represents the atom of one of the heavier elements. In Fig. 2 the positive nucleus is shown as a single circle with eight positive charges. In reality, this positive nucleus actually consists of eight separate and distinct positive electrons. It will be noticed that the positive nucleus, with a positive charge of 8, is surrounded and neutralized by eight negative electrons.

In the above, we have briefly considered the electron and the electronic theory of matter. In addition to being, in a passive or static way, the basis of all matter, let us see what other characteristics or properties the electron possesses.

Since an electron is really an electrical charge, a stream of electrons proceeding from one point to another results in a flow of electrical energy and we have the familiar *electrical current.*

Certain substances are said to be conductors of the electrical current—that is to say, they permit an electrical current to freely pass through them. These conductors are usually the various metals (copper is the best practical conductor), although certain solutions, usually acidic, are also fairly good conductors.

When a substance is in solution, *i. e.*, dissolved in a liquid, usually water, one or more of the negative electrons of which it is composed become detached from the atom and are free to move about in the solution. So, too, it is believed that the factor which makes the metals conductors of the electrical current as distinct from those substances, like glass, for example, which are nonconductors or insulators, is the fact that at least one of the negative electrons of each atom is free to leave the atom and move about among the other atoms. Thus, a concerted movement, or drift, of these negative electrons through the metal—usually in the form of a wire—constitutes the electrical current.

Electrical Definitions

We have just seen that the flow of the electrical current through a wire is the movement of a stream of negative electrons. What causes these negative electrons to flow in a definite direction?

We have previously observed that it was a fundamental law of electricity that unlike charges attract each other and like charges repel each other. Negative electrons thus flow from one point to another in a wire only because the latter point is maintained, or is at a higher degree of positive charge. The attraction of the greater positive charge, then, causes the electrons to move toward that point in the wire, and since each electron carries—really is—an electrical charge, the movement or translation of all these negative charges from one point to the other constitutes, as we have seen, the electrical current.

The difference between the amounts of positive electrical charge at the two different points on the wire between which the electrons flow is called the "difference in potential" and is measured in *volts*. (Named after Volta, an Italian physicist of the early nineteenth century.) This difference of potential is sometimes called the *electromotive force* and is abbreviated as *E. M. F.*, or in formulas as *E*.

The greater the difference of potential between the two points, the greater will be the attraction exerted on the negative electrons and the greater will be the number of negative electrons passing between the two points in a given length of time. Thus, if we double the attracting force, we double the number of electrons or negative charges or the electrical current flowing in the wire. The electrical current is measured in *amperes* (named after Ampère, a famous French physicist of Volta's time), so we say that as we double the voltage, we double the amperage.

We may liken the voltage or E. M. F. to the head or pressure which forces a stream of water through a pipe, the stream itself corresponding to the electrical current or amperage.

Just as a stream of water flowing through a pipe encounters friction or resistance from the inner wall of the pipe and a certain amount of energy must be expended in overcoming this friction, so a conductor offers resistance to the electrical current. The resistance is actually friction between the negative electrical charges or electrons and the atoms or molecules of which the conductor is composed. This resistance is measured in *ohms* (after Ohm, a German scientist).

The relation existing between the E. M. F. between two points on a wire, the resistance of the wire between these two points, and the number of electrons, or the electrical current, flowing between these points is known as Ohm's Law, and is written as follows:

$$I = \frac{E}{R}$$

where I represents the amount of the electrical current measured in amperes, E represents the difference of potential or E. M. F. measured in volts, and R the resistance measured in ohms.

We might express Ohm's Law, then, as: the amperes equal the volts divided by the ohms.

Thus, if the E. M. F. is 110 volts, and the resistance of the wire—the filament of an electric lamp, for instance—is 220 ohms, the current will be ½ ampere (110÷220=.5).

There are two kinds of electrical current—*direct* and *alternating*. Direct current is that in which the electrons always flow in one direction through the wire toward the point of higher positive charge or potential. If we

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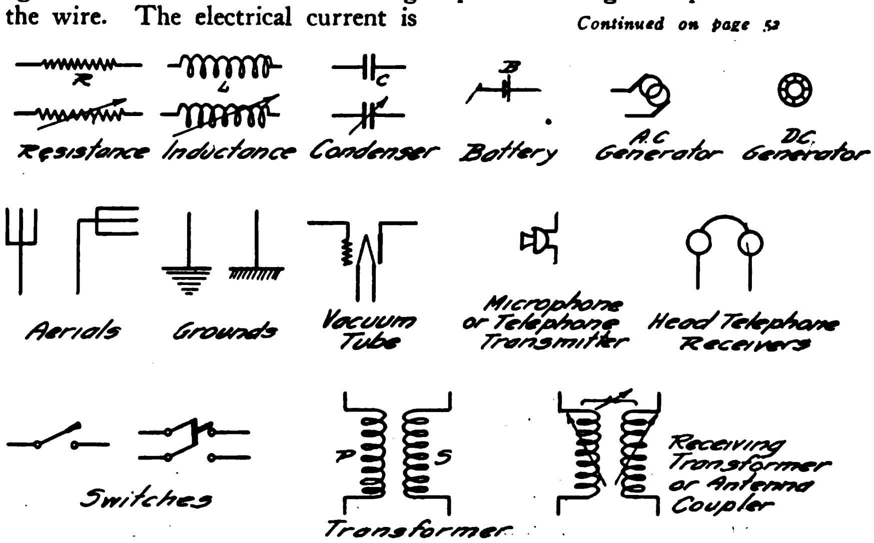

Fig. 4—Conventional Symbols

Armstrong Super-Regenerative Circuit

By B. F. McNamee

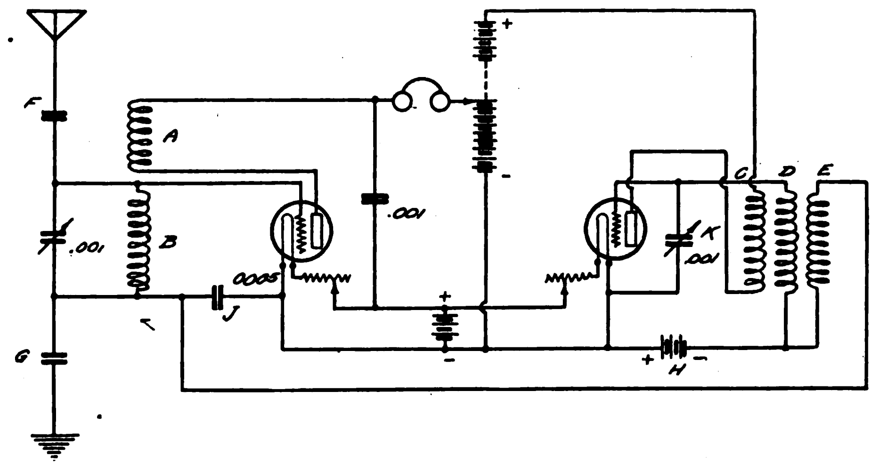

Fig. 1—Simple Form of Armstrong Super-Regenerative Circuit with Outside Aerial

MANY experimenters have been busy lately trying out the various forms of the new Armstrong super-regenerative circuit, with varying degrees of success. Most of them have come to the conclusion that it is, to say the least, extremely critical in its adjustments. The writer believes that Fig. 1 shows a particular form of this circuit which has not been given publicity and which is easier to adjust and gives better results than many of the other forms that have been shown. Of course, the underlying principle is the same in this as in the other forms.

Referring to Fig. 1, *A* and *B* are two closely coupled coils of a size suitable for the wavelength to be received. For 360 meters *A* may be a 100 turn honeycomb coil, and *B* 35 or 50 turns. However, small honeycomb coils do not permit a very close coupling and much better results may be obtained by making *B* the rotor and *A* the stator of a variometer. Of course, it is necessary to break the connection between the rotor and the stator before using it for this purpose. *F* and *G* are two extremely small fixed condensers. For each of these condensers the writer used two pieces of annunciator wire, about 4 or 5 inches long, twisted around each other. The insulation on the wires forms the dielectric.

It is reasonable to suppose that a high non-inductive resistance would do in place of condenser *F*, since all that is necessary is to prevent free oscillations in the aerial circuit.

C may be a Giblin or honeycomb coil of 600 or 750 turns; *D* is a similar coil of 1250 or 1500 turns, and *E* is a 1000 turn coil. They may be mounted in a triple coil mounting or simply placed one on top of the other with a few folds of paper between them.

The battery *H* consists of half a dozen small flashlight cells, variable in steps of one cell each. The B battery may be as high as 200 volts. The variable tap connected to the phones will usually be found to work best on about half the total B battery—in this case about 100 volts. However, the circuit will function nearly as well with the 86 volt battery usually at hand, with the variable tap at about 43 volts.

The voltages mentioned above have been determined when using two C-301 amplifier tubes (or two UV-201 amplifiers). The proper voltages for any given set-up must be determined by the experimenter himself. While it is not extremely critical, the circuit will not function if the ratio of the voltages applied to the two tubes is very far out. The alternating voltage developed by the second tube is quite high when the circuit is working properly, and consequently more care must be taken with insulation than in ordinary receiving circuits. For example, fixed condenser *J* should be a mica condenser, as paper condensers will usually puncture. The coils *C*, *D* and *E* must also be properly insulated from each other. A convenient way of doing this is to place a sheet of thin bakelite or empire cloth, or even a few sheets of dry paper, between these coils.

To operate this set, turn on the first tube only, and by varying the coupling between coils *A* and *B*, make sure that *A* is connected in the proper direction for regeneration. It is to be noted that when the second tube is not lit, the first tube and its circuit constitute simply a single-tuned, regenerative receiving set, and consequently one should be able to hear signals with this tube alone. Therefore, before lighting the second tube, it must first be determined that this simple receiving set is working properly.

When the second tube is lit and variable condenser *K* is set at full capacity, there should be a very high-pitched note in the phones. In order for this to take place, coil *C* must be connected in the proper direction for the second tube to oscillate. Once this high-pitched note is heard, the tuning condenser should be varied until signals are heard in the phones.

If the B battery on the second tube is too high, the voltage developed in coil *E* will be too great and nothing but the high-pitched note can be heard in the phones. If the B battery on the second tube is too low, the voltage developed in coil *E* will not be sufficient to paralyze the first tube and stop it from oscillating.

It will be noticed when this circuit is functioning properly, that coils *A* and *B* may be much more closely coupled than when they are used with the first tube as a simple regenerative circuit.

The filament rheostats on both tubes will be found to offer further means of controlling the operation of this circuit.

Fig. 2 shows one method of using this circuit with a loop aerial. Only the first part of the circuit is shown,

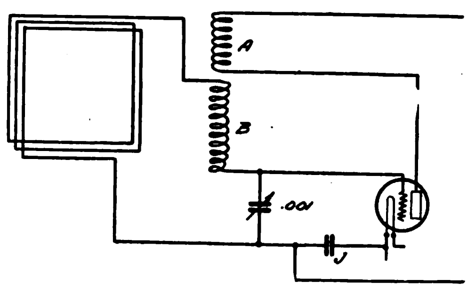

Fig. 2—Loop Aerial Connection

the remainder being the same as in Fig. 1. It is important that the loop be small enough so that when connected in series with coil *B* and the variable condenser, the circuit will tune to the desired wavelength.

So many adjustments present themselves in the use of the Armstrong super-regenerative circuit and many of them are so critical that it is not the kind of a circuit one would install with the reception of broadcast music the chief object in view. Rather, this set may be classed as the "experimenters' delight." The results that can be obtained are certainly amazing, especially if little or no aerial is used. Due to the fact that the aerial circuit must not be allowed to freely oscillate, this new Armstrong circuit cannot take advantage of a large aerial.

Using a good aerial, one or two steps of some form of tuned radio frequency

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BROADCASTING BY "WIRED WIRELESS"

EXPERIMENTERS may be interested in carrying out tests with radio transmission over electric lighting wires and thereby eliminating interference with and from the "air" transmitters. Under the direction of Major-General Squier a series of such tests has been carried on at Washington and Cleveland by R. D. Duncan, Jr., Chief Engineer, U. S. Signal Corps, Research Laboratory, Bureau of Standards. The information herewith is taken from his report as published in the *Electrical World*.

The transmitter was a 50-watt set with plate modulation and the addition of protective and tuning condenser for coupling to the high voltage power lines as shown in Fig. 1.

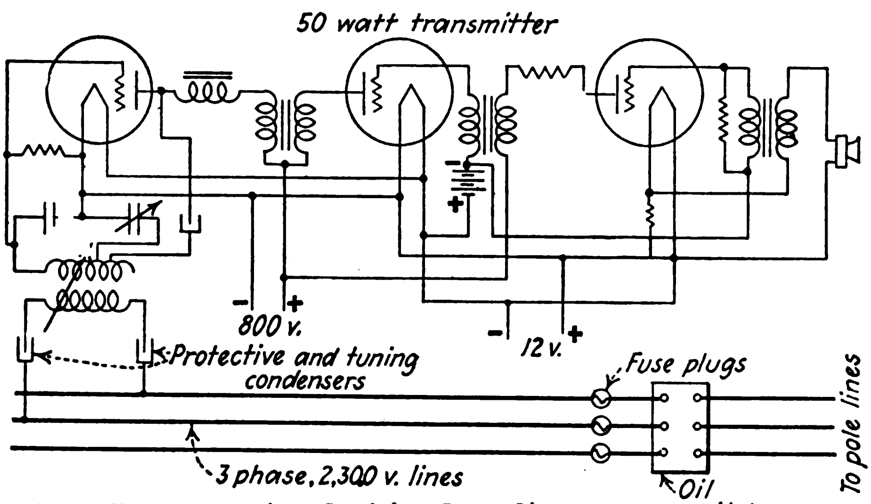


Fig. 1—50-watt Transmitter Coupled to Power Line

The receiving apparatus consisted of a coupled circuit tuner, a vacuum-tube detector and a two-stage audio-frequency amplifier, as shown in Fig. 2. During most of the tests the receiving circuit was purposely maintained in the non-regenerative condition, so that the only amplification obtainable was that due to the amplifier. The receiving set was plugged into the light socket of the 115-volt lines with a blocking condenser. Ground connection was effected in the usual manner.

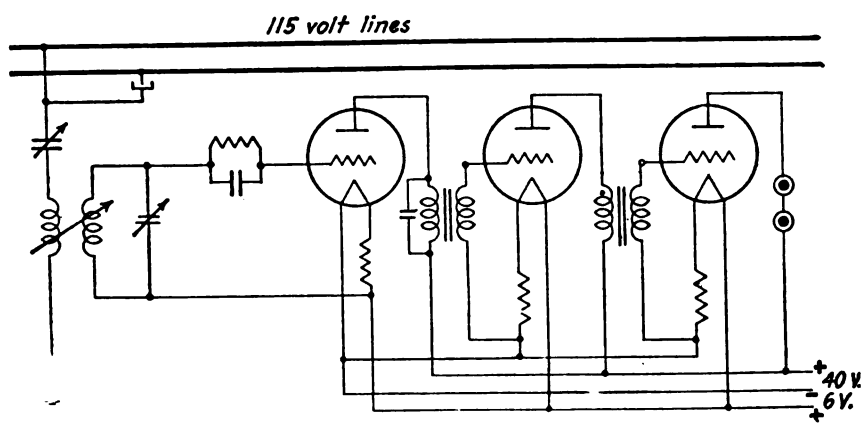


Fig. 2—Receiving Set Coupled to Convenience Outlet

Five wavelengths—*viz.*, 350, 420, 710, 3800 and 13,000 meters—were tested. Of these the three lower gave neither consistent nor dependable results when received at different points on the lines. Furthermore, on the short wavelengths there was appreciable radiation from the lines, as was evidenced by the fact that fair radio reception was obtained on an antenna several miles from the transmitter. The latter result is more or less contrary to certain theoretical predictions which have been made relative to radiation from transmission lines at high frequencies. To reduce the radiation effect and also the attenuation or linear dissipation of the useful high-frequency energy, which should decrease with increasing wavelength, the wavelength was increased first to 3800 meters and then to 13,000 meters, of which 3800 meters gave the best results, both as to the quantity of speech received and as to the quality of modulation. Assuming the transmitter conditions to be the same for both wavelengths, this would indicate the existence of an optimum wavelength for the particular distribution system operated on. It points to the possibility of the existence of similar optimum wavelengths for other transmission systems. Time did not permit investigation of the region of wavelengths between 3800 meters and 13,000 meters to settle this point definitely.

Further to investigate the radiation effect, wherever possible, careful comparison was made between reception over the 115-volt lines and on an antenna. On the 3800-meter and 13,000-meter tests and with the same order of magnitude of line current obtained at the shorter wavelengths the very faintest reception was observable on the antenna at certain times only. With the same receiver conditions a good quantity of speech was receivable from the lighting wires. This result was obtained on a number of tests, and it is believed it is perfectly general.

PIONEER AMATEUR RADIO WORK

By HOWARD C. SEEFRED

READERS of RADIO may be interested to learn what was done in long distance amateur work before radio laws were adopted, when amateurs used to use anywhere from one to five kilowatts on a wavelength from 300 to 1000 meters.

Such "old-timers" as Clarence Keller, Dean Farran, Harold McIntosh, Frank Hopkinson, Fritz Faulk and others, who are active in amateur radio of today, will no doubt remember "them was the good ole days, but no more." These fellows live in or near Los Angeles and have been in the radio game for nearly fifteen years, including myself and my brother.

My first experience in long distance amateur reception was made in the fall and winter of 1912, using a pair of 2000 ohm Superior Brandes phones (bought on December 19, 1911, and used up to February 17, 1922, when they were sold), a home-made 1000-meter loose coupler, fixed condenser and galena detector, using an antenna (4 wires) 50 ft. high and 50 ft. long.

During this time I heard SJB (Palo Alto, Calif.), SAZ (San Jose, Calif.), SAG (San Francisco, Calif.), DO (Hollister, Calif.), PH1 (Burlingame, Calif.), PH2 (Santa Cruz, Calif.), and PH3 (Pacific Grove, Calif.). All are from 300 to 350 miles from Los Angeles. Later on I made a quarter kilowatt transformer, using straight gap and helix. I worked NPL (San Diego, Calif., 115 miles), which was my best distance covered. At that time I used KM or CFS for call letters. Some time later I made some improvements by adding a rotary gap and oscillation transformer (helix type). One good night I worked KH (Bakersfield, Calif., 100 miles), the first long distance amateur I worked.

"Ye good ole days, eh, fellows!"

Radio Frequency Amplification with Standard Regenerative Sets

By Donald K. Lippincott

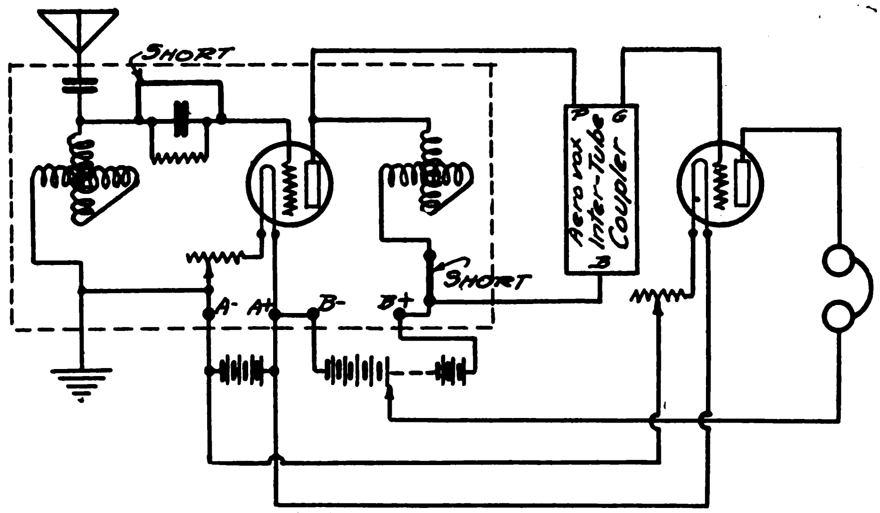


Fig. 1—Conversion of Single Circuit Set

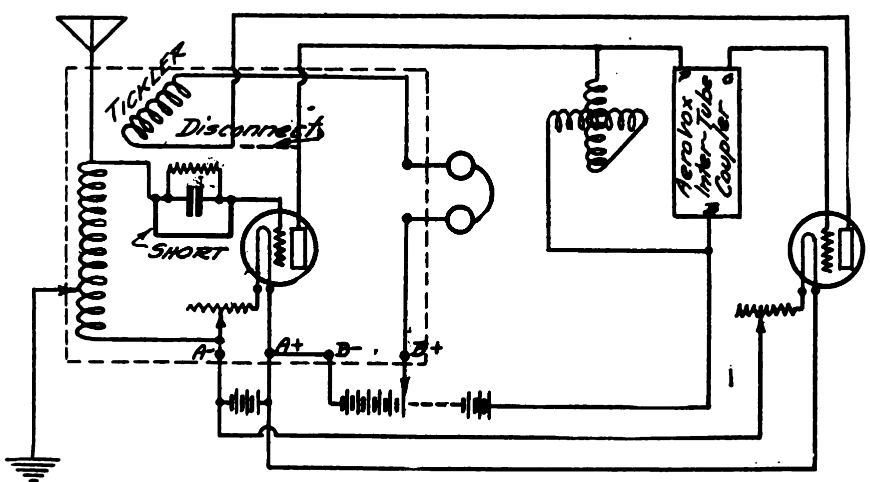


Fig. 2—Conversion of Tickler Regenerative Set

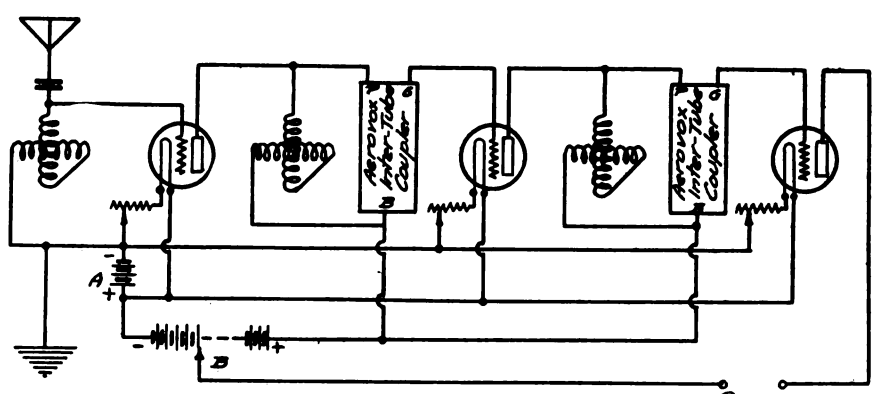


Fig. 3—Hook-up for Two Stages

THE following hook-ups were developed owing to a conviction that the mere possession of a standard type of regenerative receiver does not necessarily kill the urge to experiment, and that many a man who owns one would add a stage of radio frequency if it could be done without a major surgical operation.

Tuning raises the efficiency of any amplifier of this class to such a marked degree that its use is always advisable, especially on the shorter wavelengths. This has been done in the circuits shown, which use the Aerovox inter-tube coupler. For any other type of coupling device or transformer a modification of the circuits would be necessary.

The easiest type of set to convert to this plan of operation is that using the tuned plate circuit feed-back. Most of the short wave sets come under this head, as do the Kennedy Universal and Intermediate outfits when used on short wave reception. The materials needed for making the addition are: tube-socket, amplifier tube, rheostat, and inter-tube coupler.

Fig. 1 shows the connections. No wires are to be disconnected inside of the set, but the grid condenser must be shorted out, and the amplifier tube substituted for the detector tube, which is now placed in the new socket. The only other change within the set is an additional wire connecting the plate terminal of the tube to the terminal post *P* on the inter-tube coupler. The output binding posts are shorted, and from one of them a lead is carried to the post on the coupler *B*. From *G* the wire is taken which connects to the grid of the detector tube. The phones (or the primary of the audio-frequency transformer where used), connect to the variable B battery and to the plate of the detector tube.

Tuning is carried out as usual, but will be found to be very sharp, especially on distant signals. The diagram shows a single circuit set, but this is only for the sake of simplicity. In the case of a loose coupled oufit the procedure is exactly the same. The tuning of course is still sharper in this case. Whether this is an advantage or not depends on the taste of the operator, as well as his skill.

With tickler regeneration the change is not quite as simple. Fig. 2 shows the hook-up. The tickler connection is shifted to the plate of the second tube, and the lead from terminal *P* of the coupler substituted for it. A variometer is connected to terminals *B* and *P*. The grid condenser is shorted out as before. This gives a hook-up which is identical with the previous one except for the addition of the tickler coil.

Since the current in the plate circuit of the second tube is 180 degrees out of phase with that of the first the tickler is now reversed. It is used in this manner, but with a coupling approaching zero, to prevent oscillation of the first tube, which may therefore be used at such filament current and plate voltage as give maximum amplification, and still allow the variometer to be sharply tuned. This is not only the condition for maximum feed-back from this source, but also for maximum output from the second tube. With the tickler direct, the set becomes capable of a highly complicated series of howls, as is true of any system of double feed-back.

Having mastered one stage of radio frequency, many amateurs yearn to try the effect of two. Fig. 3 gives the hook-up. More stages may be added *ad lib.*, the limit being the ability to tune. Three stages have been used successfully, but the writer feels that it would take a better operator than he to handle four.

In using any of these hook-ups success is dependent on careful construction. Reckless use of soldering paste seems to rank first as a cause of failure, with loose contacts a close second, but careful construction and close tuning will bring results.

Radio Fire Alarm Test

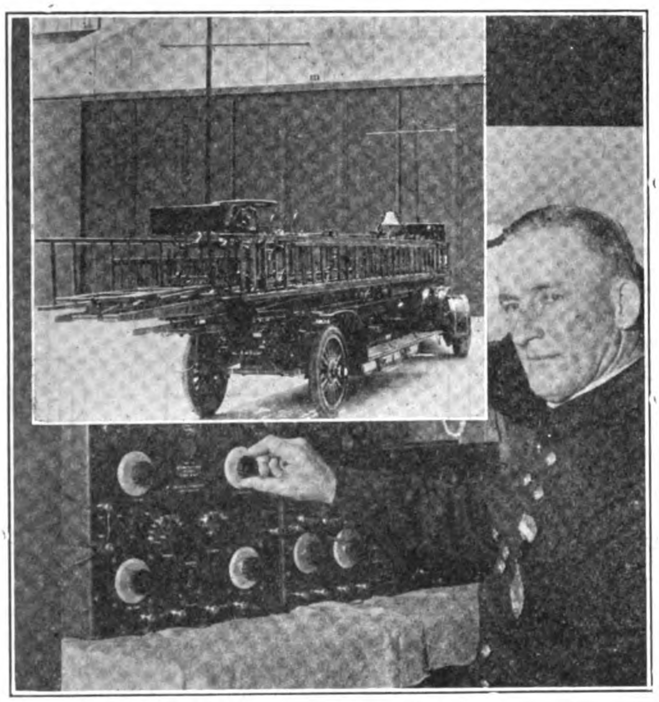
Demonstration of the possibilities of radio as a public safeguard in time of disaster was a feature of the parade in connection with the Golden Jubilee convention of the International Association of Fire Engineers at San Francisco in September.

A general alarm of fire, under emergency conditions, was sent from a 200-watt radiophone broadcasting station, installed by the Radio Corporation of America at the Civic Auditorium, and the signals were picked up by motor apparatus in transit on the streets. The signals were also picked up by a Kennedy receiver and a Western Electric loud speaker in the convention hall and at the central fire station on a Westinghouse aeriola, Sr.

A United States army truck, operated by Sergeant David Reeves of the Air Service Unit, traveled through the streets at high speed. This truck received the fire signals and was controlled and maneuvered for a demonstration of the mobile possibilities of emergency work from the broadcasting station in the Auditorium. Records of two-way work between truck and station were kept at the central fire station.

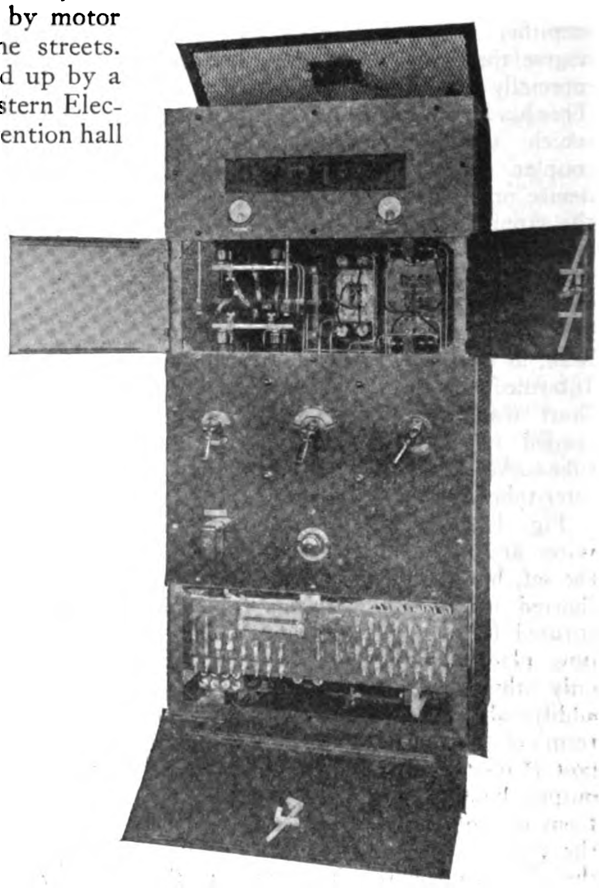
The demonstration was arranged by Fire Chief Thomas R. Murphy and members of the Pacific Radio Trades Association, with the co-operation of the Radio Corporation of America, the Electric Railway and Manufacturers' Supply Co., the Colin B. Kennedy Co., the United States Army Air Service, Ralph Wiley, chief of the department of electricity, and the National Carbon Co., who supplied batteries.

The purpose of the demonstration was to show visiting fire chiefs to the annual convention the practical application of radio in fire protective work, as already incorporated in the budget plans of several cities for addition to existing equipment.



Fire Chief Thomas R. Murphy Listening to Signals from Radio Equipped Fire Truck (in upper left-hand corner)

Photos by T. P. Stroupe, Staff Photographer, S. F. Bulletin, and by U. S. Air Service.



Radio Corporation 100-watt Radiophone Transmitter Used in Test

COMMON RADIO CODE ABBREVIATIONS

AHR—Another	HR—Here or hear
ABT—About	KW—Know
AGN—Again	MNY—Many
B4—Before	MK—Make
BT—But	MSG—Message
B—Be	NW—Now
BK—Break	NR—Number
CNT—Can't	OTR—Other
C—See	R—Are
CUM—Come	RCD—Received
CUL—See you later	STP—Stop
DNT—Don't	TT—That
DWN—Down	TMW—Tomorrow
DA—Day	TNI—Tonight
ES—And	TKS or TNX—Thanks
GA—Go ahead	U—You
GG—Going	WI—Will
GT—Get	WIX—Wireless
GM—Good morning	WL—Well
GN—Good night	WT—What
GB—Good-bye	73—Regards
HW—How	88—Love and kisses

AIR MAIL RADIO SERVICE SAVES MONEY

A report of the communication activities of the Air Mail Radio Service shows that during the first six months of 1922 nearly four million words were handled at a total cost of $35,000, for messages transmitted between Washington, New York and San Francisco. In view of the fact that there are only fifteen stations in the Air Mail Radio Circuit, it is believed that this traffic total is an achievement, as is also the extremely low cost of .009 cents per word, as compared with an estimated cost of .02½ cents per word for commercial telegram service. This gives a saving of over $50,000 for the six months' period.

Variable Condensers

By D. B. McGown

A CONDENSER is a piece of electrical apparatus so designed that the most important and principal property is its electrical or electrostatic capacity. The device may be constructed to have a fixed capacity, or it may be variable, the actual difference being in the mechanical construction. In general, a condenser consists of two conducting surfaces, usually in the form of parallel plates, carefully insulated from one another, and separated by an insulating medium. The capacity or "size" of the condenser depends on the area of these plates, their separation, and the medium between them. For example, two sheets of copper, or other metal, separated by one millimeter of air will have a certain capacity which we may assume as unity. Now, if this distance is increased to two millimeters the capacity will be equal to half of the first, or one-half unity; if it is decreased to 0.5 millimeter the capacity is two units. If a means is provided for varying this distance at will, say, by means of a screw or lever, a variable condenser is obtained, with limits of capacity from 0.5 to 2.0 units (the edge effect being entirely neglected).

Suppose the same plates are taken and arranged as above, and instead of being left in air, are immersed in oil. Now, in this case, if the distance remains the same, as in the case of unity, we will, however, have a much larger capacity. This is due to the fact that the oil intervening has a much greater inherent dielectric capacity than has the air. Thus, for most oils, the capacity will be from two to four times unity, although no actual change has been made in the mechanical arrangements of the plates. The insulating value of the condenser is also very much greater, as oils, unless damp or impure, have a very much higher insulating strength than air.

Generally speaking, practical variable condensers are made up of inter-leaved plates or sheets of metal of various forms. The commonest type is the familiar semi-circular plate type, where there are a number of carefully spaced semi-circular stationary plates with end bearings supporting an equal or approximately equal number of similar plates, which are mounted on a shaft, the shaft turning in the bearings at the end of the stationary plates. A condenser of this type is shown in Fig. 1. The plates are usually made of aluminum or brass, and are separated by accurately cut spacers or washers. The dielectric used in such condensers is the air between the plates. This is the type condenser used most commonly on radio sets today

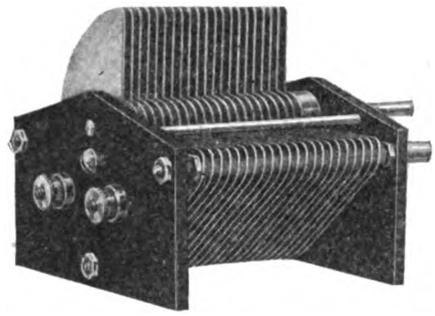


Fig. 1—Variable Condenser

and it is used chiefly because it is easily constructed, convenient and can be made up to have a large capacity in small bulk.

Various types of rotary variable condensers have been manufactured, but very few differ in any important particulars from the one illustrated. Sometimes very thin sheets of hard rubber are cemented to the plates, which forms the dielectric, as well as the intervening air. Again, as in the Kolster decremeter, the plates are made of peculiar shape (that of a logarithmic spiral), so that the capacity increases in such a way that the circular scale used to indicate degrees will indicate an equal change in wavelength, per degree, over the entire limit of the condenser's capacity. Large condensers of the ordinary type with wide spacing between the plates immersed in oil are used on transmitting sets, such as vacuum tube equipment. A precision condenser (the Seibt) is on the market, which is made up similar to the ordinary type of rotary variable, but which has the rotary and stationary plates milled out of solid aluminum blocks. This enables the spacing to be made very much closer, and, furthermore, permits a condenser of much greater accuracy than the usual type possesses.

A simple condenser may be made up by taking two concentric metal tubes, the smaller of which is, say, 1/16 in. smaller outside than the inside diameter of the larger, and of any convenient length. Ends may be provided for the smaller tube, and a rod mounted inside in such a manner that one tube telescopes inside of the other, and still remains insulated, and if proper leads are taken off they may be connected in the circuit wherever needed.

A number of flat plates may be taken and arranged to slide between an equal number of stationary flat plates, and connections taken off and connected to the circuit wherever needed, and the capacity varied by sliding the plates in and out.

Liquid condensers have been designed, using mercury for one plate, the other being composed of some suitable metal separated by thin celluloid or other material. One type has a single semicircular plate with thin mica or celluloid overlaid. On the other side of this insulating material is placed a small quantity of mercury and the whole condenser as a unit is revolved. As it is of circular shape the capacity can be varied, depending on the amount it is rotated, and a circuit tuned as required. Another type using mercury forces a cylinder down into a small pot of mercury, which mercury then is raised up in the container and acts as one plate of the condenser, a tinfoil or other metal covering on the outside of the glass containing vessel forming the other plate.

In general, variable condensers should be made up so that their capacity will not change, due to wear or warping of the parts. They should be well insulated, even for receiving, as large losses may occur in them if they leak. They should be made up with sufficient ruggedness and rigidity to withstand considerable handling. If used in receiving circuits they should be shielded, so as to prevent detuning, as a result of the body capacity of the operator.

Variable condensers are little used outside of radio and high frequency circuits. In the first place, they are of very low capacity, very rarely exceeding a capacity of 0.005 mfd. (and very seldom that large), so they are only useful at extremely high frequencies. Furthermore, resonant circuits are little used outside of radio and kindred high frequency circuits. A radio circuit handles extremely little power, even in transmitting, as compared to the thousands of kilowatts handled by the huge power houses and supply lines. A radio circuit can be tuned with a condenser so it will resonated to a given frequency and handle all its power without danger to the condenser, even though it might be a power of several kilowatts, with excellent results in radio, while the same amount of power would practically never be noticed in a power plant. True, some alternating current lines use huge condensers on their circuits to balance up their power factors, but these are so much larger than those used in radio work that there is absolutely no comparison.

One of the chief objects in using a variable condenser is to allow the person using a receiving or transmitting apparatus to tune and adjust with the greatest ease. For example, in tuning the antenna circuit of a receiving set it is possible to take out a large number of taps and do away with the need of a condenser. The same thing could be done, although less easily, with the secondary circuit. If we take a primary coil and put a condenser in series with the aerial, what is the effect? First, we have reduced the capacity in the aerial circuit, and therefore must "load up" to get to the wave we want, but the greater ease in tuning and the increase in sharpness well makes up for this. Again, take a secondary circuit in a receiving tuner. We may take a 25 turn honeycomb coil and with the condenser we may cover a wavelength range of from about 150 to 400 meters, with a single condenser of .0015 capacity or less. To cover this same range with a multi-point switch would entail countless contacts and then we would not be able to tune sharp enough to be sure of getting in all of the C. W. and phone signals wanted. A variable condenser can be used with great success as a variable "feedback" in an oscillating circuit and most minute adjustments may be made.

For a wavemeter a variable condenser is absolutely necessary. A coil of wire of suitable dimensions with a low reading ammeter in series with a condenser in shunt to the coil will make an ordinary wavemeter. Now, it would be useless to try to change the coil, while in use, but if the capacity and resultant wavelength of the circuit is varied by the use of the wavemeter, accurate results can be had.

The condenser's place may be taken in some cases by a variometer, but generally no other instrument can take its place unless radio changes considerably in future and all stations are put on one or two wavelengths.

RADIO TANKS PLANNED FOR ARMY AND MARINES

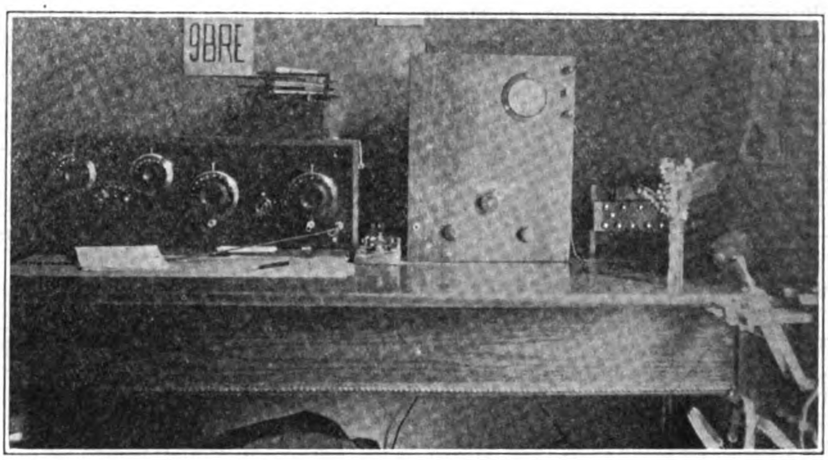
Efforts to produce radio-controlled tanks appear to be the very latest step in Government radio work for the Army and probably for the Marine Corps materiel. Today one out of every ten Army tanks has a radio transmitting and receiving set, enabling this leading or control tank to keep in close touch with headquarters constantly, and communicate by signals with its fellows in battle. Such efficient liaison would be a tremendous step in military science, as the tanks could also serve as message centers for the infantry troops, as well as spot artillery fire, and keep headquarters posted as to the position of the advance lines. Before the year is out, it is believed that all Army tanks will be equipped with radio communicating outfits and that the Marine Corps will also have tanks equipped with radio.

9BRE

The radio station of A. Maxwell, located at C-1 Park Apartments, Evanston, Illinois, has as yet made no great DX records, due to an inconvenient location, but since the C. W. set has been in conditions seem to be improving.

The station is located in a corner of the parlor (but that does not make it a parlor radio set). The receiver is the standard regenerator, using one tron tube, baldies, etc. Formerly an amplifier was used, but as it did not make any material difference in the distance covered, it was sold.

The spark set employs a ½ kw. Thor oil immersed condenser, "Super" Benwood gap on a 1750 r. p. m. motor, and a Thor O. T. The transmitter is kept in the "smoke room" behind the boiler. This deadens the sound greatly, but not enough to keep more than ten of the eighteen families from raving. Fortunately our janitor is a "ham," so he keeps all but the most violent in check. As it is, for suffering humanity's sake, no spark transmitting is done after 9:30 p. m. Therefore no spark DX, because it is almost impossible to get out of Chicago before 10 p. m.



Station 9BRE

The C. W. set employs two 5 watt tubes, using the British aircraft circuit, which meets every expectation. Five hundred volts rectified a. c. supplies the plate current. A separate transformer lights the tubes. Either C. W., chopper, or fone is used. My best distance up to date has been done on fone, when a conversation with 9DHQ (in the next block) was heard in Minneapolis. Since the picture was taken two more meters have been added.

The aerial is a four wire cage, 80 ft. high at the far end and 55 ft. at the near. Seeing as the front yard is a park, it cannot be dug up, so a counterpoise is used, much to the disgust of the non-radio tenants. But as previously stated, THE JANITOR IS A HAM, HI.

NEW SWEDISH RADIO STATION

The Radio Corporation of America has a contract with the Swedish Government for furnishing apparatus for a high power radio station to handle direct wireless communications between the United States and Sweden. The total cost of the station erected will probably be over $2,000,000. The new station will be near Gothenburgh, which is on the west coast of Sweden. The contract for the installation of two 200 kw. Alexanderson alternator equipments which, when associated with the multiple tuned antenna, will each deliver to the antenna a current of 600 amperes, and is similar to the equipment which is being supplied to Poland by the same company. The receiving equipment will consist of two complete and independent modern sets composed of tuners and the necessary amplifying apparatus and will be used in conjunction with receiving aerials devised for the reduction of static disturbances.

At the time that the apparatus contract was signed a very important traffic contract was signed which assured the direct communication between Sweden and the United States for a long period of years.

NEW WORLD RECORD IN RADIO RECEPTION

A record of 55.1 words per minute of perfect copy was made by T. R. McElroy of Boston during the Radio Marathon held at the Pageant of Progress Exposition in Chicago August 6. Mr. McElroy, in another test, copied 58 words per minute with 5 errors.

Radio is like the ouija board in that anybody can work it (see current advertisements) but it works better for some persons than for others, and that's no hallucination, either. When you don't see things at a seance it is because you are not in harmony, but when you don't hear things in radio it is because you are either tuned in or tuned out.

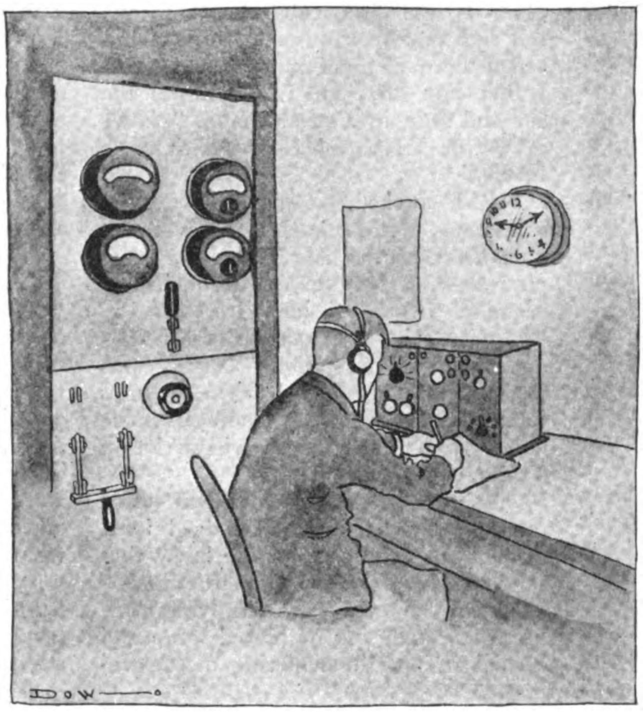
"The Mystery of VZZ"

By Bernard S. Greensfelder

THE freighter *West Camden* was sailing smoothly through the warm seas of the Pacific a few degrees below the Equator. She was now about three days out from Honolulu bound for Melbourne with $11,500,000 in gold bullion from San Francisco in her hold. The senior radio operator, George Duncan, especially realized his responsibilities because of the valuable cargo.

At nine o'clock in the morning Duncan received the last dot of the noontime signals from NPL. He adjusted the set to 600 meters to see if he could possibly pick up the NPK weather report on the three-step amplifier he had recently constructed. He patiently listened for a quarter of an hour and then disappointedly raised his hands to remove the phones when a 500 cycle note of an odd, hollow character attracted his attention. It was a spark he had never heard before, therefore he decided to learn the identity of the mysterious station.

Evidently the station was tuning. Suddenly it became very much louder and clearer. Then, in perfect Continental, came "SOS SOS de VZZ VZZ— SS Validas—position 7° 30′ 10″ south lat., 168° 47′ 16″ west long. —forward plates smashed in by derelict pumps working poorly—slowly sinking—may last three hours—comdr—"



"Then in perfect Continental came 'SOS - SOS de VZZ - VZZ'—"

Duncan immediately threw the aerial switch to sending position and acknowledged the SOS.

VZZ replied—"only need one ship for aid—can you come?"

By this time the second operator was standing by, ready to assist. He had already summoned the captain.

In a moment the captain entered. Duncan said, "The *Validas,* sixty miles to the north, is sinking. They say they only need us. Shall I reply OK?"

"Are any other ships offering aid?" asked the captain.

"It's queer, but we seem to be the only one who heard him," responded Duncan.

The captain said, "Tell him that we'll be there in three hours, at the most." He then proceeded to the bridge, rang full speed ahead, and changed the course to north.

In the radio room the 5 kw. transmitter flashed the welcome message through the air. A reply came back in a feverish splutter of dots and dashes —"One pump already disabled—crowd on steam—"

Duncan O. K.'d the message and then, after communicating with the captain, stood by for further information. The second operator went to the bridge to help locate the crippled ship.

Fifty miles, forty miles, thirty miles, and yet no sign of a ship. When the expanse of water separating the two ships had been cut down to twenty-five miles a small island appeared to the north. The captain, with a worried look on his face, hurried to the radio room.

"There is an uncharted island, about two miles wide, just where the *Validas* should be," he informed Duncan. "Ask them again for their exact position."

In a minute the message was sent, and VZZ replied, after a moment's hesitation, "Keep on your present course—we're grounded on sand-bar on north side of island." The captain appeared relieved and departed to scan the horizon once more.

A sudden thought came into Duncan's head. He relinquished the apparatus to his assistant and left to find the captain.

"Captain," he said, "do you know anything about this disabled vessel?"

"A little," replied the commander. "She is a 3500-ton freighter on the Honolulu-Australia run. I had imagined that she was out of commission. However, it is our duty to render aid, no matter who the ship is."

"Thank you, sir, that is all I wished to know," said Duncan. He turned and left, but instead of returning to his post, he walked to the rear of the ship to attend to an unfinished job.

THE ship was now within hailing distance of the island, which was seen to be rather heavily wooded; a closer view revealed a number of inlets. Soundings were taken at frequent intervals, and the ship was run at half-speed.

As they were about to round the last promontory on the northwest side of the island a high-powered motorboat came swiftly from one of the inlets and steered directly for the ship. The approach was so rapid that before an alarm could be given the small craft was but a few lengths from the *West Camden.* At that instant a shot rang out, and a projectile from a hidden gun on the island sailed over the bow of the freighter. A second shot followed and the foremast supporting the antenna was severed. Fortunately it fell overboard, nevertheless it carried with it a tangled mass of wire and supports, thereby totally disabling the *West Camden's* radio set.

By this time the crew of the attacked ship was on deck, but the men in the motorboat lost no time. They threw a rope ladder over the side of the ship and were clambering up like lightning. The crew on the *West Camden* tried to resist the attack, but to no avail. They were so surprised that the pirates had little trouble in herding them into the messroom and locking them up.

Even the officers, whose first thought was of the valuable cargo, realized that resistance would be futile and soon were forced to surrender. The victors immediately took charge of the ship and skilfully maneuvered it into a secluded cove.

There were probably thirty outlaws all told. It could easily be seen that the attack had all been elaborately planned, doubtlessly under the supervision of some master-mind.

After a search had been made of the ship for any remaining members of the *West Camden's* crew, the pirates commenced to haul the treasure on deck.

By nightfall it was ready to be transferred to the shore. Several of the pirates were left on the ship to guard the imprisoned sailors, while the rest departed for the island.

INTO the inky blackness of a tropic night George Duncan raised his head from beneath the canvas covering of a stern lifeboat.

From the stern of the ship he had seen the motorboat come dashing out. In a moment his course of action was decided upon. He had realized in a second the meaning of the unexpected appearance of the launch.

The absence of other responses to the SOS, the unfamiliar spark, the uncharted island! These thoughts flashed through his brain as he leaped into the lifeboat and dived under the cover. There he had escaped detection, and when darkness descended he lowered himself noiselessly to the deck. He grasped a nearby rope and, after fastening it to the railing, slid down the side of the ship into the water. After a few powerful strokes he felt the sand beneath his feet and soon was walking on dry land.

Here and there down the sandy beach small points of light revealed the presence of the pirates who were enjoying a smoke. Duncan warily proceeded to make his way inland. Suddenly a harsh voice exclaimed, "Who's there?"

Duncan's reply was a smashing blow which landed full in the questioner's face, knocking him out. He found the revolver of his victim and also a large flashlight. Guided only by a gleam of light in the interior of the island, he slowly crept along a path he easily found.

Twenty minutes more and Duncan emerged into a cleared space. The moon had now risen and by its light he discerned a well-lighted shack. The sound of the muffled exhaust of a gasoline engine issued from it. To the right of the shack a square frame some sixty feet high rose into space. Approaching it, Duncan noted that it was the support for a number of wires. Then the truth dawned upon him. A directional transmitting loop! Small wonder the signals had so suddenly increased in strength! Small wonder that no other ships had heard the SOS from "VZZ"!

Suddenly a rising, droning purr brought Duncan to a realization of his precarious situation. Stealthily he crept to the door of the shack. He removed his shoes. As he did so, the operator inside commenced to send. From the hiss of the quenched gap Duncan read "SOS SOS de VZZ VZZ——" Duncan opened the door, crept up behind the operator, and without giving him time to even turn around, knocked him unconscious with the butt end of his revolver.

Duncan surveyed the room. In front of him was a standard 15 kw. transmitter panel. A separate semi-enclosed motor-generator was humming away to Duncan's right. He could hear the gasoline engine puffing in the next room. To the left was a two step amplifier on a large table. Secured to the table was a detail map of the South Seas, and projecting through it was a steel rod with a heavy knob and pointer secured to its upper end. The rod pierced the map at the exact location of the uncharted island. The senior operator of KIIK grasped the situation at once, and seating himself at the table he moved the knob until the pointer was in line with Pearl Harbor, T. H. The large transmitter loop outside, he discovered, was electrically geared to the rod and moved in unison with it. Duncan listened in for a moment and heard NPM sign off. He took hold of the key and sent, in a steady hand, "NPM NPM de KIIK KIIK—SOS SOS de KIIK."

NPM checked.

Then—"NPM de KIIK—ss *West Camden* captured and looted by radio pirates—send help quick to uncharted island 7° 10′ 30″ S. lat.—168° 47′ 15″ W. long.—sig—Duncan, op of KIIK—operating outlaw station." NPM came back, "QRX O M." Two minutes later NPM sent "OK—sending revenue cutter from nearby port—will arrive in six hours——"

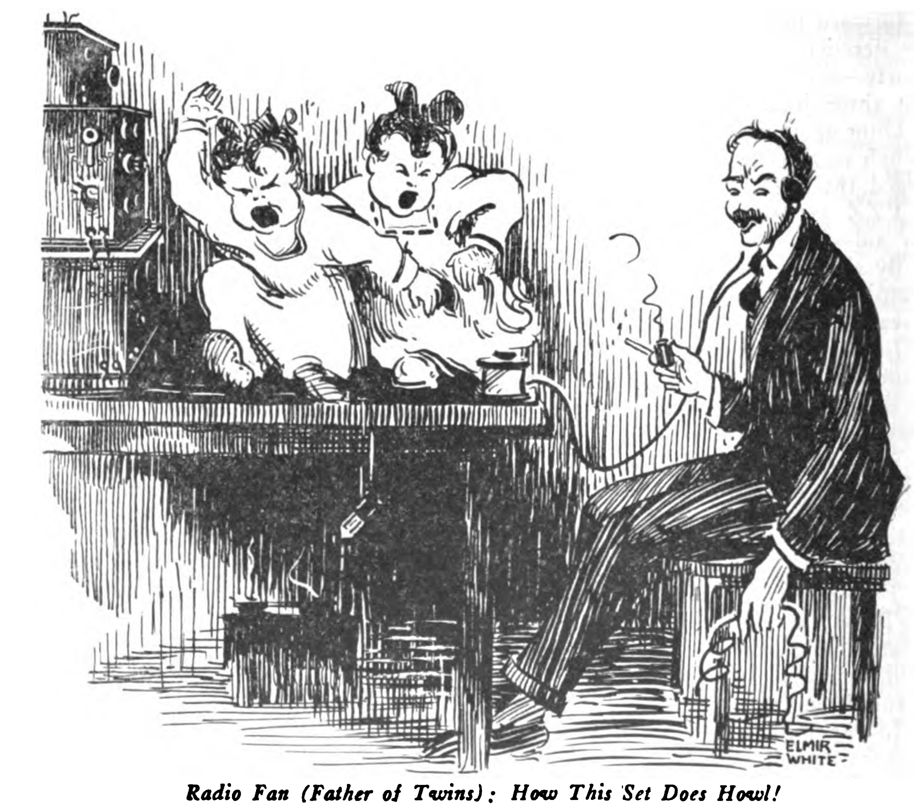
Just then a sharp report was heard and a bullet from a .44 lodged itself in Duncan's right arm. He knew that it would be useless to resist the desperadoes; a monkey-wrench was lying nearby on the table, so he picked it up and hurled it into the whirring motor-generator. A crash, then the sound of torn and bent metal marked the end of the means of transmission.

The first shot had come through one of the windows of the shanty. The pirates, thinking that they had wounded Duncan more seriously than they had, immediately ran around to the door. Duncan was waiting for them, but he had to shoot with his left hand, and his aim was poor. One of his assailants fired point-blank at him and he fell, shot in the ribs. He saw the bandits standing over him and then he drifted into unconsciousness.

The pirates had no doubts as to the nature of the message Duncan had just sent. They did not know, however, how soon the rescuers would arrive. No time was lost in assembling the band and preparing the launch for immediate service. They had no time to unload the heavy sealed chests of gold from the captured ship. In not more than half an hour the imprisoned crew of the *West Camden* heard the staccato explosions of the departing craft.

EARLY the next morning the cutter arrived. The half-starved sailors on the *West Camden* were released from their confines. Duncan had been missed from the first and a search for him was quickly started. He was found in the shack, nearly dead from the loss of blood. They carefully removed him to the ship and upon reaching Melbourne he was taken ashore and in time fully recovered from his wounds.

Later he was magnificently rewarded for his quick-witted deed of heroism that saved millions and blocked any further attempts by these modern buccaneers.



Radio Fan (Father of Twins): How This Set Does Howl!

Construction and Operation of a Tube Detector

An electron tube detector, which may be substituted for the crystal detector in the complete tuning and detecting unit shown in April, 1922, RADIO, is described in a recent circular from the U. S. Bureau of Standards. The details of making single circuit and two-circuit tuners may also be found in Circulars 120 and 121, which may be obtained from the Superintendent of Documents at Washington, D. C., for five cents each. Its cost complete with the necessary batteries will be between $23 and $37. Additional electron tube amplifiers which will greatly increase the sensitivity and hence the receiving radius of the receiving set, will not require additional storage batteries. This will make the added cost of the amplifiers small. This publication describes simple apparatus of satisfactory performance without reference to the possible existence of any patents which might cover parts of the apparatus. Apparatus in general similar to that described can be purchased from responsible manufacturers whose announcements can be found in current radio periodicals.

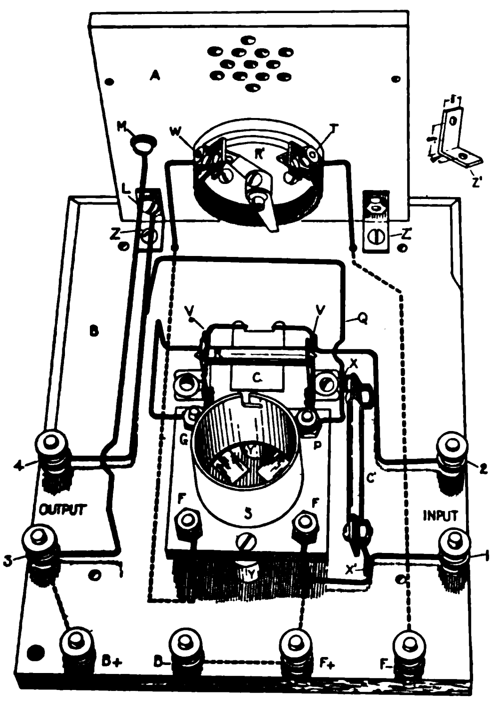


Fig. 1—Sketch of Detector Unit

The unit is composed of a baseboard *B* and an upright panel *A*. On the baseboard *B* is mounted an electron tube *E*, an electron tube socket *S*, a resistor (grid leak) *R*, a grid condenser *C*, a by-pass condenser *C′*, and eight binding posts. On the upright panel *A* is mounted a filament rheostat *R′*, and two telephone receiver binding posts *L* and *M*.

Accessories required are a six-volt battery, used for lighting the filament, often called the "A" battery, having about 60 ampere-hour capacity, a 22½ to 45-volt dry battery ("B" battery), binding posts, stiff copper wire, wood boards for the baseboard and upright panel, and two brass angle braces for supporting the panel. The "A" battery will usually be placed on the floor beneath the table upon which the other parts of the equipment are mounted. Its comparative size is much reduced in the drawing. An insulating material panel may be substituted for the wood if desired. The electron tube detector may also be entirely enclosed in a wood cabinet with a hinged cover, if desired.

BASEBOARD. (*B* Figs. 1 and 3.)—The base *B* is any kind of dry wood about 6¼ in. by 8¼ in. by ¾ in. thick. Eight holes are drilled through the base in which the binding posts are fastened. Spacing of these holes is shown in Fig. 3. By the addition of two more binding posts properly connected, this detector may be used in a "regenerative" circuit when the binding posts are externally connected to a "tickler" coil coupled to the tuner. These binding posts are added to the detector baseboard *B* in line with the "input" binding posts Nos. 1 and 2 (see Fig. 1). They are 7/32 in. from the edge of the baseboard, and the four binding posts are arranged in such a manner that they are equally spaced, 1½ in. between centers. Referring to Fig. 1, the wire which leads from the terminal *P* of the electron tube socket is cut at some convenient place *Q* and the two ends thus formed connected to the extra binding posts. The method followed in making these connections corresponds with the style of wiring used in the complete electron tube detector unit. The connection *X* from one terminal of the condenser *C′*, is also removed and a longer wire connected from this terminal to the other side of the point *Q* where the wire was cut. The base is arranged so that the three remaining sides and a hinged cover may be added without changing the relative positions of the binding posts. Under each of the four corners of the base *B*, rubber or wood feet (risers) are fastened in order that the binding post heads and wiring will be protected on the under side of the base.

UPRIGHT PANEL (*A* Figs. 1 and 4).—The panel *A* is any kind of wood about 4½ in. by 5 in. by ⅜ in. thick. In Fig. 4 a back view of the panel is shown which brings the two holes for the telephone receiver binding posts in the lower left-hand corner. If the panel is viewed from the front these two holes will be at the lower right-hand corner. It seems quite desirable that this board present a good appearance, it being the front panel. Four holes are drilled in the panel *A*, one for the bolt which fastens the panel to the brace (see *L*, Fig. 1), two for the telephone receiver binding posts *L* and *M*, and one for the shaft of the filament rheostat *R′* (see Fig. 1). The exact location of the hole for the rheostat shaft is determined from the rheostat itself. It is drilled so that the rheostat will occupy as low a position as possible, allowing room enough to do the necessary wiring.

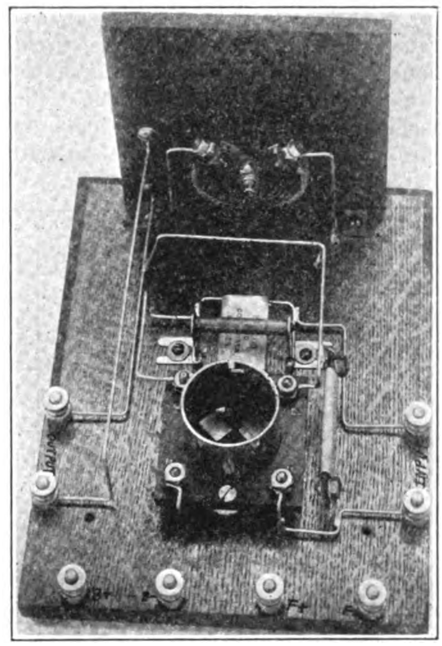


Fig. 2—View of Completed Unit

THE ELECTRON TUBE SOCKET *S* is of commercial design. No suggestions are offered as to the particular kind of socket to use. There are many types available and the majority of them will be found satisfactory for this purpose.

GRID LEAK AND GRID CONDENSER.—The grid leak and grid condenser may be purchased together or separately or they may be constructed. If one expects to use a detector type of electron tube (sometimes called "soft" or "gas" tube) it is recommended that these two parts be purchased with the tube, care being taken to select the proper values of resistance and capacity for the grid leak and the grid condenser, as specified by the manufacturer of the tube purchased. The resistance of the grid leak will usually be between 1 and 5 megohms (1,000,000 and 5,000,000 ohms) and the capacity of the grid condenser will be about 0.0003 of a microfarad (300 micromicrofarads). If an amplifier type of electron tube (sometimes called a "hard" tube) is used, the resistance of the grid leak may generally be anywhere within the resistance limits specified above and the same size of grid condenser used as mentioned above. Experimental grid leaks may be made for such electron tube detectors. This is only suggested for its educational feature. If the two-stage audio-frequency amplifier is used also, it will be quite difficult to make a grid leak that will work satisfactorily. Such an experimental grid leak may be made from a piece of fiber about ⅜ in. wide, 1½ in. long and from 1/32 to ⅛ in. thick. Two ⅛-in. holes are drilled along the center line of the piece, about 1 in. apart. A line is drawn between the two holes, using India or drawing ink. Contact with the ink line may be made by the use of two brass (6/32 or 8/32) machine screws about ½ in. long and each equipped with one nut and two washers. The machine screws are put through the holes in the ends of the fiber strip with

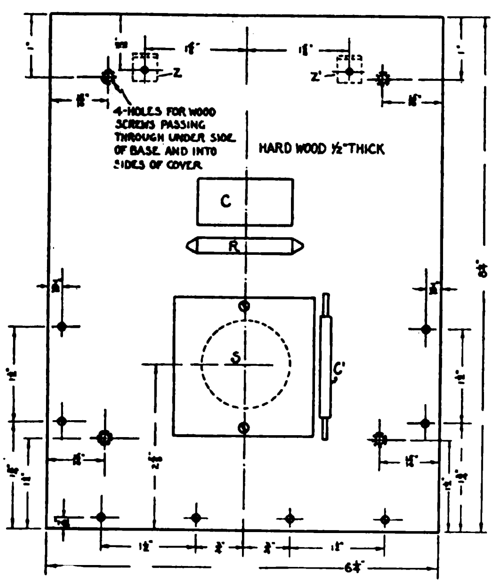


Fig. 3—Baseboard

one washer on each side of the fiber strip. A small piece of tin-foil may be rolled up and wound around each machine screw between the fiber and the washer, so that the tin-foil pad will make contact with the ink line. When the nuts are tightened down, the tin-foil pads will flatten out and form a contact between the brass washers and the ends of the ink line. Since the ink line makes a partial electrical conductor of high resistance, the thickness and width of the ink line will determine the resistance of the grid leak to a great extent. The value of resistance may be decreased by inking the line over several times, until the electron tube detector works best. A suitable condenser may be made from tin-foil and paraffined paper after the manner described in Bureau of Standards Letter Circular No. 46, the shape of the condenser being modified to suit the present space requirements, and the total area of each of the tin-foil sheets reduced to six square inches.

BY-PASS CONDENSER C' is any small sized fixed condenser having a capacity of from 0.0003 to 0.0015 microfarad (300 to 1500 micromicrofarads) which may be purchased or made according to the description given in Bureau of Standards Letter Circular No. 46. While this condenser is not absolutely necessary, its use is advisable.

THE BINDING POSTS used on the base may be 6/32 or 8/32 brass machine screws each equipped with two nuts and two washers, if regular binding posts are not available. The telephone receiver binding posts L and M should be of the set-screw type to admit the tips of the telephone receiver cords.

FILAMENT RHEOSTAT R'.—The filament rheostat may be constructed, but no details are furnished. If the rheostat is purchased, it is desirable to select one designed for panel mounting as well as one having a neat appearing knob and pointer. The rheostat should have a resistance of about 7 ohms and a current-carrying capacity of about 1½ amperes.

THE ACCESSORY BATTERIES are commercial articles. The purchaser of a storage battery for lighting the filaments should get full instructions from the dealer for testing and re-charging the battery. The dry battery ("B" battery) usually used for the plate circuit cannot be re-charged. The normal life of a battery of reliable manufacture is about six months. Storage batteries for use as "B" batteries are available. Their first cost is greater than that of dry batteries, but they may be re-charged.

Assembly and Wiring

WOOD FINISH.—It is essential in electron tube sets that the wood be protected from moisture. While the wood base and panel may be treated with paraffin, it was found more satisfactory to first dry the wood and then stain and varnish it, using a good varnish, preferably insulating varnish. Shellac is not recommended. It is rather difficult to give definite suggestions concerning drying and staining of wood. Wood may be put in a warm oven for an hour or so to insure more or less complete drying. A lamp-black or carbon pigment stain is not used ordinarily on such radio parts and it would be well to avoid the use of such. The stain and varnish are thoroughly dried before the apparatus is mounted on the wood baseboard and panel.

BASEBOARD.—The eight brass machine screws or binding posts are put in the holes already drilled in the baseboard. If machine screws were to be used the heads would be put on the under side of the baseboard with a brass washer between the head and the baseboard. A brass washer and two nuts are then fastened to each screw, on the upper side of the baseboard, with the washer next to the baseboard. The tube socket S, the grid condenser C, the grid leak R, and the by-pass condenser C', are next screwed to the baseboard. (Certain types of condensers will be held in position by the wiring only.) The exact location of these parts cannot be stated because the several types of parts commercially available will vary somewhat in dimensions. The tube socket S is mounted so that the two terminals marked G and P (Fig. 1) are nearest the upright panel. Blocks Y and Y' are put under the socket S so that the four terminals of the socket do not touch the wood baseboard. This is done by cutting off two round wood blocks just long enough to raise the socket terminals clear of the base, and mounting them so that the screws

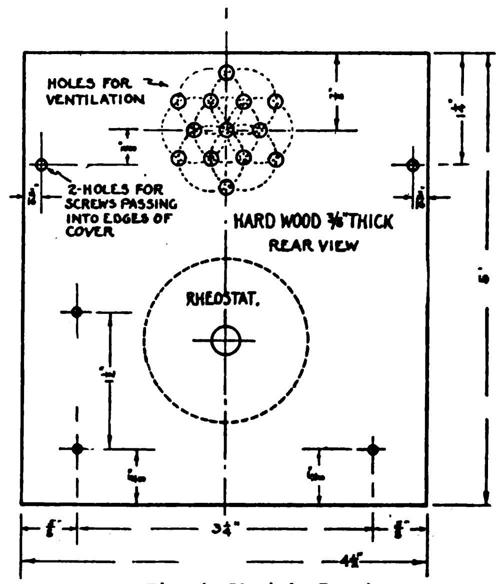


Fig. 4—Upright Panel

which hold the socket to the baseboard will pass through holes in the centers of the blocks. After the socket S, grid condenser C, grid leak R, and by-pass condenser C' are mounted the parts are wired up.

No. 14 bare tinned copper wire is used in wiring. This makes the connections stiff and self-supporting. This wire is ordinarily furnished in rolls. The wire should be straightened before it is used. It can be straightened by clamping or otherwise fastening one end solidly and pulling on the other end just hard enough to stretch the wire slightly. It is also a good plan in wiring such sets to have all wires run as directly as possible, neatly, and all bends made at right angles. When a wire it attached to a binding post, a loop or eye is formed on the end of the wire and the wire at the eye flattened with a hammer. This gives more contact surface. Special lugs may also be soldered to the ends of the wire before the connection is made.

A small hole is drilled through the baseboard just back of each of the tube socket terminals marked *F* (see Fig. 1). A short piece of wire is fastened to the right-hand socket terminal marked *F* and is then led through the small hole in the baseboard to the under side of the baseboard. The same wire is led to the binding post *F*+ and fastened between the machine screw head and washer underneath the baseboard. The same wire is further led to the binding post marked *B*— and fastened between the machine screw head and washer underneath the baseboard. All wires which are run on the under-side of the baseboard are shown by dotted lines.

A short piece of wire is soldered to the wire leading from the right-hand socket terminal marked *F*, just above the baseboard and led to the "input" binding post No. 1, and fastened between the washer and the first nut. This wire is shown as a solid line which means it is on the upper side of the baseboard. The wires do not touch the wood boards except at the terminals and where the wires pass through holes in the baseboard. The wires may be raised more or less to accomplish this. The two terminals of the grid condenser *C* are connected to the two terminals of the grid leak *R*, as shown in Fig. 1. A wire is soldered at *V* and led to the input binding post No. 2.

This wire is kept quite close to the baseboard. Another wire is soldered at *V'* and led to the tube socket terminal marked *G*. The remainder of the wiring is left until the upright panel is assembled and fastened to the baseboard. Notes on soldering are given later.

UPRIGHT PANEL.—The filament rheostat *R'* is mounted on the upright panel *A* so that the two terminals will be in a convenient position for wiring. Two binding posts of set-screw type, *L* and *M*, are inserted in their proper holes, and the upright panel mounted in position by bolting it to the two brass angle pieces *Z* and *Z'*, shown in Figs. 1, 2 and 3. One of the telephone receiver posts *L* serves as a bolt. Two small holes are drilled through the baseboard near the two terminals of the filament rheostat *R'*. A wire is run from the "output" binding post marked 4 (Fig. 1) along the upper side of the baseboard to the back of the telephone receiver binding post marked *L*. A wire is fastened to the tube socket binding post marked *P* and from thence led to the back of the telephone receiver binding post marked *L*, or else soldered to a convenient place on the wire leading from binding post *L*. These wires are shown in Fig. 1. A wire is run from the binding post marked 3 to the back of the telephone receiver binding post marked *M* and also a wire from *B*+ to binding post No. 3, underneath the baseboard. One of the terminals of the by-pass condenser *C'* is connected at the point *X* and the other terminal of the condenser is connected at the point *X'*.

The method of making these connections depends to some extent on the particular type of fixed condenser which is used. If the condenser be provided with flexible leads one of them is soldered at the point *X* and the other is likewise connected at the point *X'*. If the condenser is provided with lugs, connections are made by bending the wires into the proper shape and soldering thereto. A wire is run from the filament rheostat binding post marked *T* through the hole in the baseboard and thence along the under-side of the baseboard to the binding post marked *F*—. This wire is shown in Fig. 1 by a dotted line. Likewise a wire is run from the rheostat binding post *W* underneath the baseboard and up through the left-hand hole in the baseboard at the rear of the electron tube socket *S* and connected to the left-hand binding post marked *F*. This completes the assembling and wiring of the electron tube detector unit.

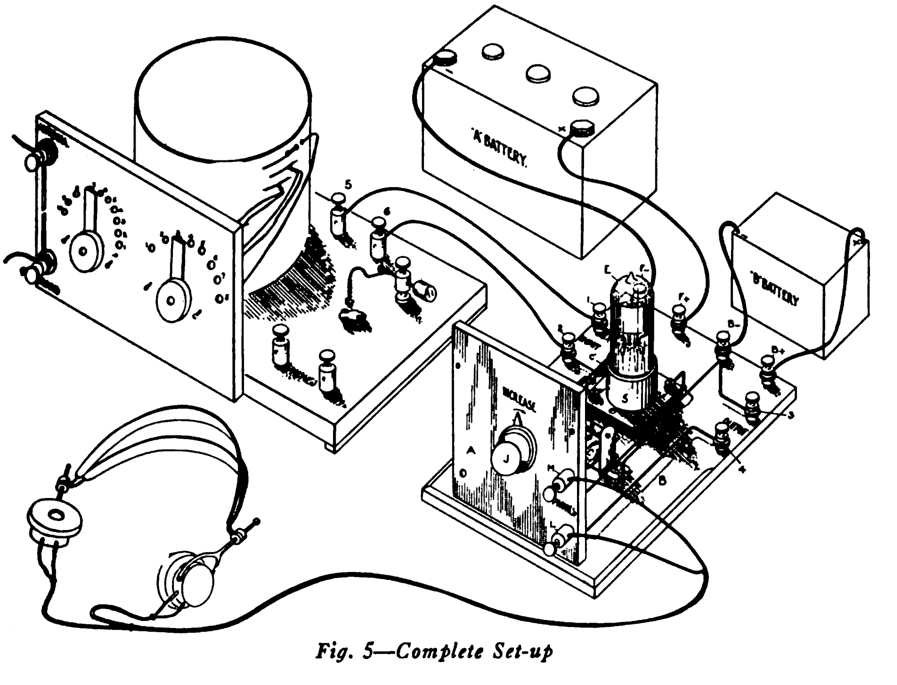


Fig. 5—Complete Set-up

Directions for Operating

CONNECTIONS.—It has already been stated that better results are obtained if the two-circuit tuner described in Bureau of Standards Circular No. 121 is used with the electron tube detector. However, the single-circuit tuner described in Circular No. 120 may be used or the electron tube detector may be connected to any tuner not already supplied with an electron tube detector.

If the single-circuit tuner is used with this electron tube detector the several parts are arranged somewhat as shown in Fig. 5. The single-circuit tuner (shown at extreme left) is fully described in Circular No. 120. The greater portion of the wiring is beneath the baseboard. The wires shown as ---- are those already described in Circular No. 120. The wires shown as .... are the new wires added. Such wiring will not disturb the set for use as a crystal detector receiving set. The second unit to the right is the electron tube detector described in this circular. Accessory parts, such as telephone receivers, "B" battery and "A" storage battery are also shown in Fig. 5. As previously mentioned, the "A" battery is shown here reduced in size, and it is usually placed under the table upon which the rest of the apparatus is mounted.

If the two-circuit tuner is used with this electron tube detector the arrangement of the parts is similar to that shown in Fig. 5, except that the two units consisting of the coupler and the variable condenser with crystal detector replace the single-circuit receiving set shown at the left. Connections between the secondary of the coupler and the terminals of the variable condenser are the same as described in Circular No. 121. Two more binding posts are added at the rear edge of the baseboard supporting the variable condenser and crystal detector (see Fig. 6). The dotted lines clearly indicate the new wiring connections as described for the single-circuit receiving set.

The antenna and ground wires are connected as described in Circular No. 120 and as shown in Fig. 5. Binding post No. 5 is connected to binding post No. 1 and binding post No. 6 is connected to binding post No. 2. The telephone receivers are connected to the binding posts *L* and *M* as shown in Fig. 5. The red (positive,+) wire of the "B" battery is attached to the electron tube detector binding post marked *B*+ and the black (negative,—) wire to the binding post marked $B-$. An insulated flexible copper wire is run from the red (positive,+) terminal of the 6-volt "A" storage battery to binding post marked $F+$ (Fig. 5) and a similar wire from the black (negative,−) terminal of the "A" battery to the binding post marked $F-$.

OPERATION.—The filament rheostat knob *J* (Fig. 5) is turned to the extreme left and the electron tube *E* inserted in the electron tube socket *S*. The filament rheostat knob is then turned to the right until the electron tube filament becomes lighted, the brilliancy depending upon the type of electron tube used. When one of the telephone receiver terminals is removed from its binding post and again touched to the post, a sharp "click" in the telephone receivers will be an approximate indication that the circuit is in working condition. If the test buzzer as described in Circular No. 120 is available, it may be attached (as described) to the tuner binding post marked "ground" and then the rheostat adjusted until the sound in the telephone receivers is the loudest. The reader should bear in mind that the electron tube detector unit is merely substituted for the crystal detector and the tuning of the receiving circuit is the same as described in Circulars Nos. 120 or 121. When signals from a desired transmitting station are heard as loud as possible by tuning, the intensity may sometimes be improved by adjusting the knob on the filament rheostat so as to increase or decrease the filament current (current from the "A" battery). The knob is kept in the position of minimum filament current without reducing the strength of the incoming signals.

If a detector type of electron tube be used, the voltage of the "B" battery is changed until the greatest signal intensity is obtained. This necessitates the use of a tapped "B" battery.

The operator must not expect too much of the apparatus at the first trial, and even assuming that he has had experience with crystal detectors, some difficulty may be experienced in getting the electron tube to operate. In this case he should first ascertain if the various parts of the complete receiving equipment are properly connected; or again, it may be found that some of the connections to the electron tube detector unit are improperly made. Special care should be taken to see that the "A" and "B" batteries are connected to the proper terminals of the electron tube detector unit. After a little experience the operator will find the electron tube to be much more positive in adjustments than the crystal detector.

Notes on Soldering

It has been stated above that certain connections were soldered. In fact, one could well advise that all connections about a radio circuit be soldered, but soldered correctly. There are some general hints that may be given but judgment and experience are essential. (1) The soldering copper must be clean and the tip well coated with solder. If the tip of the soldering copper is not bright it should be filed clean. It is then heated, care being taken that the tip is not directly in the flame. After the copper is hot—not red hot—it is dipped in the soldering flux or paste and the copper tip coated with solder. (2)

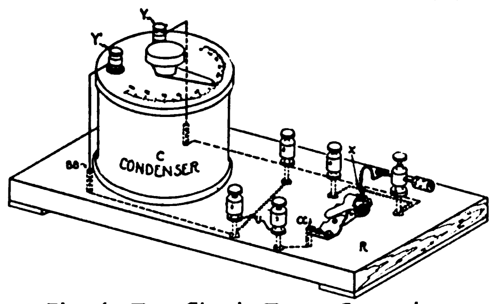


Fig. 6—Two-Circuit Tuner Connections

The wires are cleaned where the soldering is to be done, using fine sandpaper, then a small amount of soldering flux or paste is applied at the joint, and the wires to be soldered are tinned or coated with solder before the wires are joined. After the wires are tinned they are soldered together, using just enough solder to make the joint solid. The joint should not be jarred while the solder is still soft; to do so weakens the joint and gives the solder a dull appearance. A good soldered joint will be smooth and bright. (3) All excess soldering flux or paste should be cleaned off. Gasolene or alcohol will assist in cleaning off the paste. This last point is sometimes overlooked and the excess flux often causes the copper wires to corrode.

Approximate Cost of Parts

The following list includes the cost of parts of the electron tube detector unit and the "A" and "B" batteries. It does not include the cost of the telephone receivers or of any of the other equipment used to make up the complete receiving outfit, since this has been given in Circulars Nos. 120 and 121.

Electron Tube Detector Unit—	
Electron tube	$5.00 to $6.50
Electron tube socket	.75 to 2.00
Filament rheostat	1.00 to 2.50
Grid leak and grid condenser	.50 to 1.50
By-pass condenser, about	.35
Ten (10) feet No. 14 bare tinned copper wire, about	.10
Miscellaneous binding posts and screws, about	.75
Batteries—	
"A" storage battery, 6-volt, 60 ampere-hour capacity	$15.00 to $20.00
"B" battery, 22½ to 45 volts	1.00 to 3.00
Total	$23.25 to $36.70

The Navy has sold its 30,000 surplus Radio transmitting tubes to Bachrack Brothers of New York at $2.51 each. The successful purchaser was not the high bidder, but due to the elimination of some bids which did not comply with technicalities, this company secured the award.

NAVY PLANS AIRSHIP AND RADIO STATION

The two largest airships in the world, now building for the Navy, one at Lakehurst, N. J., and one in Friederichshafen, Germany, will have the latest and best radio equipment capable of development. Anticipating their completion, their home port is being fitted up for their arrival with a high powered radio station.

A new type of radio transmitting antenna without towers has just been installed at the Naval airship base at Lakehurst, N. J., Naval Radio Station NEL. In an effort to keep the big landing field clear for the two giant rigids ZR1 and ZR3, and to eliminate high towers and aerials, the radio engineers of the Navy designed a long low aerial. It is nearly 800 ft. long and fully 120 ft. wide, forming a sort of gridiron, mounted on poles 60 ft. in height. Technically, it is a multiple-tuned antenna with several ground leads. By erecting the aerial along one side of the field a clear open space is left for maneuvering the ships.

Recent transmission tests with the new aerial have carried messages on 900 meters to Newport, R. I., and Norfolk, Va., distances approximating 200 and 250 miles, which indicates excellent daytime service. Daytime communication with the big airships when they are cruising within about 300 miles of the station is promised. At present a vacuum transmitting set with 1 kw. in the antenna is used, and the experts believe that on clear nights in winter communication can be carried on with aircraft or ships fully 2000 miles out on the Atlantic. This will insure the picking up on the German-built ZR3, on her maiden trip to her home port, before she is a third of the way over. When the R-38 made her initial trans-Atlantic cruise she was not heard from until within about 600 miles of New York.

The new aerial was designed and built by the Naval Aircraft Radio Laboratory at Anacostia, and installed at Lakehurst by radio men from the Philadelphia Navy Yard.

In addition to the new radio transmitting set, Lakehurst will have a radio compass station which will enable the dirigibles to determine their positions in the air within a radius of 200 miles, and locate the field when returning from a cruise in darkness or in dense fogs. Radio equipment for the big rigid ships has not yet been designed, but it is understood that as plenty of room will be available for engine-driven generators producing great transmitting power, a very long range set can be installed, and it is hoped that both radio telegraph and telephone communication can be carried on up to 300 and 100 miles, respectively.

Training Broadcast Announcers

WHEN KDKA was first started and popular phonograph records comprised the musical entertainment, the announcers had little difficulty in properly pronouncing the singers' and composers' names. However, it was not long before the Westinghouse company decided to make the greater part of the radio program classical rather than popular, and the difficulties of the announcers really started from this decision.

The first announcers at KDKA were chosen for their voice modulation and the fact that their tones, when heard on the radio receiver, were pleasing and well rounded. The fact that they might not have great success at pronouncing the names of the composers and the additional fact that the French, Italian and German music might be announced in a manner which made it ludicrous, was not taken into account. However, the radio division was not kept in doubt very long as to the manner in which the announcers were fumbling the pronunciation of the foreign names.

For instance, one evening when there was a long list of French names confronting the announcer who boldly called them off one after another in his best Anglo-Saxon intonation and accent, he was interrupted by the strident voice of his manager.

"How do you pronounce 'Berceuse,' by Godard?"

The answer was short and to the point. It sounded something like " 'Berkoos,' by Goddard." The manager's next remarks were lost when they were choked off half-way down his throat, and he promised the announcer that in the morning he would receive some further instruction on pronunciation, adding some extra words that had very little to do with pronunciation.

However, the radio audience had started to object strenuously to the Anglo-Saxon pronunciation of the French and Italian words long before morning. The telephone kept ringing constantly. Many linguists all over the country were anxious to impress the announcers with the fact that their pronunciation was all wrong.

The next afternoon the colleges were heard from. Almost all the colleges in the East sent in protests against the improper pronunciation of these well-known words. The music lovers were even worse. Some of the more temperamental actually shed tears at the manner in which the names of the beloved masters were Anglicized.

So, in the morning, even before the protests began to arrive in great numbers, the announcers went into strict training. They were required to pronounce all the names of the pieces on the program for that evening and rehearse them several times in order to memorize them. This was the beginning of the Westinghouse system of training.

As the program has increased manyfold over the schedules of those early days, the announcers have found it much more difficult to guard against errors creeping into their enunciation. Therefore, before the announcer goes on duty he must rehearse his program in detail before the literary critic of the department of publicity. Every word uttered by the announcer during the entire program is first criticised and corrected, if in error, by the critic. The manner of delivery, the intonation, the pitch of the voice, and all the little details of announcing must first pass the critical ears of the man who sees that no errors are broadcast.

Rehearsing Program to Literary Critic

This does not mean that only those announcers whose experience is limited are required to rehearse their programs, but even the ones who have been on duty the longest, almost two years, are required to go through their daily paces just the same. They must have every word correct. If there is the slightest doubt about the pronunciation of a word, it is looked up in the encyclopedia and this authority used. If it is necessary to look up a foreign word whose accent is difficult to the American tongue, one of the linguists employed by the Westinghouse company is also called into consultation.

Even with all this care, an occasional error does crop out in the program, and with an audience of almost a quarter of a million there is bound to be some protests and criticisms. Perhaps the announcer is quite familiar with the proper pronunciation of the word, but a slip of the tongue in an unguarded moment, and he is in for it. Not only his immediate friends in the office in which he works, but also those who know him only remotely, take great delight in phoning him the first opportunity and telling him of his error. Then the returns from outlying districts make mention of it until the announcer feels that everyone in America must know of his error. This outside check, or the criticism of the radio public is the thing which the announcer feels most keenly, even more so than the correction of his manager. He is ever trying his best to improve his diction and to guard against the transmitting of any errors in speech.

So, between his daily training before the literary critic, and the criticism of the radio audience, which is always sincere, the announcer is kept on the *qui vive* to improve himself. It is, therefore, only rarely that a serious mistake is heard in Westinghouse broadcasting, and when this occurs the audience can rest assured that "coals of fire" will be heaped on the offender's head, and that it will have been his first and last offense. Public opinion will see to it that he does not repeat.

Unable to dispose of a good, but not modern, house in Dallas, Texas, in spite of alluring offers which brought no bidders, an enterprising real estate operator equipped the old mansion with the very latest radio receiving set and so advertised in the leading paper. Replies came immediately and from dozens of offers he was able to dispose of the house with a good profit.

The Improbability of Radio Power Transmission

By Dr. Charles P. Steinmetz, Chief Consulting Engineer of the General Electric Company

THE successful development of radio communication by telegraph and telephone raises the question of the possibility or impossibility of radio power transmission.

In some respects, radio power transmission exists today, for the message which you receive by radio has been carried by the power of the electromagnetic wave from the sending to the receiving station. However, while the sending station sends out electro-magnetic waves of a power of several kilowatts or even hundreds of kilowatts, this power scatters in all directions, and it may be only a fraction of a milliwatt which we receive, that is, less than a millionth of the power sent out. But this small power is sufficient, when amplified, to give us the message.

The problem of power transmission essentially differs from that of the transmission for communication, that in power transmission most, or at least a large part of the power sent out by the generating station must arrive at the receiving station, to make it economical to transmit the power.

Hence, the problem of radio power transmission is that of directing the radio waves so closely that a large part of their power remains together, so as to be picked up by the receiving station. Much successful work has been done in directing radio waves, and for instance our trans-Atlantic stations send out most of their power eastwards. But still, even as directed, the power scatters over the coasts of Europe from Norway to Spain, so that it is impossible to pick up an appreciable part of it. The limits of impossibility of concentrating a beam of radio waves may be illustrated by comparison with a beam of light. Light is an electromagnetic wave, differing from the radio wave merely by having a wavelength many million times shorter. While usually the light scatters in all directions, like the wireless wave, we can direct it in a concentrated beam by the searchlight. But there is inevitably a scattering of the light in the searchlight beam, and when the beam starts perhaps with a square yard section at the searchlight mirror, at 10 miles distance it has at the very best scattered to a diameter of 2000 ft., and at 100 miles distance the beams cover a section of 16 square miles. If it were a beam of radio power, it would thus require at 100 miles distance a receiving station covering 16 sq. miles—about four miles wide and, what is still more difficult, four miles high, to pick up a large part of the power. The cause of this scattering is two-fold. First, the inevitable imperfections of any apparatus. No matter how perfect a reflector, there are slight imperfections, and at 100 miles distance they seriously count. Furthermore, even with an absolutely perfect reflector, the beam of light would stay together only if the light came from a mathematical point. As it must, however, come from a small area, this causes an inevitable scattering, which at best gives an angle of scattering of about two degrees. This is about 100 times as much as would be permissible to economically transmit power a hundred miles by a direct radio beam.

Thus the probability of power transmission by directed radio is very small, except perhaps, in very special cases where the distances are moderate and the efficiency of transmission of secondary importance.

The second possibility of radio power transmission—at least theoretically—is by resonant vibrations or standing waves. Suppose we had a very large sending station sending out electromagnetic waves not of hundreds, but of hundred thousands of millions of kilowatts, and suppose we could find a wavelength where the absorption in the passage of the wave through space is sufficiently small so as to be negligible compared with the amount of power. Assuming first there were no receiving stations. Then the waves issuing from the sending station would circle the globe and return to the sending station, and if the wavelength is adjusted so that the return wave coincides with the outgoing wave, it would return its power, and little power would be required from the sending station to maintain such a system of high power standing waves, only enough to supply the losses—just as little power is required in an electric wire transmission system, to maintain the voltage wave, as long as no current is taken off. Suppose now we erect a second station, tuned for the same wavelength as the sending station. It would resonate with the standing electromagnetic wave issuing from the sending station, thereby stop its passage by absorbing its energy. It would, as we may say, punch a hole in the standing wave sheet coming from the sending station. Power would then flow into this hole; the sending station would begin to send out additional power to maintain the wave sheet, and this power would be received by the receiving station. This would give a real radio power transmission. Any receiving station of suitable design would then be able to pick up power from the universal power supply carried by the standing wave sheet covering the earth. Also several sending stations may send out power. These may either have different wavelengths, then would not interfere, and the receiving station could be tuned to receive power from any of the generating stations. Or — what would be preferable—all the generating stations would be tuned to the same wavelength, that is, the same frequency. Then they would have to be synchronized and operate in synchronism, just as different electric generating stations on the same transmission line are operated in synchronism.

Theoretically, this is an interesting speculation, but whether it could ever become a possibility would depend on the question whether a radio wave of such length could be found as to make the losses of power by absorption, etc., economically permissible, and whether stations for such wavelength and power would be economically feasible. Furthermore, it would have to be an international development. Therefore, even if such radio transmission by a stationary electromagnetic wave sheet were possible, its realization at best is rather distant, so that the present outlook for radio power transmission is very remote. I thought it of interest, however, to bring this before you as an interesting speculation of future possibilities.

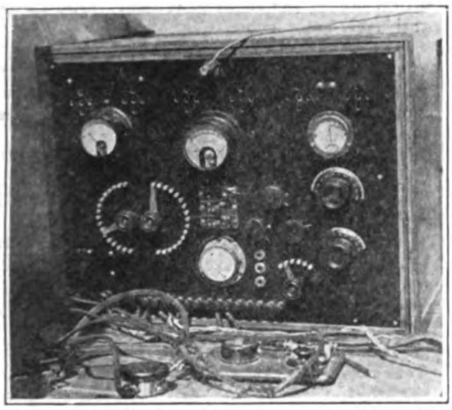
UNCERTAINTY AS TO BRITISH BROADCASTING PLANS

There is still much uncertainty regarding the conditions under which wireless broadcasting will be carried out in England, according to Electrical Division of the Department of Commerce. Differences have arisen between manufacturers and the Postmaster General, and conferences are now being held, attended by representatives of between 40 and 50 firms, including those which have applied for licenses to broadcast. The vital question is as to the erection of broadcasting stations, one group wishing to have the construction of all of them handled by one organization, and the other, composed of smaller manufacturers, opposing this office, which they characterize as monopolistic. The scheme as outlined calls fo reight stations which are expected to cost approximately £20,000 each. In connection with the cost of the broadcasting program it has been suggested that the Government's "listening in" license fee be increased and that the additional sum thereby obtained be placed in a common fund out of which the program would be provided. At present it is proposed to charge 10/6 ($2.44 at par) for registration of receiving sets.

Tests with a Portable C. W. Transmitter

By Dr. A. E. Banks

WITH a view to determining the radio possibilities in the mountains inland from San Diego, California, a special portable set was built consisting of a detector and two-step amplifier for receiving, using the CR5 circuit, and a 15-watt C. W. set, incorporated in the unit, using the Heising circuit. While the apparatus when assembled is not as compact as the commercial products, it is very compact, and on test, on a regular antenna, proved as efficient



Portable Transmitter and Receiver Used in Test

as the ordinary uncrowded C. W. set of the same power. For preliminary tests a special antenna was mounted on the automobile, in this way permitting prospective sites to be felt out tentatively prior to erecting a more efficient antenna.

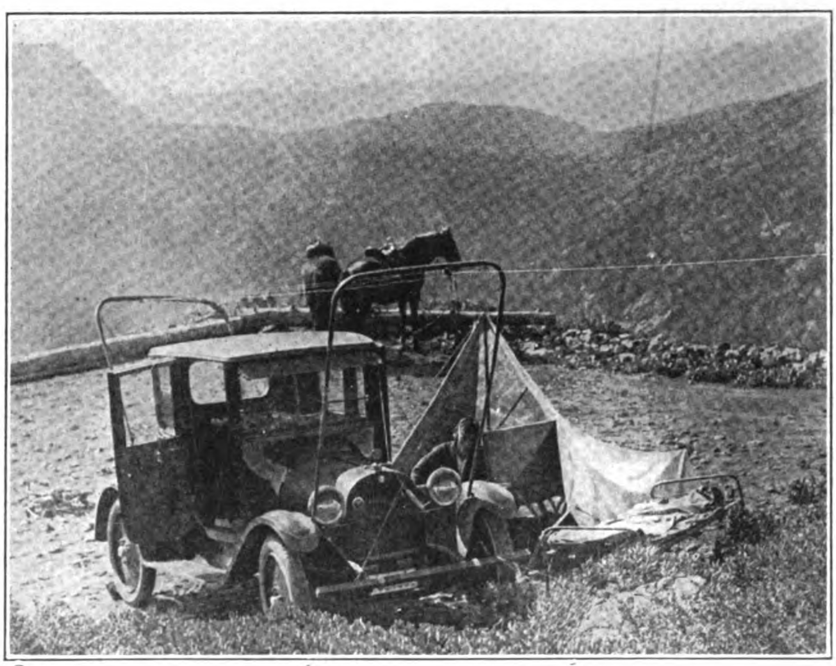
Laguna Mountain was selected for the first experiment because of its isolation and the practical need of communication. It is in the Cleveland Forest Reserve, rising 6200 feet above sea level. While heavily wooded on one side there is a reasonably large area at the summit fairly clear of timber. This area extends back to what is known as the "rim of the desert," where there is a precipitous drop into the Imperial Valley district, the view from which point forming one of the wonders of Southern California.

The tests were carried out during the week-ends of August 18th, 19th, and August 25th, 26th. During the first tests comparisons were made between the car antenna and a single wire. There was little difference in the efficiency from the receiving standpoint, though from the transmitting the car antenna amounts to little more than a loop, and the addition of a single wire was considered necessary. The body of the car was added as counterpoise in both cases. On the second trip a 2 x 4 was lashed to a pine tree and a two-wire antenna thus elevated 45 ft. at the free end and 15 ft. of 2 x 4 at the lead-in completed the antenna system. During this trip also a four-wire counterpoise spiderweb suspended 5 ft. from the ground was employed. With this, results were better, but it was found that increased efficiency resulted from adding the body of the car as further counterpoise.

During the first tests .5 amp. was the best that could be done on the single wire. During the second tests 1.0+ amp. was put into the antenna with great increase of audibility at the San Diego end. The Forest Ranger, Mr. Edward Miller, very kindly consented to care for the experimental antenna during the absence of the writer, so that further tests may be made with the least possible loss of time in installation. The station site is 61 miles from San Diego.

The receiving characteristics even at this short distance were so remarkably different from those in San Diego as to be almost startling. This has already been noted in a letter by Lee Roy Potter in September RADIO and his remarks coincide with our findings. Owing to heavy static and the presence of electric storms, it was feared that receiving would be next to impossible; caused us to discontinue on the first Friday without having hooked up with Deputy Radio Inspector D. P. Trim, who was copying us in San Diego. The following night the failure of the storage batteries caused us to discontinue prior to the DX time. This night, however, we copied the following before discontinuing: 9CJF, 9AMB, 9BP, 5QI, 9CJJ, 6ZX, 9ZN, 6BPZ, 6AQA, 6RU, 5OC and others. We got quite a sensation when 9ZM's C. W. was picked up, in spite of heavy static.

The following week most of the time was devoted to the installation of the antenna, and transmission was not attempted until Saturday, though a short test was carried on Friday night. Mr. Trim reported the signals as being received with greatly increased audibility at station 6TW and he endeavored to establish communication. Troubles never come singly and the fusing of a switch point thereby disconnecting the power supply caused us to shut down, this time at the very moment when success was imminent. Owing to darkness and lack of facilities for quick overhauling it was decided to abandon further work until the future.



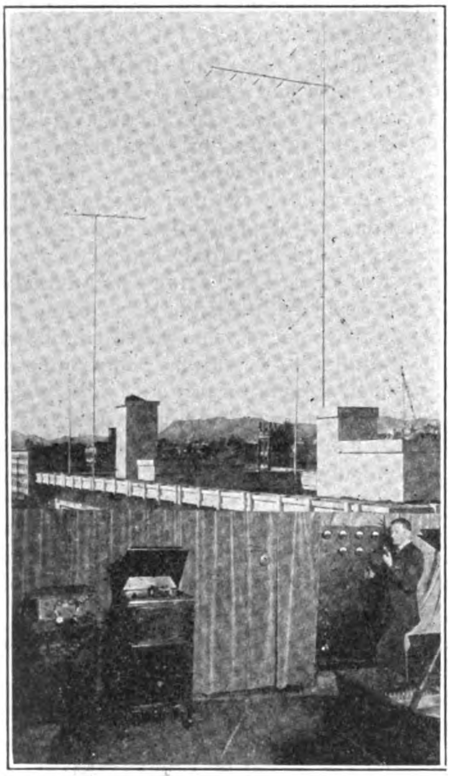
Portable Station on Laguna Mountain

at 8:15, however, on the first night the tests were attempted, 5ZA came pounding in louder than we had ever heard him in San Diego and the following stations were copied: 5ZA, 9CJF, 9AMB, 5OL, 9BP, 5QI, 9CJJ, 6ZX, 6APW, 9AJT, 6EPZ, 6AQA, 9ZN, 6RD, 6ARB, 6RU. Unfortunately on both occasions communication was not actually established. Static interference

The following additional stations were copied during this trip: 6BQC, 6BPZ, 6ZA, 6ZB, 6TW, 6FT, 6BJY, 6AGR, 6BOE, 7LU, 9CCS, 9CJJ, 9DUG, 5QI. All San Diego stations were copied with greatly decreased audibility. The Los Angeles stations were not nearly so loud as the eastern and more northern ones. 6KA, whose audibility is ordinarily tremendous, was found to have less audibility than either 5ZA or 7LU, at Laguna.

Peculiarly enough the NPL arc mush was not in evidence though harmonics could be found. All sparks were practically inaudible.

Reception during the whole test was really difficult for the reason that thunder storms were in full swing and the resultant crash in the receiver extremely unpleasant.



Radio KFI

A few words may be of interest relative to the apparatus. With the assistance of E. P. Merritt, manager of the Radio Department, Southern Electric Company, standard parts were mounted on a bakelite panel and enclosed in a three-ply oak cabinet. A second oak cabinet of the same light material was arranged as a protective housing during transit. The whole installation is rugged and has proven extremely efficient from the mechanical standpoint. As to the electrical efficiency, when tried out on the regular antenna at Station 6ZB using a storage battery and dynamotor, the same as in the field, communication was easily established with Los Angeles and Long Beach, audibility being favorably commented on.

Laguna is isolated, having no direct communication with the outside world except by heliograph, which is uncertain. The Forest Ranger, Mr. Edward Miller, is intensely interested in the experiments and has done everything possible to arrange for our comfort during the week-end trips.

News of the Broadcasters

WLW AT CINCINNATI

WLW, the new and powerful radio broadcasting station of the Crosley Manufacturing Company, Cincinnati, Ohio, has been constructed under the supervision of Charles E. Kilgour and Dorman Isreal in the company's new factory.

Four 250 watt radiotron tubes are used, two as oscillators and two as modulators, with the Heising system of modulation used in connection with speech amplifier. This speech amplifier is composed of three Western Electric No. 216A amplifying tubes, arranged with one connected to the microphone circuit, with its output impressed upon the other two, which will be arranged as a push-pull circuit.

Their output is impressed on two 50 watt radiotrons, operated back to back, or as the push-pull system, while the output of the entire amplifier is impressed upon the grids of the modulator tubes. Normal radiation will be nine amperes.

This set also can be operated as a master oscillator-modulating outfit, using one 50 watt tube as a master oscillator, modulated by another 50 watt tube. The high frequency output of this unit will be amplified by one 250 watt tube, and its output, in turn, amplified by three 250 watt radiotrons. Sufficient tests have not yet been made to determine which will be the better method of transmission.

The antenna is 140 ft. long, with an average height of 125 ft. This is composed of twelve wires on 23 ft. spreaders. The four outside wires are doubled and the lead-in is a cage 1 in. in diameter and made up of 768 strands of No. 30 wire. The counterpoise is 60 ft. below the antenna at the lead-in end and 90 ft. at the other end. This contains 15 wires on 34 ft. spreaders, the four outside wires being doubled as in the case of the antenna proper.

The high voltage supply is obtained from a Glow Electric motor-generator composed of two 1000 volt, 1½ kw. generators coupled to a 5 h. p. three phase 220 volt squirrel cage motor. One ¾ kw. exciter is belted to the set and supplies 220 volts for the field excitation.

RADIO KFI

RADIO KFI, owned and operated by Earle C. Anthony, Inc., of Los Angeles, is equipped with a 100 watt transmitter, consisting of two 50 watt oscillators, two 50 watt modulators, one 50 watt speech amplifier, and one 3 tube input line repeater. The announcing is done from the panel, and phonograph, piano and any other entertainment is all picked up from one microphone located in center of broadcasting station.

A ½ kw. 1000 volt motor-generator set is used to supply plate voltage. Filaments are lit off storage batteries with mercury arc charging unit for charging the batteries.

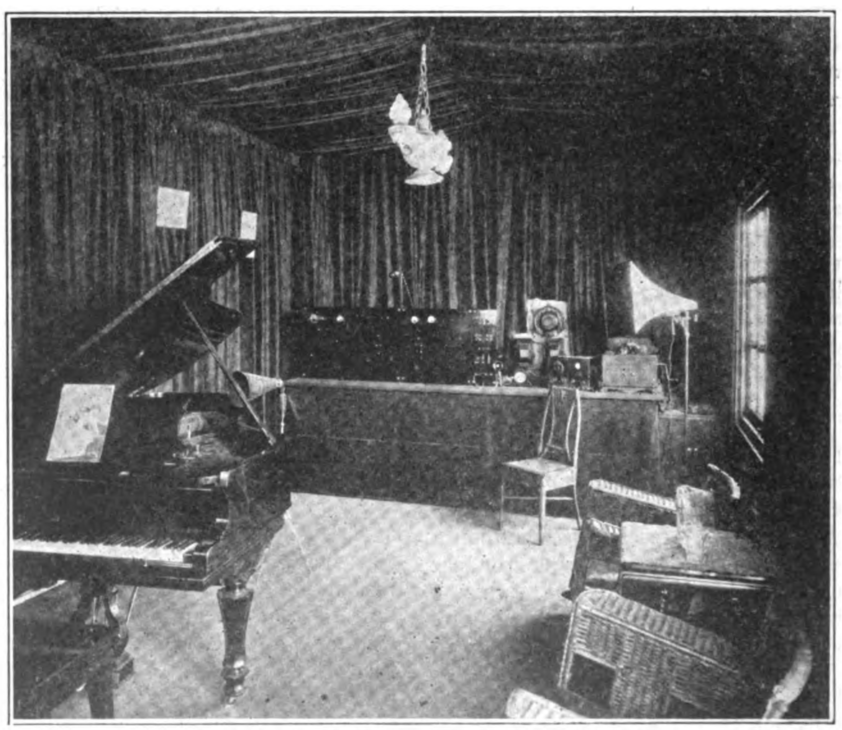
The room is draped with heavy velour on walls and a canopy over the ceiling in addition makes the room practically sound proof and free from echo.

Antenna current, no modulation, is 4 amperes. Modulation on voice and music and tone test runs between ¼ and 1 ampere increase in the antenna circuit. A tuned counterpoise and ground system is used.

The antenna consists of two 65 ft. steel masts located on top of the Packard building, which is four stories, approximately 100 ft. high, with six wires, No. 7-18 phosphor bronze antenna wire, separated 3 ft. apart, 100 ft. long; T type antenna. The counterpoise is located directly under the main transmitting antenna, approximately 100 ft. long.

Special filters, reactors and inductances were designed and made specially for this installation under the direction of A. MacDonald, operator. It has an approximate daylight range of 300 to 500 miles and on the 510 meter wavelength from 7 to 9 p. m. it has been heard over distances of 1500 miles.

Wiley Winsor, physical director of the Y. M. C. A. at San Francisco, is broadcasting setting-up exercises at 10 a. m. Monday, Wednesday and Friday from KSL, The Emporium broadcasting station. This has been arranged for by Major A. H. Hutchinson of the Junior Signal Corps.

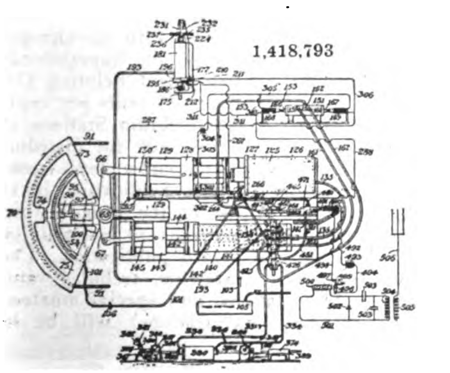


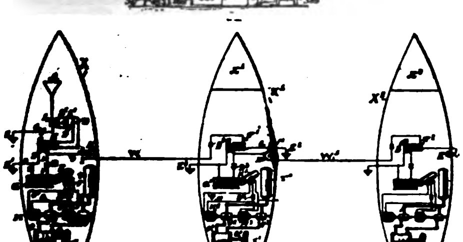
Studio and 150-watt Transmitter Operated by E. J. Martineau for Hale Bros., San Francisco. KPO

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

John H. Hammond, Jr., Pat. No. 1,418,793; June 6, 1922. **System of teledynamic control for dirigible bodies.**

A radio receiving circuit 505, 506 is arranged to energize solenoid 500 upon receipt of radio impulses. This in turn causes actuation of solenoid 490 which moves a piston valve in cylinder 471, so that the main control valve 425 may be rotated. Corresponding to various positions of this valve, the steering wheel 70 may be affected to cause the vessel to move to the right or left. The arrangement is such that a gyroscope normally prevents deviation by the aid of mechanism 181, to the shaft 175 of which the gyroscope may be connected. The control valve 425, however, may cause the control to pass temporarily to the distant operator. By prolonging the radiant impulse, fluid may also be admitted to pipe 451 which causes actuation of the piston in cylinder 330. This may be utilized for such purposes as varying the throttle opening of the engine or for controlling a searchlight, or both.





John H. Hammond, Jr., Pat. No. 1,418,794; June 6, 1922. **System of teledynamic control.**

A plurality of bodies to be steered, such as X, X^1 and X^2 are connected to each other by variable conductors W, W^1, which are reeled on spring drums H to permit variations in length of the conductors. The main vessel X is equipped with a receiving system A, L, C, E, so that relay F may be operated when radiations are received. This relay actuates rudder Y and also causes simultaneous actuation of relays F^1 and F^2 on the auxiliary vessels X^1 and X^2. These latter relays in turn cause the corresponding rudders to be actuated.

SIGNIFICANT RADIO DEVELOPMENTS FROM THE PATENT OFFICE VIEWPOINT

By S. R. WINTERS

When any art or science has progressed with such surprising swiftness as is true of radio-telephony and radio-telegraphy within recent months, it is not an unseemly procedure to lift the curtain and bare to the spotlight the personalities whose respective contributions have made remarkable achievements possible. The United States Patent Office is the logical source to consult when an appraisement of "Who's Who" in the significant developments of wireless communication is being made.

The files of voluminous letters of patent (approximately two thousand having been granted since Guglielmo Marconi first transmitted a commercial wireless message) of Uncle Sam's inventive-appraising bureau yield the protective papers whose discoveries have proven epochal in hastening the realization of radio-communication. The writer is indebted to Dr. Wm. A. Kinnan, First Assistant Patent Commissioner, for his generous co-operation in supplying data as to the notable steps.

Five names are inseparably identified with radio-communication: Guglielmo Marconi, J. A. Fleming, Lee De Forest, Edwin H. Armstrong and Edwin H. Colpitts. Their respective contributions, in agreement with the order of their names just cited, were: The application of the first complete radio-telegraph set in the transmission of a message by electromagnetic waves; the vacuum-valve detector for receiving wireless communications; the audion tube or bulb for the reception of radio messages; the regenerative feed-back circuit for the audion receiver; and the audion oscillator for generating modulated high-frequency waves.

Of historical interest and in respect to the claims of friends of the inventor, reference should be made to a patent granted Mahlon Loomis, a dentist of Washington, D. C., which bears the title "Improvement in Telegraphy." The date of its issuance was July 30, 1872—a half-century ago—or 25 years before Guglielmo Marconi accomplished his feat of the transmission of a communication in the absence of wires. Undoubtedly this was the earliest patent granted by the Patent Office regarding radio-communication. From the viewpoint of Uncle Sam's appraiser of inventions, however, the Loomis discovery was lacking in the essential particular of a means of generating high-frequency electromagnetic waves. Radio-signaling, obviously, involves the use of some system of generating the Hertzian waves, and for this reason writers of textbooks and radio engineers are prone to discount the invention as disclosed in the Loomis patent, No. 129,971. His priority in the direction of radio-communication, however, merits consideration.

Among the earliest of experiments with electromagnetic waves, without having established their identity, were conducted in England in 1879, when a Professor Hughes employed a kind of generator of sparks, the device taking the form of a trembler bell. By the use of a telephone receiver and a coil of wire acting as an antenna, he was enabled to produce sounds while pacing to and fro in front of his home. The ridicule of his friends who were invited to observe the experiments, served to put a damper on his activities. He was signaling by electromagnetic waves, but the disconcerting comments of his neighbors stifled his discovery a-borning. Professor Joseph Henry of Princeton University, in 1842, indicated that the discharge of a Leyden jar was, under certain conditions, capable of oscillating—that is, the current proceeded first one way and then the other over the circuit connecting the inner and outer coatings of the jar. Sir William Thompson, afterwards Lord Kelvin, in 1853, demonstrated mathematically the soundness of this theory. The oscillations of the current from the Leyden jar bear similarity to those employed to produce electromagnetic waves used in radiotelegraphy and -telephony. James Clerk-Maxwell, professor of physics at Edinburgh University, in 1865, was responsible for the expressed conclusion that electric oscillations in a circuit produce electric waves in the surrounding space which travel with the velocity of light.

It was, however, in 1888, that the notable scientific stroke of Professor Heinrich Hertz of Karlsruhe was accomplished, namely, establishment of proof of the existence of these waves. Hence the use of the term "Hertzian waves," which is synonymous with the designation "electromagnetic waves." He produced, detected and measured them. Likewise, he indicated that they were polarized and could, not unlike waves of light, be reflected and bent. The instrument employed has been since identified as the "Hertz oscillator." Structurally, it consisted of two flat metallic plates, 16 in. square, each connected to a rod approximately 1 ft. in length and terminating in a small knob. These rods were buttressed end to end with the knobs adjacent and ¼ in. apart. They were connected in a circuit with the secondary winding of an induction coil, thus making it necessary for the current to span this space between the knobs in order to complete the circuit. Within the primary of the coil was placed a make and break unit. Once the primary circuit was broken, these plates became charged and then they discharged back and forth across the gap between the knobs and produced sparks. Each of the latter dispatched a train of electromagnetic waves. The detection of the presence of these elusive particles was made possible by use of a so-called "resonator." This device consisted of a metallic wire bent into form of a hoop, 14 in. in diameter, with its ends divorced by a slight gap. The precise dimensions of this hoop-like apparatus, so that it would be in "tune" with the oscillator, was determined by prearranged tests. By installing a piece of sheet zinc, 6 ft. wide and 12 ft. high as a reflector and causing the waves striking the latter to be forced back toward the os-

Continued on page 40

LETTERS TO THE EDITOR

Antenna Height

Sir:—This communication is regarding the article by Dr. Banks about the height of antenna.

First, as regards his practical instances Dr. Banks assumes that the same set uses the antennæ listed in his table. Might not these results be due to the fact that in the city the height of an antenna is limited, due to limited space for guying, but also that in a city a large amount of money is available to the amateur for apparatus, and due to the greater efficiency of his apparatus he reaches out in spite of, rather than because of, the low antenna? Even in the table given, the higher antennæ have the greater ranges listed.

Dr. Banks states that "the current squared multiplied by the resistance of our antenna will then indicate the watts we are radiating."

This means that the *power output* is equal to the current squared times the resistance for *D. C.* In alternating current this statement is not exact, the error increasing with the frequency. This also does not include the capacity of the antenna. If the capacity is high enough the antenna may be charged within its capacity and discharge through the antenna inductance on the reverse oscillation, the energy radiated depending only on the radiation resistance which is low in a low and small antenna.

In this formula "radiation resistance" should be substituted for "resistance." The radiation resistance, according to *QST* in "Letters to the Editor," cannot be computed, but it may be supposed that the radiation resistance increases as the radiation surface with a certain increase for effective height increase, and an inverse increase as the wavelength. The problem resolves itself as to whether or not the radiation resistance varies faster with the increase in height than does the square of the current decrease. If some engineer with the "dope" will enlighten us on that point, our problem is solved. The following is from an article in the August *QST* by Mr. A. M. Young, who has certainly had a considerable amount of experience:

"The most important thing about the antenna is to have the center of capacity as high as possible. * * * I have tried many times lowering or raising the antenna * * * with the result that, although the antenna current is often lowered by raising the antenna, my signals were reported much more QSA when it was at the greatest height."

When 8XV was testing for the trans-Atlantics he installed a receiver four miles away and put in a galvonometer in place of the phones for audibility meter. By raising his transmitter antenna 22 ft. his radiation dropped from 22 amps. to 15.2 amps., but the galvonometer reading increased from 51 to 72 divisions, showing what some additional height can do. (*QST* March No. 14.)

If you average the heights of the antennæ used by the successful trans-Atlantic stations you will find as follows: C. W. stations, 70 ft.; spark, 77 ft. These averages were pulled down by two stations with heights under 30 ft.

The whole trouble seems to lie in the fact that not enough accurate information is available. Won't some amateur with a lot of money hook a 50-watt tube onto a 50-ft. eight-wire cage and try every five feet from 20 to 120 ft. of height, using cage lead-in and counterpoise 10 ft. above ground, and prepare graphs showing variations of total resistance, fundamental wavelength, current (T. C.), and audibility measured by galvanometer in receiver one mile away? Then we could get some dope to go by and could settle the question once and for all. We can't tell anything by individual station performance because of the varying powers, locations, and efficiencies of various sets.

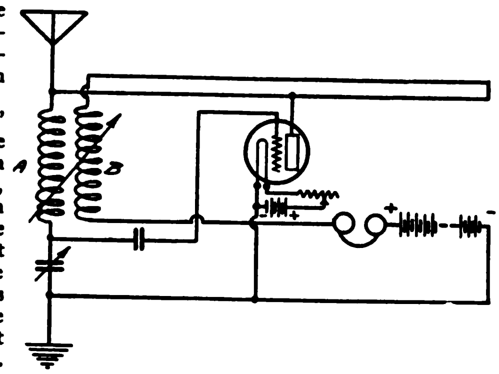
Yours truly,
A READER.
Claremont, Calif.

The Gibbons Receiver

Sir: Here is just a little hint that some amateurs like to know about. It is about an article in the August RADIO, on page 22, by D. P. Gibbons. Before I tell of this hint of mine, I will say that the set he describes is some peach. It is all that he says it is —and more.

By my own experience, and that of others, I find that a Pen Brand grid condenser is best, because this set is hard on them. When trouble comes, it can most always be traced to the grid condenser.

Now, if you already have one of these wonders you know how well it works, and probably are willing to make it work better. Try this: Get a 400 turn coil and put it in as shown below. Couple it at about 20 degrees, then go to work as usual. This coil greatly improves the clearness of music and at the same time amplifies. If it does not amplify the local stations, don't worry, because it doesn't. In getting Los Angeles,



though, it increases the strength a very great deal.

This coil also helps in tuning the set, and greatly reduced interference.

For the benefit of those who may not have seen Mr. Gibbons' article, the following instruments are required:

1 70 turn honeycomb coil—*A*.
1 400 turn coil—*B*.
1 grid condenser.
1 .001 mfd. variable condenser.
1 rheostat (plain).
1 18 volt B battery.
1 6 volt A battery.
1 socket.
1 soft tube.

And, of course, aerial, ground and phones.

It is very important to connect coil *B* just where it is shown and *not* between the plate and aerial. This decreases the wavelength of the set a very little bit.

I will be glad to hear from other experimenters on this line. Yours truly,

GILBERT EARLE.
149 Parkside Drive, Berkeley, Calif.

Effect of Mountains on Radio

Sir:—I saw Mr. Potter's letter in RADIO for September and thought it might interest him as well as others to learn just what effect the mountains seem to have on reception in Reno.

This city is almost completely surrounded by mountains—the highest range being on the west. Broadcasting stations in San Francisco and vicinity have always been difficult to pick up here. Aside from a few instances, the Rockridge (KZY) and Presidio (AGI) stations have never been heard here satisfactorily, although they have been heard with great clarity many miles east of here. Amateur spark and C. W. stations in the same vicinity with these broadcasting stations are very little affected by the intervening mountain range, although they seem to be more subject to fading than stations located in other directions. At the same time there are other broadcasting stations west of Reno which push through in spite of the mountains, using less power than the previously mentioned stations. The best of these is the Kennedy station at Los Altos (KLP). So it seems, on second consideration, that there must be some cause other than the mountains to produce this peculiar condition. A strong argument in favor of this is the fact that the reception from coast stations directly west is very noticeably better in Carson City than here, and Carson City is so close to the range on the west as to be in what is popularly believed to be the radio "dead zone."

Broadcasting stations as far south as San Diego, north to Portland, and east to Denver are received with great distinctness and very little fading. On one occasion last winter a broadcasting station in Winnipeg, Canada, was heard here with plenty of "punch," although the feat has never been duplicated.

All considered, it apparently still remains to be proven that it is the mountains and not the atmospheric conditions that so noticeably affects radio transmission and reception.

Very truly yours,
B. W. CASSELBERRY.
620 Plumas St.,
Reno, Nev.

NEW LIST OF RADIO STATIONS OF THE U. S.

Copies of the new list of Commercial and Government Radio Stations of the United States, edition June 30, 1922, will be ready for distribution about the 15th of October and may be procured from the Superintendent of Documents, Government Printing Office, Washington D. C., at 15 cents per copy. The new list of Amateur Radio Stations of the United States will be ready for distribution about the same time or a few weeks later. The price of this publication is 15 cents per copy. A list of the broadcasting stations in operation on June 30 last will be included in the first-named publication. The list of experimental stations, technical and training school stations, and special amateur stations (special land stations) will be in both publications.

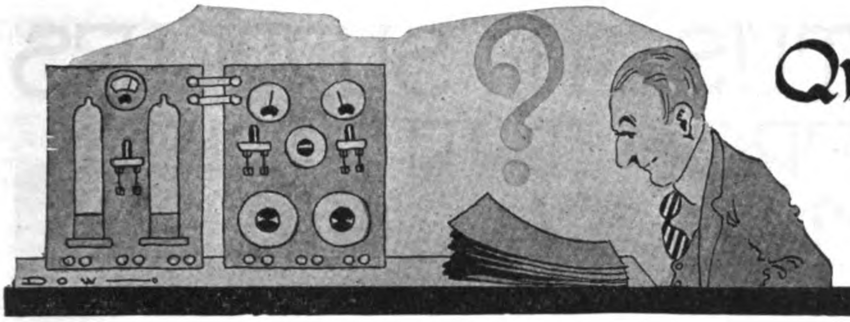
NEWS OF THE OPERATORS

6FZ has moved from 2436 Dwight Way, Berkeley, to 1463 76th Avenue, Oakland.

KDN, operated by Leo J. Meyberg in connection with the *San Francisco Bulletin* at the Fairmont Hotel, announces that jazz music has been entirely eliminated from its programs.

Midwest Radio Company of Cincinnati, Ohio, announces that their Mirage radio frequency broadcast receiver is now ready. This instrument was designed to meet the demand for a moderately priced long distance vacuum tube receiving outfit with the added feature of a radio frequency amplifier which makes for sharp tuning and the elimination of static to a large degree. Under average conditions stations up to 300 miles may be heard and much longer distances under favorable conditions.

A. H. Grebe & Co., Inc., have established a western branch at 451 East Third Street, Los Angeles, Calif., for the distribution of products throughout the territory west of the Rocky Mountains. Factory shipments arrive weekly by boat, via the Panama Canal, and will be distributed from this point to the dealers.



Queries & Replies on C.W. practice by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

What are the correct physical and electrical values of the Western Electric amplifying transformers mentioned in the article on page 17 of July RADIO?
2CNB, New York.

As these transformers you mention are an integral part of the Western Electric 7-A amplifier, and are not sold separately for amateur use, no information as to their characteristics has been issued by the manufacturer up to the present time.

Please show where to add a potentiometer to the radio set shown on page 24 of March RADIO. Also indicate where to place a second stage of amplification.
F. W. U., Trenton, N. J.

This information is shown in Fig. 1.

Suggest that you obtain a copy of Bureau of Standards circular No. 74 from the Government Printing Office, Washington, D. C. wherein you will find considerable information on the subject.

Given size of wire, diameter of tube, capacity of condenser to be shunted around the finished coil, please indicate a simple formula for determining the number of turns on the coil for various wavelengths.
C. H. C., Pasadena, Cal.

See answer to previous question. The space devoted to this column is insufficient to explain formulae.

What would be the natural wavelength of an antenna 65 ft. high, 60 ft. long, of six wires? What would the size of the counterpoise be for this antenna? What would be the resistance of the antenna with or without counterpoise?
L. M. N., Los Angeles, Cal.

Approximately 150 meters. A counterpoise of twelve wires, six or eight feet above the ground, directly under the antenna, and of the same length, would be adequate. A counterpoise will generally reduce the antenna resistance to from one-half to one-third the resistance with the ground connection. It would be difficult to determine the resistance of your antenna system without making direct measurements.

What kind of tube and what capacity of grid condenser was used in the set shown on page 22 of August RADIO? What size of wire should be used in wiring this set?
J. H. T., Victoria, B. C.

The tube used was a Cunningham C-300 and the grid condenser was .00025 M. F. No. 20 wire should be large enough for this set.

I intend to install a 50-ft. "T" type cage antenna. Would a cage type counterpoise be practical for this antenna?
A. K. C., San Francisco, Cal.

A cage type would not be necessary if you have the room for a flat counterpoise, suspended a few feet above the earth. If you are cramped for room, a cage type of counterpoise would work, although I do not believe it would serve as well as one of the flat types.

Please publish a circuit for a two-stage amplifier using two circuit jacks, to add to a single coil circuit.
C. R., Santa Ana, Cal.

This circuit is shown in Fig. 1.

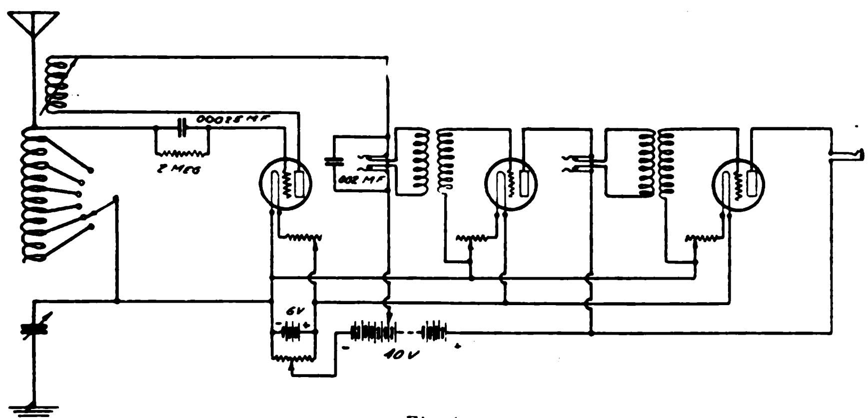


Fig. 1

Is capacitive feedback more efficient than tickler feedback for C. W. reception? What are the advantages of audio frequency amplification using choke coils instead of transformers? What circuit does Mr. Dow, 6ZAC, use for reception?
B. B. S., Brooklyn, N. Y.

Tickler feedback is the most universally used, although both have their good points. Audio frequency amplification with choke coils usually gives a better frequency characteristic than with transformers. Mr. Dow uses a regenerative receiver with the Armstrong tickler feedback and two stages of audio frequency amplification.

Which C. W. transmitter should give the best results (a) one using two 5-watt tubes on pre-rectified (using Kenotrons) A. C., or (b) one using two 5-watt tubes in a self-rectifying circuit similar to that used by C. J. Dow's transmitter?
A. E. W., Watsonville, Cal.

The latter type is the least expensive and unless you wish to experiment with telephony, the latter is the easiest to operate.

Please publish the formula for computing the wavelength of aerials.
R. I. N., St. Paul, Minn.

There are no simple formulas that do not involve considerable mathematics.

CLASS "B" RADIOTELEPHONE BROADCASTING STATIONS

A new class of radiotelephone broadcasting station license has been established to be known as Class "B." A wavelength of 400 meters has been assigned for the use of stations of this class which must be reasonably free from harmonics. The power supply must be dependable and non-fluctuating. The minimum required will be 500 watts in the antenna and the maximum shall not exceed 1000 watts.

The modulation system must be so arranged as to cause the generated radio frequency current to vary accurately according to the sound impressed upon the microphone system. Sufficient tubes and other material must be readily available to insure continuity and reliability of the announced schedule of service. The antenna must be so constructed as to prevent swinging. Some dependable system must be provided for communication between the operating room and the studio. The radio equipment in the studio must be limited to that essential for use in the room. The room shall be so arranged as to avoid sound reverberation and to exclude external and unnecessary noises.

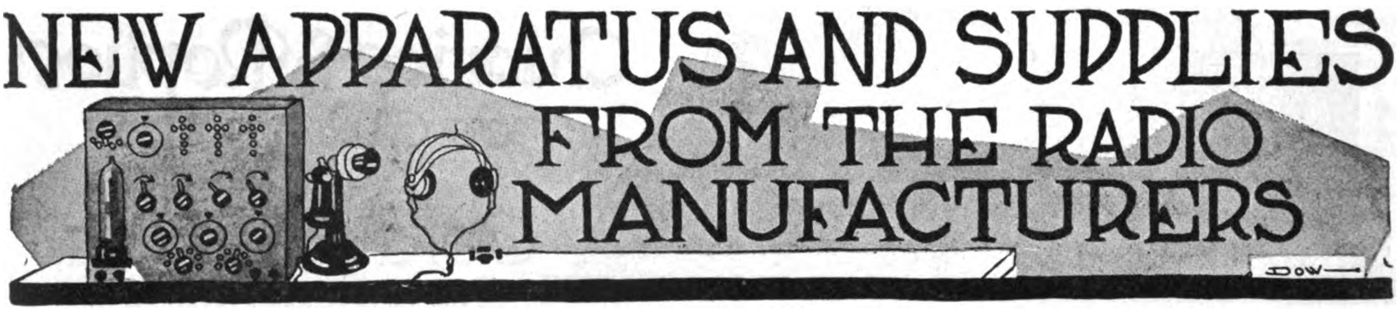
The programs must be carefully supervised and maintained to insure satisfactory service to the public. Mechanically operated musical instruments may be used only in an emergency and during intermission periods in regular program. Where two or more stations of Class "B" are licensed in the same city or locality a division of time will be required if necessary.

Licenses issued for the use of the 400 meters wavelength shall specifically provide that any failure to maintain the standards prescribed for such stations may result in the cancellation of the license and requiring the station to use the 360 meters wavelength.

RADIO TELEPHONE RANGE TESTS

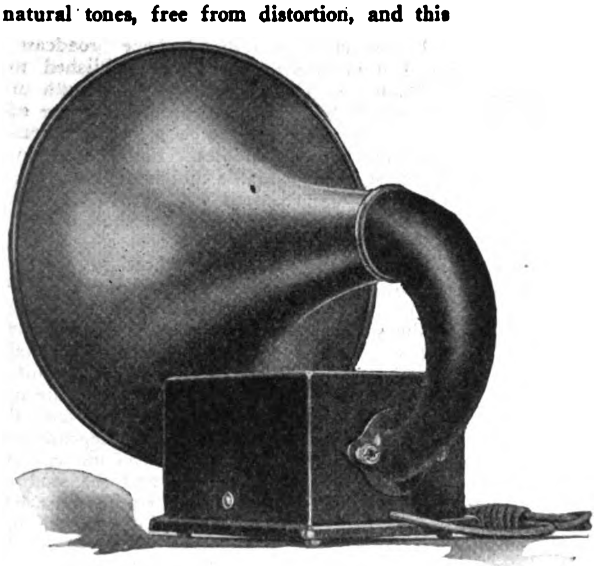
The Bureau of Standards is planning to conduct comprehensive tests to determine the effective working ranges of radio telephone communication when using various kinds of transmitting and receiving sets. Preliminary plans have been outlined for this work, and some correspondence conducted in regard to it.

For a plain, untechnical definition, static is that thing in radio that sometimes sounds like frying eggs and sometimes like the cat's meow. It's what you hear when you can't hear anything.



NEW DICTOGRAPH RADIO LOUD SPEAKER

The Dictograph Products Corporation, of New York City, has produced a radio loud speaker constructed on the principles of the "Acousticon," through which deaf people have been enabled to hear lectures, the voices of their loved ones, music, sermons, etc. It is obvious how sensitive and finely constructed this instrument must be to perform its delicate work. One of the chief essentials is the transmission of sound in its natural tones, free from distortion, and this



Dictograph Radio Loud Speaker

quality of the Acousticon has been incorporated in the Dictograph loud speaker. No attempt has been made to develop volume at the expense of clearness or articulation, but tonal quality and musical reproduction in volume sufficient for the home is now within the reach of all radio users.

The design and construction is such as to permit of maximum amplification and the elimination of side tones, distortion, mechanical vibration and the metallic sound common in the phonograph.

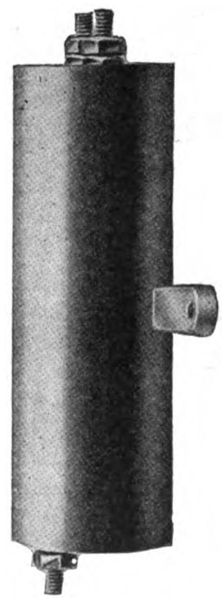
It is adapted for use in all types of radio receiving sets in which a detector unit is employed and also two stages of amplification. It is not recommended for use with crystal receiving sets unless these sets are located close to a broadcasting station and the volume of the sound received through a head set is quite strong.

In using the Dictograph radio loud speaker all that is necessary is to tune the receiving set so that the maximum volume it is capable of receiving is had in the head set. The cord, which is attached as standard equipment, is then plugged in to the receiving set in place of the head set. No other wiring is necessary. It is not essential that a head set should be used before using the loud speaker, as good results are secured by plugging the loud speaker directly to the receiving unit and tuning in directly.

THE AEROVOX INTERTUBE COUPLER

A new device that is rapidly making enthusiastic boosters is the "Aerovox" Intertube Coupler. While it serves, as its name indicates, as a coupling from the output circuit of one tube to the input of the next, regardless of frequency, its special field of usefulness is in radio frequency amplification.

The designers of this instrument are D. K. Lippincott, of the Aerovox Corporation,



Aerovox Intertube Coupler

and B. F. McNamee, of the Radio Devices Co. of San Francisco. They have avoided the mistake of attempting untuned radio frequency amplification for short wave work. Realizing that a broadening out of the waveband to the extent necessary in untuned work can only be done by introducing losses into the circuit, they have provided a method for sharply tuning the coupler on short wavelengths.

ACOUSTIC PROPERTIES OF "MADERAWARE" DIE CAST WOOD

The American Art Mache Company, Chicago, some time ago developed a process of die-casting wood fiber into any desired form. Their earlier products included a wide range of wood castings to replace hand-carved wood, as for instance in interior trim for fine homes, for statuary, etc.

But their discovery that "Maderaware" had remarkable acoustic properties for horns for radio has led them to abandon practically every other line of manufacture and to concentrate their large producing facilities upon the manufacture of radio horns.

They have adopted the term "Clearspeakers" for the Maderaware horns, to typify the clear voice-like messages that they deliver.

In presenting their claims to the radio public they contrast the metallic reproductions of early table-top talking machines with the full, sweet resonance of the modern wood cabinet machines; and prophesy that "Maderaware" die cast wood will render as great a service to radio-telephony as the cabinet makers did to the talking machine industry.

The violin-like resonance of "Maderaware" wood is ascribed to the fact that the die casting process compresses the wood-fiber

Maderaware Radio Horn

to a density 200 per cent greater than that of seasoned hardwood, and that this density is uniform thruout the structure.

It seems also to have the effect of amplifying the sounds by adding to the electric vibrations the vibrance of the wood itself. Yet, however loud the message, it is stated to be uniformly clear, pure, musical and free from metallic discord.

DIFFERENCE BETWEEN RADIO AND AUTOMOBILE STORAGE BATTERIES

"How does the radio 'A' storage battery differ from the ordinary six volt automobile starting and lighting battery?" This question is asked about as often as any other propounded to the radio equipment dealer who supplies the correct answer: "It has thicker plates and fewer of them per cell." According to the Willard Battery Company, there is a need for a uniform delivery of current at a constant voltage over as long a period of time between recharges as it is possible to obtain. The immediate demand for a great flood of current, such as is required in starting a car, is absent here. Thin plates with much exposed plate surface produces the current required for car starting, but thick plates give more uniform current over a longer period between recharges, and what's more, contribute to longer life of the battery.

NEW RADIO CATALOGS

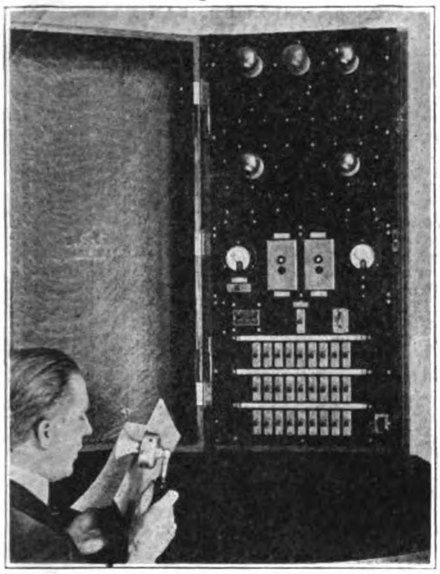
Northern Radio and Electric Co. of Seattle, Wash., has issued a price list of standard radio equipment for which they are distributors.

The Radio Electric Co. of Pittsburgh, Pa., has issued a circular illustrating and describing their type CA concert receiver, 175-800 meters. This consists of one compact unit 18 x 12 x 11 in., containing tuner, detector, 3 stages of amplification and loud speaker.

LOUD SPEAKER INSTALLED IN HIGH SCHOOL

A most interesting installation has recently been completed for the Piedmont High School, Piedmont, Calif., involving a distinct improvement over present methods of inter-classroom communication.

Developed by The Magnavox Company, pioneers in the field of devices for sound amplification, the installation consists of a central or master station and twenty-five receiving stations, each equipped with a No. LS-2 Magnavox Telemegaphone, the motor generator and battery being installed in a steel cabinet in the basement.



Talking to the pupils of 25 classrooms at one time by means of a Magnavox Telemegaphone installation equipped with radio hook-up.

The master station is operated like an ordinary telephone (as illustrated). Talking into the Magnavox in ordinary tones, the speech is amplified in any or all of the twenty-five classrooms as desired, in sufficient volume to be distinctly audible to all the students.

While similar Magnavox installations have already been developed for hotel, railroad terminal and similar commercial uses, this is its first application to school service. A distinctly novel feature of this installation also is the fact that, by means of a special switch, broadcasted radio lectures and concerts may be connected so as to be reproduced in any or all the classrooms by the same instrument.

THORKITE

An extremely rare bismuth-copper-silver-sulphide mineral, thorkensonite, has been placed on the market under the trade name "Thorkite." This mineral is claimed to be one of the most efficient detectors for crystal radiophones so far discovered.

This mineral is known to occur in but one mine in America. Its value as a rectifier was unknown until recently, as few specimens of the mineral exist, and for this reason very little experimental work could be conducted on this ore. The mineral as first broken from its silicious lime matrix is only an indifferent detector crystal, but after the surface has been exposed to the atmosphere, or artificially aged by means of an electric current, it becomes extremely sensitive as a rectifier for the high frequency radio waves; continued exposure to the atmosphere tends to increased sensitiveness, the result being that this crystal lasts almost indefinitely and actually improves with use. This distinguishes it from most other detector minerals as they are most efficient with a freshly broken surface and deteriorate to a greater or less extent when exposed to the atmosphere.

The extreme ease of adjustment and constantly increasing sensitiveness makes this crystal a very efficient rectifier for radio receivers where vacuum tubes and transformers are used for radio-frequency amplification.

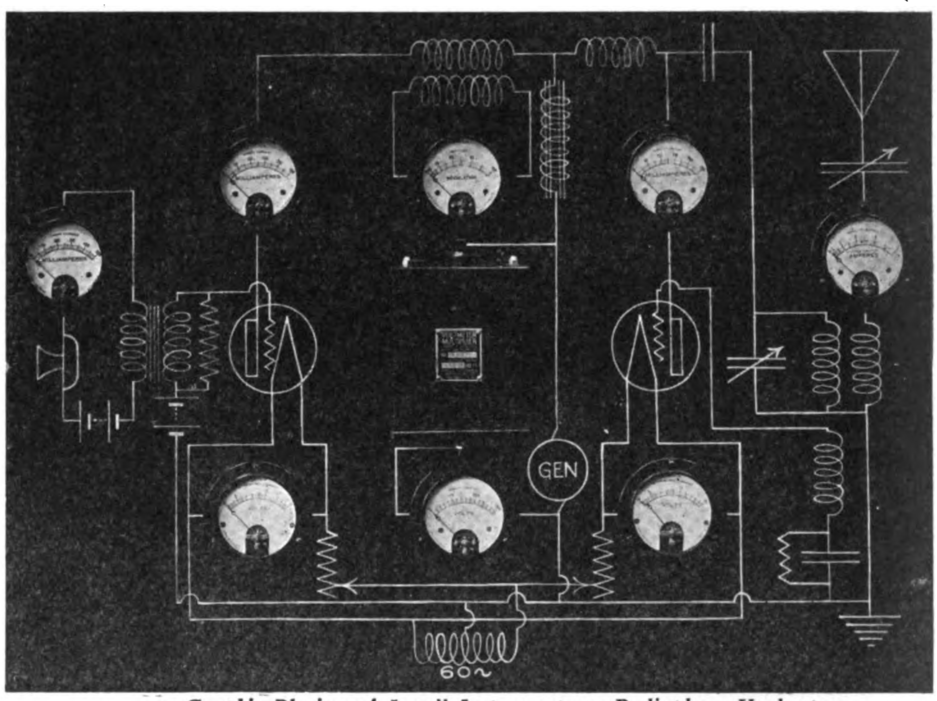
NEW JEWELL CATALOG

The Jewell Electrical Instrument Company of Chicago have recently added so extensively to their line of electrical measuring instruments that it became necessary for them to issue an entirely new catalog. This new catalog is now off the press and in addition to being an attractive piece of advertising and printing matter, it is indeed a most complete and valuable addition to electrical engineering literature. Each instrument is clearly illustrated and its applications, size, scale length, accuracy and general characteristics described in detail. In the back of the catalog detailed dimensional drawings are shown of each instrument together with full size scales and complete listing of readings and prices.

The sales department of the Jewell Electrical Instrument Company is revising their entire mailing list, and it is their wish that every electrical engineer and user of electrical measuring instruments send their names asking for a catalog. They are also preparing to send out their 1922-23 leather vest pocket "Jot-book" covers. The Jewell "Jot-book" or vest pocket memorandum pad with monthly calendars and filler pads has become an established and permanent feature of Jewell publicity.

Probably the most important addition to the Jewell line has been their new miniature movements for A. C. and D. C. instruments, both switchboard and portable. They are very urgent in their solicitation that instruments in which these two movements are used be tested and compared with those of other manufacturers of high-grade instruments, both foreign and domestic. Their new poly-phase watt-meter development also deserves much creditable comment. In the radio field, in addition to their widely known and recognized line of uniform size instruments, they have developed several special instruments, such as their Triplex filament meters, wavemeters, and A-B battery testers.

The Jewell Electrical Instrument Company have been adding new representatives and making changes in several of their territories. Their line has developed and grown to such an extent that a more intensive selling program has been possible and many of the changes made were to enable their representatives to devote more time to the sale of Jewell instruments. Briefly enumerated the territories and representatives affected by recent changes are as follows: New York by John Forshay, 45 Vesey Street; Philadelphia by L. B. Underwood, 139 N. Fourth Street; Buffalo by J. H. Burroughs, 70 Bloomfield Avenue; Cleveland by P. J. Burrill, 517 Bangor Bldg.; Dallas by F. T. Morrissey, 305-306 Slaughter Bldg.; Seattle by Messrs. Eicher & Bratt, 2107 L. C. Smith Bldg. All other territories and representatives remain as before.



Graphic Placing of Jewell Instruments on Radiophone Hook-up

THE VARIO-ANTENNA

One of the most novel of the many plugs now available for converting the electric wiring system in a home into an antenna for receiving radio signals is the Vario-Antenna invented by George C. Clark, president of the Clark Radio Manufacturing Corporation of Oakland, Calif. As indicated by its name, the essential part of this device is the variable capacity, whereby the wiring system can be tuned to any given wavelength by simply rotating an adjusting knob provided for the purpose. It is claimed that this device eliminates any a. c. hum and reduces static. By its use, of course, an outside aerial and lightning protective device is unnecessary. It is also claimed that by reason of its variable adjustment several sets may be connected to the same lighting system throughout a hotel or an apartment house. The variation also properly balances the ground wire.

Mr. Clark, the inventor, has had wide experience in electrical work, having been associated with the Thompson Houston Electric Co., the Western Electric Co., Peter Cooper Hewitt, and A. Frederick Collins in various capacities since 1890. In the course of his experience he patented many well-known electrical devices, particularly as applied to X-ray and electro-medical equipment.

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY 6AWT, 653 UNION ST., SAN FRANCISCO, CALIF.

C. W.—4cb can, (5br can), 5za, (6bf), (6cu), (6ea), (6eb), (6en), (6ft), (6gd), (6gh), (6jd), (6ka), (6pi), 6za, 6zg, 6zn, (6zs), (6zz), (6aeh), (6agh), (6alu), (6avd), (6awp), (6bcd). (6beg), (6bes), (6bfp), (6bko), (6bqc), (6bqq), 6xad, 6xaq, 6zac, (7dp), 7go, 7iw, 7lu, (7mf), 7mw, (7na), 7nf, (7nn), 7nx, (7oz), (7pb), (7qe), 7qw, 7rn, (7sc), 7xg, 7aaw, (7aea), (9bd Can.), 9no, 9wd, 9wu, 9amb, 9ayu, 9zaf, cl8, kfc concert, kfi concert.

Spark—(6ea), (6eb), (6gi), (6gt), (6iv), (6ke), (6mh), (6od), (6ol), (6up), (6aak), (6acy), (6ahp), (6aiu), (6ald), (6amn), (6asc), (6avr), (6awi), (6awx), (6baj), (6bjx), (6box), (7bb), (7bc), 7bh, (7bk), 7cu, 7ed, 7fj, (7fr), 7fq, 7ga, (7ge), 7gi, 7jd, 7jw, (7kj), 7kp, 7nf, 7mp, 7mu, 7mw, 7nn, 7nw, 7oh, 7ot, (7oz), 7qq, 7sg, 7sr, 7tc, (7to), (7tj), 7xz, 7ve, (7vf), (7ya), 7yg, 7zj, 7zm, 7zu, 7aab, 7aea, (9bd Can.), (cl8).

BY 2LJ, WEEHAWKEN, N. J.

6xad on July 15 with two stages audio while at Sugar Loaf, N. Y.

BY 6BNT, 225 N. WILLARD ST., SAN FRANCISCO

Spark—6ec, 6gf, 6gt, 6gr, 6gp, 6ic, 6on, 6oc, 6ke, 6no. 6wa, 6aak, 6aei, 6agf, 6ahf, 6ajh, 6ajr, 6amn, 6atj, 6ali, 6ars, 7mf, 7ot.

C. W.—6ea, 6eb, 6en, 6ff, 6ka, 6gr, 6ku, 6cu, 6aat, 6aak, 6apn, 6awp, 6aqu, 6aqa, 62b, 6bes, 6beg, 6bqc, 6bqp, 7mf.

BY 7AFH, MONROE, WASH.

Spark—6abx, 6ajr, 6ala, 6alu, 6aqa, 6ark, 6ars, 6atu, 6cc, 6gf, 6gr, 6rr, 6tu, 7aea, 7bh, 7cu, 7ey, 7fi, 7fq, 7gf, 7hd, 7ic, 7ih, 7iw, 7jd, 7jf, 7jw, 7mf, 7mu, 7of, 7oh, 7ow, 7rc, 7sa, 7tj, 7to, 7tw, 7ve, 7vf, 7vz, 7wg, 7wr, 7zk.

C. W.—5la, 6aat, 6aiy, 6ak, 6alu, 6ams, 6arb, 6arc, 6asj, 6aw, 6awt, 6bcd, 6bcj, 6beg, 6boe, 6bqc, 6bzg, 6cj, 6en, 6fh, 6ft, 6gr, 6ka, 6ku, 6lf, 6nx, 6pi, 6rd, 6rm, 6rr, 6tv, 6vm, 6xad, 6xb, 6ze, 6zf, 6zi, 6zo, 6zx, 7ack. 7aea, 7afw, 7agx, 7dp, 7fl, 7hs, 7lr, 7lu, 7mf, 7na, 7ot, 7oz, 7qe, 7qw, 7sy, 7tn, 7zb, 7zu, 9aja, 9ayu, 9dtm, kvq. Canadians—4bv, 5ct.

Fone—7na, 7sy, kyg, kfv, klp, kwg, kdys, chcq.

BY 6BJE—300 ELEVADO DRIVE, PASADENA, CAL., AT EVERETT, WASH.

5br, 5ct, 6bk, 6cc, 6ft, 6fh, 6gr, 6ka, 6nn, 6nx, 6rr, 6tu, 6xh, 6zx, 6abw, 6apw, 6aqu, 6arc, 6ark, 6awe, 6beg, 6bqc, 7iw, 7lu, 7mf, 7tw, 7vf, and others.

BY 6CU, 2010 SIXTH AVE., LOS ANGELES, CALIF.

Spark—5xd, 5xu, 6aak, (6aau), 6abm, 6abu, (6abw), 6abx, 6acr, (6ada), (6aeh), 6aei, (6afp), 6agf, 6ah, (6ahf), 6ahu, 6aih, 6ain, (6ajh), (6ajr), 6ajw, (6akl), 6ala, (6alv), 6amk, 6aol, (6aor), (6aqu), 6ar, 6ark, (6as), 6asv, 6atu, (6auc), 6aud, 6avm, (6avx), 6awh, 6awx, (6bak), 6bgl, 6bip, (6biu), 6bjh, (6bjv), 6blv, (6cc), (6ex), 6fk, 6gf, 6gr, 6gt, 6hc, 6hp, 6ib, (6ic), 6im, 6kc, 6km, (6lo), 6ms, 6ng, 6oh, 6pj, 6po, 6qk, (6qr), 6tf, 6tu, 6uo, 6vk, 6vx, 6wg, 6xh, 6zam, 6zd, 6zi, 6zq, (6zu), 6zx, 6zz, 7fj, 7gq, 7jd, (7mf), 7oh, (7ot), (7oz), 7ya, (7yj), 7zm, 7zs, cl8.

C. W.—5za, 6agp, 6aif, 6ak, 6alv, (6ams), 6arb, (6asj), (6asv), (6awt), 6bcd, (6bcr), 6bla, (6gy), 6kc, 6ku, (6pt), (6ti), 6vm fone, 6xad, 6xaf, 6xc, 6za, 6zac, 6zad, (6zb dalite), 6ze, (6zf), 6zi, 6zq, 6zx, (6zz), 7dp, 7hs, 7nf, (7oz), 7qt, 8agz, 8xv, 9amb, (9ayu), 9dva, 9wd, 9xaq, 9xm, 9zaf, Can. 9bd, kdpw, ksl, ksx.

6BQH, 2507 E 1ST ST., LOS ANGELES, CAL.

C. W.—5za, 6cu, 6ea, 6eb, 6en, 6rr, 6ka, 6aag-v, 6aat, 6apo-v, 6aeh, 6baj, 6bbc, 6bes, 6beg, 6bfp-v, 6bjc, 6bjo-v, 6bjq, (6bjr-v), 6bjt, 6bjy, 6bmd, 6bpc, 6bpz, 6bqc, (6bqd), 6bqg, 6bqq-v, 6bqt, 6bqz, 6brf-v, (6xas-v), 6xad, 6zb, 6zac, 7nf, 7sc, 9ayu.

Spk.—6cc, (6od), 6ex, (6du), 6gr, 6mh, 6tu, 6aak, 6abw, 6abu, 6acy, 6aic, 6ajh, (6apy), 6ark, 6atf, 6avd, (6avr), (6bae), (6bbv), (6bea), (6bee), (6bem), 6bfh, (6bjx), (6bms), (6bqa), (6bqe), (6bra), (6brb), 6brz, 6zu, 6zal, 7ya, cl8.

BY 6AWT, 653 UNION ST., SAN FRANCISCO, CALIF.

C. W.—4bv, Can. (6bf), (6ea), (6eb), (6ft), (6jd), (6ka), (6alu), (6apw), (6awp), (6bes), (6bfp), (6bko), (6bpz), (6bqc), (7lu), (7mf), (7na), (7nn), (7ot), (7oz), (7qe), 7zb, (7aea), 9aja, kfc concert.

Spark—6gt, (6ke), (6od), (6ol), 6up, (6aak), 6ahp, 6apy, (7bk), (7ge), 7jw, 7kj, (7nn), 7oh, 7aea, (9bd-Can).

CALLS HEARD

BY 6BPZ, 2114 CRENSHAW BLVD, L. A.

C. W.—(6bf), (6fh), 6gf, 6gr, (6gx), 6ik, 6nx, 6oh, (6rd), (6zb), (6zf), (6zx), (6aat), 6aoz, (6aqw), (6arb), 6asi, 6atp, (6awt), (6bcr), 6bhk, (6bjy), 7na, 7lu, (7mf), (7ot), 7oz, 7sc, 7zu, (7aea), 9aja, 9amb, 9zac.

Spark—6ar, (6cc), 6fh, 6gf, (6gr), (6gt), 6hc, 6ji, 6tc, 6tu, 6aak, 6abw, (6ahf), (6ajh), (6akl), (6amz), (6avd), (6bjv).

BY 7VF, 793 MICHIGAN, AVE., PORTLAND, ORE.

Spark—6ex, (6fh), (6gf), (6gr), 6hc, (6ic), 6lu, 6oh, (6tu), 6up, 6vx, (6zq), (6abu), 6abw, (6abx), 6akt, 6alv, 6amz, (6aqu), (6ark), 6avb, 7fi, 7fq, (7ke), (7ot).

C. W.—6ea, 6en, 6fh, 6ft, 6gr, 6gx, 6ka, 6jd, 6km, 6nn, 6oo, 6pi, 6rd, 6rr, (6zf), 6aeh, 6alu, 6aot, 6aqw, 6arb, 6ark, (6asj), 6atz, 6avo, 6awp, (6awt), 6bcd, 6bes, 6bfp, 6bhk, 6bpz, 6bqc, 6brk, 6bsa, 7lu, 7ot, (7qw), (7th).

BY 6BQC, 1629 VINEYARD AVE., LOS ANGELES, CAL.

C. W.—(6ak), (6bf), (6fh), (6gr), (6gx), (6gy), (6ik), (6ku), (6lo), 6nx, 6oh, (6rd), (6za), (6zb), (6zf), (6zo), (6zs), (6zx), (6zz), (6aat, (6abq), (6agj), (6aok), (6aoz), (6aqw), (6arb), (6asj), (6awt), 6bcj, (6bhk), (6bjy), 6bqf, (6bql), 6bum, (7lu), (7mf), (7na), (7ot), (7oz), 7sc, (7aea) qra, (9aja) qra, 9amb,

Spark—(6hc), 6gr, 6ic, 6tu, 6zu, (6aak), 6akl, 6amk, (6aud), (6bju).

BY 6BQR, J. F. MOSS, 953 WEST 7TH ST., LOS ANGELES, CALIF.

Spark—5xd, 6cc, 6dk, 6eu, 6ge, 6gf, 6gr, 6gy, 6hc, 6ic, 6km, 6no, 6po, 6qr, 6tu, 6aei, 6afy, 6agh, 6ahd, 6ahy, 6ajr, 6amk, 6ans, 6aog, 6ark, 6ars, 6arx, 6atu, 6auu, 6avb, 6xh, 6zx, 7jd, 7mf, 7ya, 7zm.

C. W.—6fh, 6gx, 6ku, 6nx, 6rd, 6vg, 6zf, 6zx, 6aat, 6aoz, 6arb, 6awt, 6bcj, 6bsa, 7lu, 7me, 7mf, 7ot, 7aea, 9amb, 9ayu, 9dtm, 9zaf.

BY 6TI, 414 FAIRMOUNT AVE., OAKLAND, CALIF.

(6gr), (6fh), (6ea), (6ke), (6aak), (7bb), (7aea). 6ti's 5-watter was heard by 6ax on kkei 2,000 miles on one tube and honey-combs.

BY 9BD, BARRON HOTEL, VANCOUVER, B. C.

C. W. Canadian—(4bv), (5ct), (cfcn—Calgary, Alta.). U. S.—5qi, 5jl, 6aat, (6asj), (6awt), 6apw, 6abx, 6ak, (6bsa), 6bum, (6fh), (6gr), 6ft, 6ka, 6ku, 6gx, 6oh, 6nx, 6bes, 6boe, 6rd, 6bcj, 6zx, 6zf, (7agf), (7aea), (7iy), 7qe, (7lu), (7na), (7sc), 7tw, (7qw), (7oz),7wm, 7zb, (bt3), 8yr, 9axr, 9aou, 9pi, 9nc, 9da, 9zaf.

Spark—(6ang), (6gr), 6amz, 6ic, 6vx, (6tu), (7bb), (7bk), (7aea), (7ve), 7kj, 7km, (7vx), 7to, (7zk). All above heard on detector tube alone—during August.

BY 6BQY, 3101 S. GRAND, LOS ANGELES

C. W.—5za, 6bf, 6gr, 6gy, 6nx, 6rd, 6tw, 6vz, 6xh, 6zb, 6zf, 6zs, 6zx, 6aos, 6aqw, 6arb, 6avb, 6awt, 6bic, 6bjy, 6bjz, 6bum, 6buq, 7lu, 7mf, 7na, 7ot, 7oz, 9aja, 9amb, 9zaf.

Spark—6ar, 6gr, 6tu, 6ahf, 6ahp, 6akl, 6bju.

BY 7SG, ABERDEEN, WASH.

C. W.—5di, 5qi, 5za, 6aat, 6abx, 6aga, 6agr, 6ak, 6amu, 6aot, 6apw, 6aqw, 6arb, 6asj, 6awp, 6awt, 6bcd, 6bcj, 6bcr, 6beg, 6bes, 6bf, 6bfp, 6bhk, 6bic, 6bir, 6bjj, 6bjy, 6bmd, 6bmn, 6boe, 6boo, 6bpf, 6bpz, 6bqc, 6bqg, 6bql, 6bqz, 6brg, 6bsa, 6btb, 6bve, 6cu, 6ea, 6eb, 6en, 6fh, 6ft, 6gr, 6gx, 6ik, 6jd, 6ka, 6km, 6ku, 6lv, 6ni, 6nn, 6nx, 6rd, 6rr, 6ti, 6vf, 6wk, 6xh, 6zac, 6zf, 6zg, 6zx, 7aea, 7agf, 7agx, 7fr, 7iy, 7lr, 7lu, 7mf, 7na, 7nj, 7ny, 7oe, 7ot, 7oz, 7qb, 7qe, 7qw, 7rn, 7sy, 7th, 7to, 7wm, 7xi, 7zb, 8wr, 9aja, 9amb, 9aps, 9bsg, 9cb, 9dr, 9dtm, 9dug, 9in, 9zaf. Canadian—4bv, 5ct, cfcn. All heard on home-made short wave and one step.

BY 6BQL, 575 21ST AVE., SAN FRANCISCO

C. W.—6bf, 6cu, 6df, 6ea, 6eb, 6ec, 6en, 6fh, 6ft, 6gi, 6gr, (6gx), (6ka), 6ku, 6oh, 6rr, (6zf), 6zo, (6zx), 6aat, 6abx, 6ake, 6akw, 6ale, 6alu, 6aok, 6aoz, (6apw), 6aqa, (6aqw), 6arc, 6atg, 6awp, 6baj, 6baw, 6bbc, 6bcj, 6bes, 6bjc, 6bjq, 6bjy, 6bkb, 6bla, 6bmn, 6boe,6boo, 6bpy, 6bpz, (6bqc), 6bqd, 6bqg, 6bqp, 6bqz, 6bra, 6brg, 6brk, 6bum, 6bzg, 7lu, (7mf), 7na, 7ot, (7oz), 7sc, 7aea, 9aja, 9zaf.

Spark—6cc, 6dd, 6ec, 6gt, 6ic, 6ke, 6ol, 6qr, 6zu, 6aak, 6aau, 6abw, 6abx, 6ajh, 6akl, 6ald, 6ali, 6ark, 6ars, 6asc, 6asq, 6avm, 6avr, 7kj, 7nw, 9bd.

BY 8AUU—1611 SHORB AVE. N. W., CANTON, OHIO

Spark—1aly, 1akg, 1azk, 1nf, 2aje, 2fp, 2gp, 2om, 2rm, 3acy, 8bnu, 3gu, 8hj, 4fd, 5bi, 5io, 5py, 8afg, 8aiy, 8apm, 8anw, 8asl, 8aib, 8aqo, 8azf, 8axt, 8aux, 8axn, 8ax, 8bdz, 8bay, 8baz, 8bnh, 8bno, 8bnv, 8bda, 8brl, 8bqf, 8clo, 8cdv, 8cpz, 8cct, 8csd, 8ea, 8eb, 8ek, 8eo, 8ew, 8jpk, 8jx, 8oi, 8rk, 8se, 8tc, 8tt, 8uc, 8ud, 8oe, 8xe, 8zo, 8zy, 9aiw, 9air, 9amk, 9aix, 9aar, 9aph, 9aja, 9aaw, 9acb, 9aza, 9bxc, 9bzx, 9bct, 9cfp, 9ccj, 9wa, 9wd, 9zn.

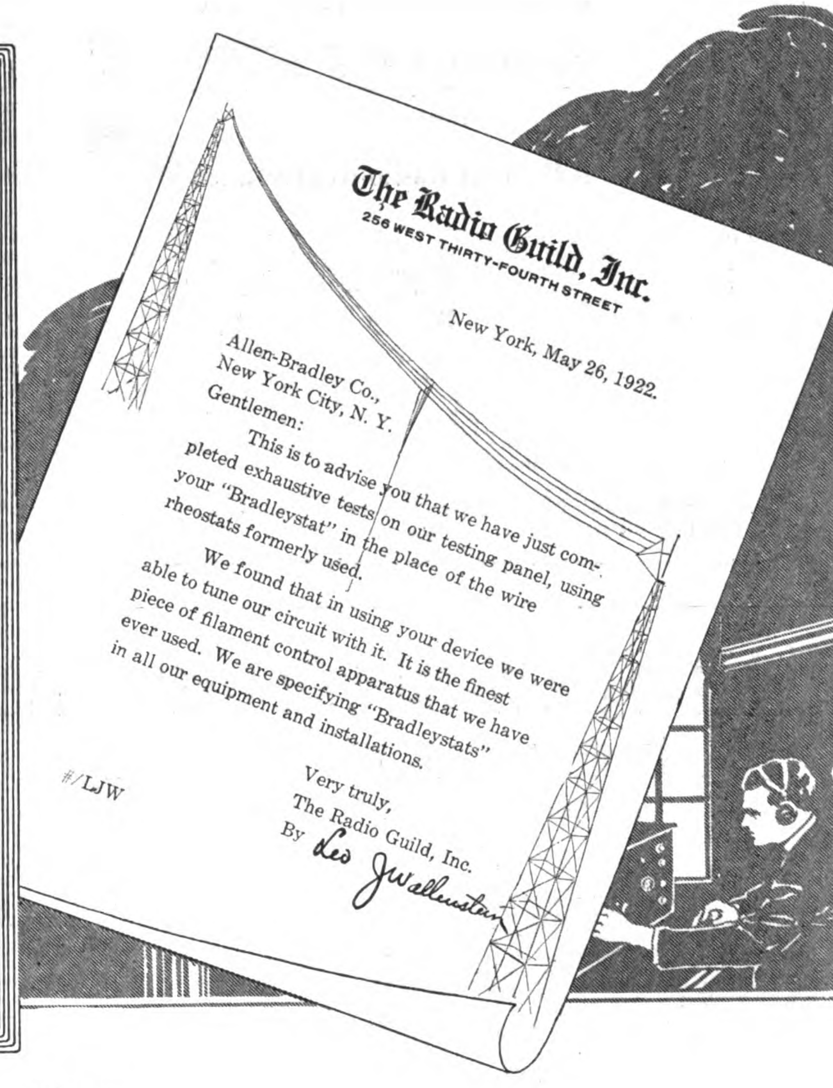
Finest Filament Control We Have Ever Used, *Says Radio Guild, Inc.*

How It Works!

Graphite discs (not loose carbon grains) provide the delicate control for vacuum tubes. A single knob, without vernier, gradually applies or removes pressure from the discs, thereby changing the filament current more smoothly and noiselessly than any vernier rheostat.

Louder reproduction, quicker tuning, and a greater receiving range follow the installation of Bradleystats in your radio set. Twenty years of experience in precision control, and a one-year guarantee protect you.

Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Ave. Milwaukee. Wis.



The Radio Guild, Inc.
256 WEST THIRTY-FOURTH STREET

New York, May 26, 1922.

Allen-Bradley Co.,
New York City, N. Y.
Gentlemen:

This is to advise you that we have just completed exhaustive tests on our testing panel, using your "Bradleystat" in the place of the wire rheostats formerly used.

We found that in using your device we were able to tune our circuit with it. It is the finest piece of filament control apparatus that we have ever used. We are specifying "Bradleystats" in all our equipment and installations.

#/LJW

Very truly,
The Radio Guild, Inc.
By Leo J Wallenstein

RETAIL PRICE
$1.85 P.P. 10¢ Extra

Bradleystat

REGISTERED U.S. PAT. OFF.

PERFECT FILAMENT CONTROL

Tell them that you saw it in RADIO

RADIO DEVELOPMENT

Continued from page 31

cillator in the path of fresh, oncoming, unreflected waves, reinforcing occurred at some points and interference at others. The effort was not dissimilar to the fact that sound waves reinforce or interfere. A shifting of this "resonator" to and fro between the oscillating device and the reflector made it possible to detect these points. The sparking across the tiny gaps in the hoop-like device increased until it reached a maximum at the point of greatest reinforcement. Subsequently, the spark expired as the "resonator" attained the point of complete interference. Harmonizing with the modern conception, this German inventor indicated that electromagnetic waves advanced in ever-widening circles. The example of the effect of a rock thrown on the surface of a pond of water is a favorite characterization. Similarly, he reasoned that they were capable of casting an electric shadow by a metal plate or screen, comparable to the ability of rays of light throwing a shadow by interposing an opaque object.

That loose iron filings, when subjected to an electric current, would cohere and their resistance forthwith fall to an extremely low value—only to have their original resistance restored instantly by tapping them—was a discovery of S. A. Varley, in 1866. He made a lightning arrester from iron filings. A scientist of the Catholic University of Paris inserted iron filings in a glass tube and placed a metal plug in each end, by which the device could be connected in a circuit. The filings, according to observation, would cohere when electric discharges were admitted passage in their neighborhood and that the tapping of the tube restored the filings to their original condition. He called his device a "radio-conductor." Sir Oliver Lodge, at a later date, dubbed the invention a "coherer," and in 1893 linked it up with a battery and galvanometer. He was thus enabled to employ it as a detector of electric waves. Professor Papoff of Kronstadt, in 1895, installed a real radio receiving system for the purpose of detecting atmospheric electric disturbances. A rod was extended above the roof of a building and its other end connected through a coherer to the earth. The coherer had a relay and battery connected in its circuit, the former being energized whenever atmospheric discharges passed through the coherer. The relay closed the circuit of a tiny electric trembler bell, the clapper of which, on being drawn up, struck the bell, to give a signal of disturbance, and when retracted tapped the coherer to restore it.

"The foregoing shows the preliminary work, the stage setting, for Marconi's masterly act," says Dr. W. A. Kinnan. "The materials with which he was to build had been created. The oscillator, including the key, the interrupter, the transformer, the spark gap apparatus, and the radiating plate; the receiver including the receiving plate, the coherer, the tapper, and galvanometer, had all been created and their use had been indicated. Other actors were hard upon him, stood ready to step upon the stage. Clerk-Maxwell and Hertz had pointed the way, Branly, Lodge and Papoff had traveled in the direction thus indicated to them and were in 1896-7 standing in the wings of the stage. But even so, they never entered and light never fell upon them until Marconi had given commercial telegraphy by Hertzian waves to the world. It was a noble gift and the reward and the glory are justly due this remarkable young Italian." The patents granted Marconi,

Continued on page 86

The Willard Radio "B" Battery with glass jars and Threaded Rubber Insulation is the most practical insurance against leakage *noises* and leakage *losses*.

Why Gamble on "B" Batteries?

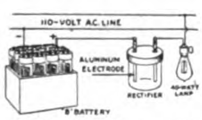
You're careful in soldering connections. You spend good money for additional stages of amplification. You give special attention to insulation of aerial and lead-in.

If you've gone that far, you simply can't afford to take a chance on having a leaky "B" Battery spoil it all with a bombardment of leakage noises. *You can't afford anything less than a leak-proof Willard "B" Battery.*

Every cell of a Willard "B" Battery is an individual glass jar. Jars are well-spaced to prevent leakage from cell to cell. Threaded Rubber Insulation protects the plates and thus guards against inside leaks.

Because of the leakproof feature Willard "B" Batteries are unusually quiet and hold their charge for long periods.

Ask your radio dealer or the nearest Willard Service Station to show you the Willard 6-volt Radio "A" Battery and the Willard 24-volt Radio "B" Battery.



This rectifier will keep your "B" Battery charged at a cost of a few cents a month.

WILLARD STORAGE BATTERY COMPANY
Cleveland, O.

Made in Canada by the
Willard Storage Battery Company of Canada, Limited, Toronto, Ontario

Willard
THREADED RUBBER BATTERY

PROFESSIONAL RADIO OPERATOR

Continued from page 12

the future method of taking radio-compass bearings, regardless of whether the radio telephone is ever utilized aboard ship or not. The advantage in having the compass aboard the ship instead of in the shore station is obvious; bearings may then be taken upon any radio station, anywhere, instead of at only a few specially arranged points, as at present.

But now, lest the shellback brass-pounder who may chance to read this goes into a blue funk and decides to will his uniform insignia to his home town museum and jump overboard with the ship's spare anchor draped around his neck, it is time to take up the more encouraging side of the question.

Whatever the ultimate development of the wireless telephone, it does not seem probable that it can ever supplant the wireless telegraph—at least not to any great extent. The perfection of the wire telephone has not put the wire telegraph out of business; in fact, the volume of telegraph business is perhaps ten times what it was when the telephone was first introduced—though it would undeniably be still greater were there no telephones. The removal of the radio operator from any class of ship is doubtful; it cannot come to pass for many years yet, and in the case of the passenger liner, never.

Even when the vacuum tube telegraph transmitter has become standard all over the world, the radiophone will still have its drawbacks. On the ship plying in foreign trade, its use will require the ability of some one aboard to speak the many different languages of the countries to which the various coastal stations belong, or *vice-versa;* whereas the telegraph handles with equal ease traffic in any language, and in cipher.

The ship-owner possibly may not strenuously resist the passage of legislation which will force him to discard his present radio equipment, since this equipment is, comparatively speaking, not expensive; but unless the radio apparatus of the future is to be unbelievably simplified, it will always be liable to derangement, and the steamship companies that demand service will hesitate to send their ships to sea with the radio equipment in charge of some one who has no knowledge of the apparatus further than the mere ability to use it. Besides, it is quite probable that the maintenance of a continuous radio watch aboard all vessels carrying more than twenty-five persons will eventually be required by law, and when such legislation is passed the operator's position will be permanently secure, no matter what perfection time may bring in wireless telephone apparatus.

In the case of the passenger ship,

Continued on page 44

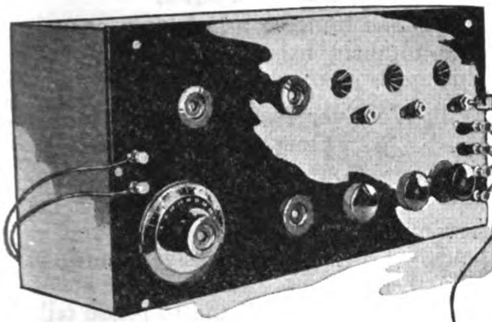
Continued from page 42

which since 1912 has been required by law to carry two radio operators and maintain a continuous watch at sea, the wireless telegraph will never be supplanted. The volume of traffic is too great; formal telegrams can be transmitted more rapidly and accurately by telegraph than by the use of the human voice, and the effective working range of the telegraph will for the same transmitting power always be much greater than that of the telephone. Even when present difficulties in regard to modulation, articulation, static and interference have all been overcome, a trained expert will almost certainly be required to manipulate and care for the apparatus, because every improvement in a device of this kind generally brings an added complication; and since in any case some one must be employed to stand the listening watches, the elimination of the radio operator is neither desirable nor possible.

As an auxiliary, however, the radiophone is perhaps destined to fill an important and a unique place on the passenger liner. It is not improbable that the wire telephone companies will in due time establish "linking stations" at various points along the coasts, whereby passengers aboard ship will be enabled to converse with subscribers to ordinary wire telephone service anywhere. From his stateroom phone the business man a thousand miles out to sea will be brought within speaking range of his office; and the moony lover and the girl he left behind him will provide huge diversion for countless thousands of eavesdropping young radio bugs—and old ones, too!

In conclusion, it seems probable that the employment, if ever, of the wireless telephone aboard ship without a licensed operator in charge of it, will be confined to yachts, river steamers and possibly small freighters and oil-tankers operating on short coastwise runs. The wireless telephone will not encroach upon the telegraphic field; it will find its own. It will be used for point to point communication in isolated districts, as for instance by large mining and development companies; and with perfected control of high power vacuum tubes will come commercial trans-oceanic telephony. Its greatest service of all, it seems to me, however, is foreshadowed in its wide utilization this early for broadcasting musical programs. The perfectly modulated transmitter and the distortionless receiver of the future will have its finest application in this field. We shall have the gist of the news, the market reports on produce peculiar to the locality, and magnificent concerts broadcasted the country over—broadcasted not so much for the entertainment of the blasé urban class, but especially for the country dweller, linking the man of the soil and the man of the city in closer bonds of community

Continued on page 46

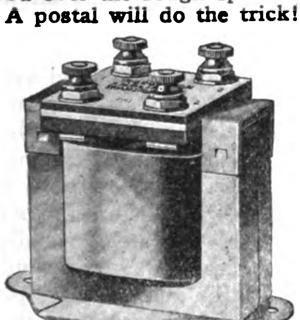


The Radio Public Is Ready to Buy

Are You Ready to Sell Them the Standard, Nationally Advertised Merchandise They Insist Upon?

A new radio buying public, made up of the great majority who "waited to see what would become of radio," are already buying well and will buy more and more as the season progresses. These cautious folks, however, are insisting upon well-known products of established quality.

You can satisfy this new demand for quality merchandise most profitably and conveniently through the services of WHOLESALE RADIO EQUIPMENT. Products of sixteen or more of the most important, nationally popular manufacturers are always obtainable at attractive prices. Prompt, careful shipment. Credit facilities that lift you over the rough spots. Let us tell you more about this service. **A postal will do the trick!**



Fall and Christmas Trade Will Flow to the Best-Stocked Store
Establish Your Source of Supply NOW. Place Your Order TODAY!

Sample Our Service

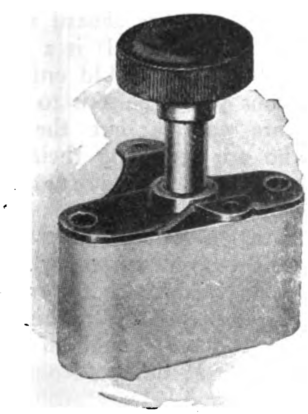
TWO FAST-SELLING ITEMS

Thordarson

Amplifying Transformers—Shell Type

Low distributed capacity. The core of special 7 mil high silicon steel is twice the cross section of the ordinary core. Coils wound with silk covered wire, in separate sections, and placed side by side on the core. Mounted on brass or nickel-plated frame. Bakelite terminal board.

LIST $4.50



Bradleystat

REGISTERED U. S. PAT. OFF.

PERFECT FILAMENT CONTROL

A graphite compression rheostat that gives absolutely even control of filament current. For ½ or 1 ampere detector and amplifier tubes and 5-watt power tubes.

LIST $1.85

DISTRIBUTORS FOR

- Acme
- Baldwin
- Bradleystat
- Chelsea
- De Forest
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- Klosner
- Magnavox
- Murdock
- Paragon
- Thordarson
- Tuska
- Western Electric

Wholesale Only

Write For Attractive Discounts and Helpful Credit Arrangements

Wholesale Radio Equipment Co.

24 WILLIAM STREET, NEWARK, N. J.

Continued from page 44

feeling and bringing a little step nearer that ultimate harmony to which the universe is destined.

Will We Ever Have Women Radio Operators?

Every so often I hear some young miss turned radio fan, or—I have a sort of suspicion—ambitious to vamp a bold sea-rover, ingenuously inquiring why there are no "lady wireless operators" on the "boats," and to please tell her, will there ever be any?

Without in the least wishing to dash the secret aspirations of any adventuresome member of the unfairer sex, I venture to reply, regretfully, but firmly—no. The suggestion that there ever will be any such is highly irritating to the average shellback operator; in fact, the merest insinuation that anything of the kind is even remotely possible is to rub all his fur the wrong way. I was once informed by one brass-pounder, though, that any such talk didn't bother him; he most emphatically knew that no "dames" could ever be wireless operators because they couldn't climb up the masts and grease the antenna insulators. In view of the way I have been climbed by some of them, I am rather doubtful about the correctness of this statement; but, all pleasantry aside, women operators in the marine service are out of the question, and any one who knows anything about life aboard ship will not need to be told why.

The reasons cannot be discussed very far in these pages; but it may be pointed out that the conditions aboard a ship are not similar to those in, for instance, an office or a store. The relations of the officers are very intimate and personal, quite like those of a close family, or a small bachelors' club. No apple of discord among the gods of Olympus ever created strife comparable to that which would ensue from the placing of a girl radio operator aboard a ship, especially a freight ship. It is a fact—we know it—that this would only lead some flirtatious young persons to aspire all the more eagerly; but the shipowners, who are operating their ships for business purposes, understand the situation well enough.

The fact that a few stewardesses are employed on the larger passenger steamers has nothing to do with the matter; these are almost invariably anything but good-looking, and old enough to be the grandmothers of the oldest men on the ship; and even so, I know from personal observation that it is not always well that they are aboard.

In the case of the land radio stations, the foregoing, of course, would not apply; but, as has already been explained, since there is sharp competition among the best shipboard operators for these berths, there is little chance for a beginner of either sex to get them.

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To return to the ships again. If it be argued that there actually have been three or four girl wireless operators, it may be replied that these were, in two cases, daughters of the captains of the ships upon which they sailed—they made only a few short voyages merely for the novelty of the thing—while the other one or two enjoyed advantages similarly unusual, and were duly chaperoned.

The radio operator is carried primarily to serve in the emergency when death comes near; and there is something incongruous in the idea of a girl sticking at the key on a sinking ship—chivalry would not permit it; and I think, too, there would be something no less incongruous in the sight of "Sparksie's" weekly wash hung out to dry with the rest of the family's on the ship's rail.

Some Final Points

That a great many radio amateurs take up commercial wireless operating with a mistaken idea as to its possibilities seems to be indicated by the fact that so few stay with the game or advance to anything higher in the radio field. If recruited from the amateurs' ranks, the operator, after perhaps two or three years of commercial experience, returns whence he came—that is, back ashore and to the status of an amateur radio enthusiast again; but he earns his living at something else. Not one in ten of those who wore the phones ten years ago are engaged in any sort of radio work today.

Whether commercial radio offers anything worth while to the prospective operator depends entirely upon his own particular circumstances and inclinations. While every professional operator likes his work, more or less, the amateur will never experience the joy in attending strictly to business with a commercial set that he finds in experimenting with that conglomeration of beloved junk in the woodshed. To hover all night in an attic over a fizzly vacuum tube and a wobbly-spined condenser in order to relay a piffling love note across seventeen states is immensely enjoyable; but when we commercialize our pleasures we find them not half so zestful.

It is sometimes asked whether it were not well for the radio amateur, before entering upon some other ultimate line of work, to become a commercial operator for a year or two, for the sake of the educational value, and to broaden his knowledge of the world. It is, possibly, but to become a wireless operator is getting to be a good deal of an undertaking in itself, and in this rapidly moving age, every day counts.

There is one class of persons for whom, it seems to me, radio operating would be a very desirable employment—cripples. For these unfortunates, if

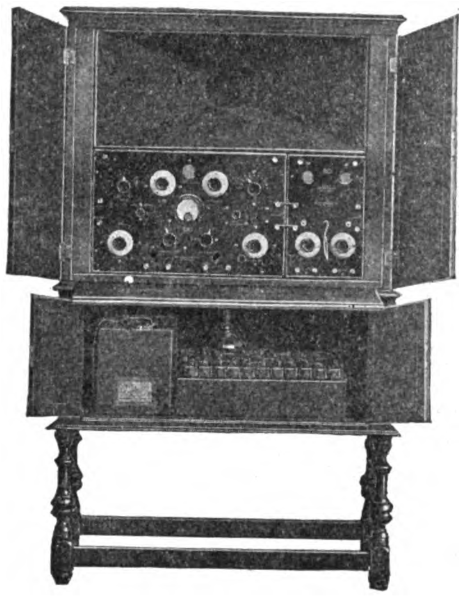
Continued on page 50

Red Seal Battery Contest

Starts Nov. 1st. Closes Nov. 15th

All Radio Sets installed FREE in the homes of the winners anywhere in the U. S. A.

Cabinet Closed



1st Prize

This cabinet type complete Radio Receiving Set is one of the finest and most complete sets on the market. It is designed and manufactured by the Colin B. Kennedy Company of San Francisco, makers of the finest type of radio receiving sets. The cabinet is walnut and stands 58 inches high—a masterpiece of cabinet making. The receiving set is regenerative, having an effective range from 175 to 25,000 meters—400 to 600 miles on "broadcasting." Contained within the cabinet are all batteries, and a most efficient loud speaker. Value complete, $725.00.

2nd Prize

It consists of the Westinghouse R. C. Receiving Set and the famous distortionless Western Electric Loud Speaker, "Tunger" Battery Charger, Storage Battery, 9 "B" Batteries, one Manhattan 3,000 ohm Headset, 3 vacuum tubes, 2 telephone plugs, and complete antenna equipment—a total value of $408.50.

3rd Prize

A complete receiving outfit made up of the well known Grebe CR No. 9 Regenerative Receiver and 2 stage amplifier, Magnavox Loud Speaker, Storage Battery, "Homcharger" Battery Charger, "B" Batteries, one Manhattan 2,000 ohm Headset, 3 vacuum tubes, 2 telephone plugs, and complete antenna equipment—a total value of $256.50.

50 Other Prizes

To 50 other contestants, whose answers the judges decide are most meritorious, will be given one of the famous Manhattan 2,000 ohm Radio Headsets. These headsets are built with the precision of a watch and have great sensitiveness and high amplifying qualities

Win this $725.00 Radio Set FREE

Only a rich man could buy it but a poor man may win it FREE

SIMPLY obtain a free "Red Seal Battery" contest blank between November 1st and November 15th from stores that show the Window Display pictured below. Each contest blank gives full simple instructions to help you write your answer and full rules of the Contest.

"Finish-the-Sentence" Contest

The prizes will be awarded for the most appropriate answers for completing *in your own way* in not more than ten words, the following sentence:

"The Red Seal Dry Battery is best
(1.) because it is the All-Purpose Battery and
(2.) because..............................

Examples

Your answer may be descriptive of the Red Seal Dry Battery or it may describe some use. For example: "It never fails on land, air or sea." Another: "It never starts what it can't finish." Another: "It rings bells and buzzes buzzers."

Judges

The judges of the Contest are: Mr. Llew Soule, Editor of "Hardware Age," New York; Mr. Howard A. Lewis, Manager of "Electrical Merchandising," New York, and Mr. Joseph A. Richards, President, Joseph Richards Co., Inc., Advertising Agents, New York.

Awarding the Prizes

Prizes will be awarded to those who conform to the rules of the Contest and whose answers, in the opinion of the judges, are most appropriate. In case two or more persons submit winning answers, prizes identical in character with those offered will be given to each successful contestant.

Announcing the Winners

As soon as possible after the judges have rendered their decision, the names of the prize winning contestants, will be announced in the Saturday Evening Post.

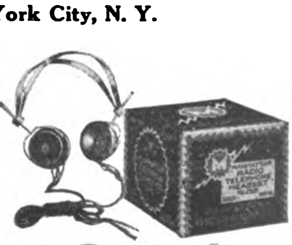
Look for this Window Display in Dealers' Windows Nov. 1 to 15. It identifies all stores that have free contest blanks.

Contest Opens Nov. 1 — Closes Midnight Nov. 15.

All answers must be written *only on contest blanks* supplied by dealers displaying Red Seal Battery Contest window display. Send as many answers as you like to:

Red Seal Battery Contest
Manhattan Electrical Supply Co., Inc.
17 Park Place
New York City, N. Y.

MANHATTAN
ELECTRICAL SUPPLY CO., INC. NEW YORK
Makers of the Famous Red Seal Dry Batteries and Manhattan Head Sets



Continued from page 48

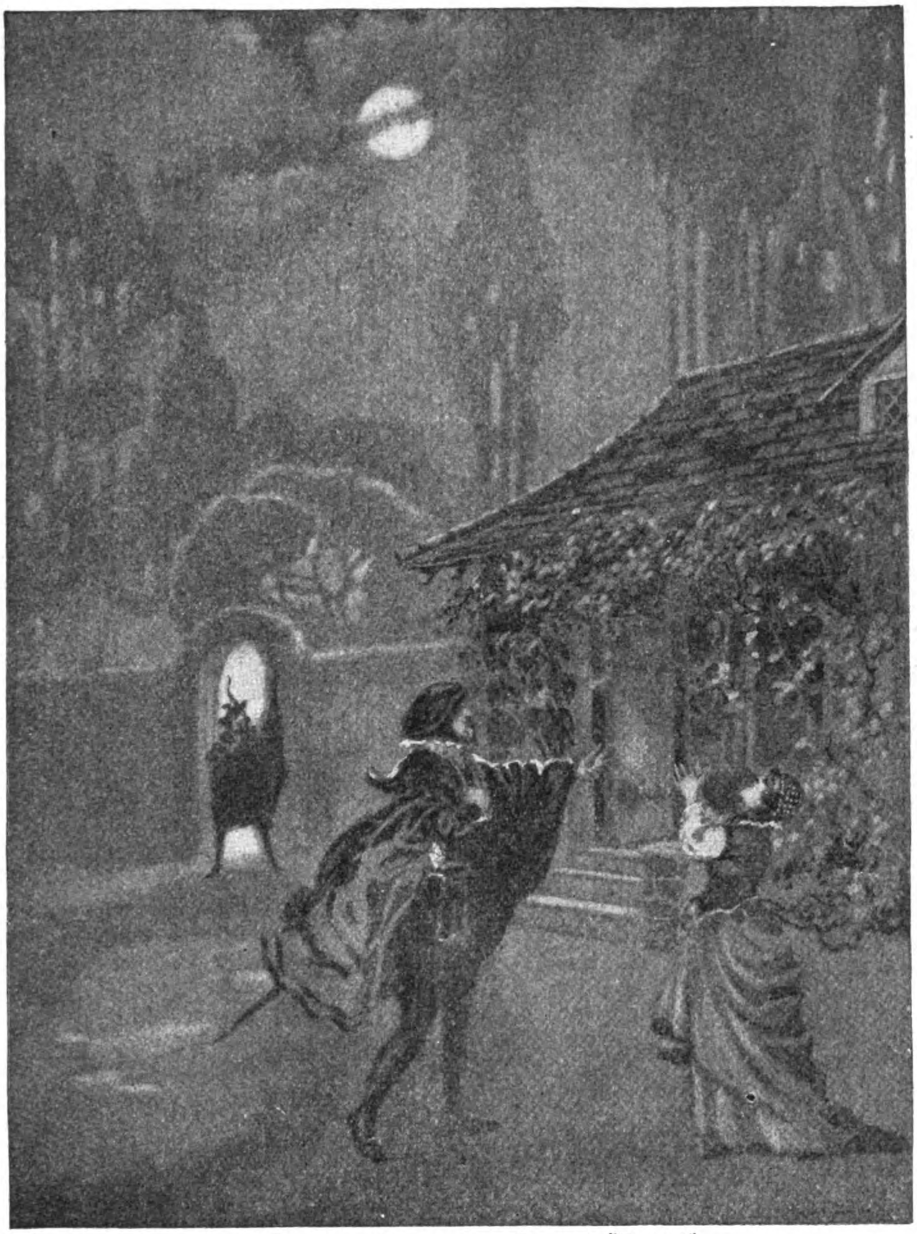
not too helpless, radio, with its light work and health-giving surroundings, is an almost ideal vocation.

It should not be necessary to say that the youth going to college, or who intends to go there, should aspire to something higher than radio operating.

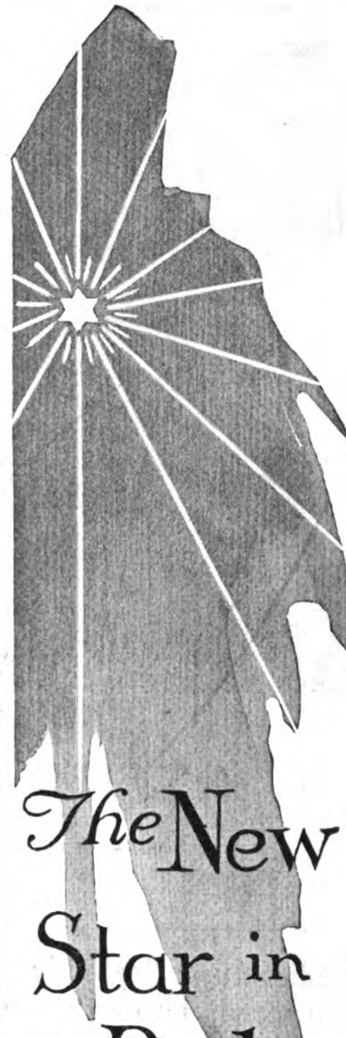
On the other hand, for the youth weighing up coffee and beans at ten dollars a week in a small grocery; for the lad hoeing in a hot and dusty cornfield for twenty dollars a month; for the unhappy boy become a slave to an automatic machine-god in one of our huge modern industrial plants; for any such as these, commercial radio operating certainly offers at least breathing room and an opportunity to work for better things.

One thousand vacuum tubes, type VT-11, manufactured by the General Electric Company, have been declared surplus, and are offered for sale to the public at $5.50 each; not more than three to any one person; licensed only for *amateur, experimental or entertainment use;* at Signal Section, San Francisco General Intermediate Depot, Polk and North Point Streets, San Francisco, California.

The Radio Marketing Corporation has been formed to supply the needs of amateurs at Oakland, Calif., by F. J. Hill, Jos. J. Rosborough, Oliver Kehrlein, Robert Thomas, and J. N. Borroughs. Mr. Thomas is acting as manager of the store at 329 Fourteenth Street. Business is done under the name of "Ramarco."

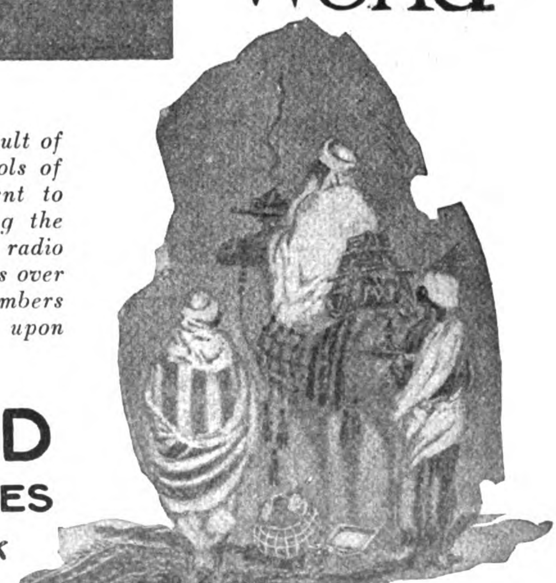


Scene from the Opera "Faust"



The New Star in the Radio World

MOMENTOUS events in the arts and sciences are the result of rising above out-worn principles, independent of the tools of mediocrity. Beginning where others have been content to finish, a forward-looking group of radio engineers, comprising the Mu-Rad Laboratories, have designed and successfully constructed radio apparatus which is as advanced as the twenty-one-jewel watch is over the key-winder. Prices of this apparatus insure that great numbers will benefit from their achievements. Descriptive literature upon request.



MU-RAD LABORATORIES
INCORPORATED
ASBURY PARK
NEW JERSEY

ELECTRONIC THEORY

Continued from page 14

should reverse the charges at these two points, however, so that the point at high potential is now at a low charge, and *vice-versa*, the electrons will reverse the direction of their flow back toward the new point of higher potential. If we continue to reverse the charges of the two points, first from low to high and back again, the current flowing between the two points will reverse its direction as often as we switch the respective charges at these two points. Such a reversing current is called an alternating current.

Either type of current when flowing in a wire is accompanied by four effects: 1, heating; 2, electrostatic; 3, electromagnetic; and 4, radiation. Let us examine these different phenomena in order.

1. We have seen that the electrical current encounters resistance in the conductor in which it is flowing, and that this resistance is due to friction between the electrons and the atoms or molecules of which the conductor is composed. Just as the friction between two pieces of wood being rubbed together gives rise to heat, so the friction in the conductor between the electrons and the atoms, if the conductor is an element, also sets up heat therein.

The more electrons there are flowing in a wire and the higher its resistance, the greater will be the total amount of friction set up by the electrons, and hence the greater the heating effect.

In an electric lamp the resistance of the fine filament wire is so great that enough heat is generated to maintain the filament at white heat.

2. Due to the electrostatic effect, a negatively charged body is one having more than its normal number of negative electrons and a positively charged body is one having less. Thus, when a piece of sealing wax is rubbed with flannel, the wax becomes negatively charged and the flannel positively so, because the friction rubs some of the negative charges off the flannel and deposits them on the wax.

Due to the fact that the flannel and the wax now have opposite or unlike electrical charges, an attraction or electrostatic strain is set up between them if they are brought close to each other. This electrostatic strain represents stored up electrical energy.

A convenient device for practically storing electrostatic energy is the *condenser*, the first type of which was the Leyden jar, devised by Musschenbroek of Leyden in 1746. As shown in Fig. 3, the Leyden jar condenser consists of a glass tumbler or jar, coated on both sides with metal, either foil or sheet metal—usually copper. The essential feature of a condenser is that it must consist of an insulator coated on both

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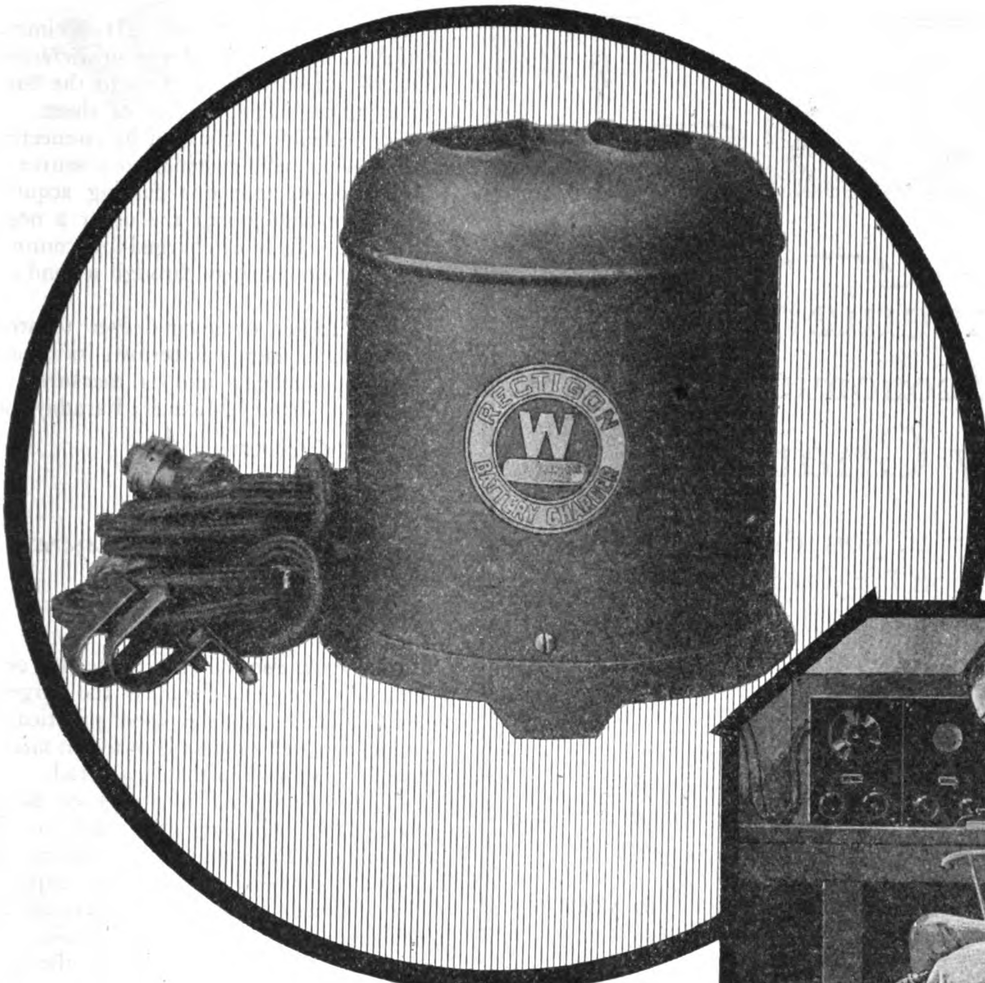
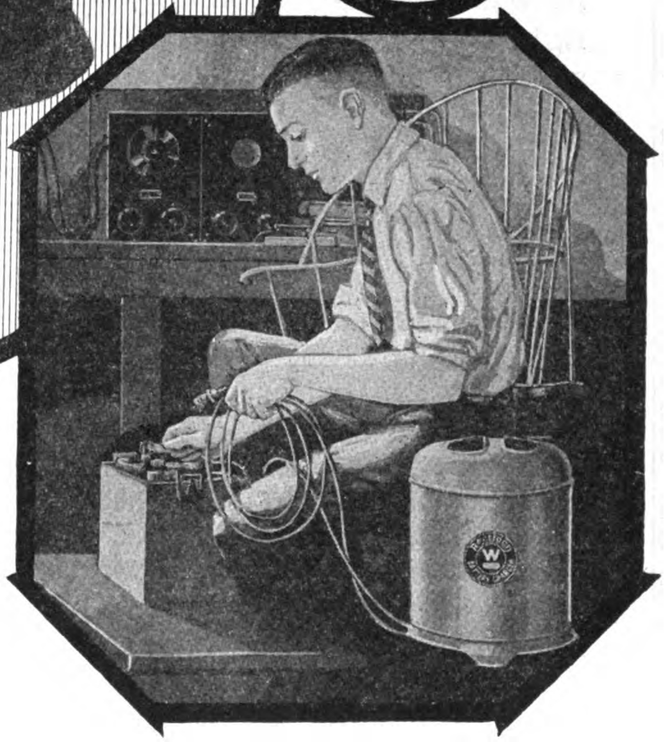


WESTINGHOUSE ELECTRIC



Charge Your Battery at Home

KEEP pep in the battery for your vacuum tube receiving set by using the Rectigon Battery Charger.

The Rectigon is a small, inexpensive device that will charge your radio battery over night. It is entirely automatic in operation and needs no attention after it is started.

The Rectigon is portable—it can be placed wherever desired. The absence of oil or grease assures you of no damage to your floor or rugs.

It is as indispensable to your vacuum tube wireless equipment as the battery itself.

For details regarding the various sizes of this type of battery charger, write for our Folder F-4491, "Charging the Radio Battery at Home."

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.
Sales Offices in All Principal American Cities

Westinghouse

RECTIGON BATTERY CHARGING

Continued from page 52

sides with a conductor. It is immaterial whether the insulator, or *dielectric*, as it is sometimes called, is in the form of a jar or simply a plate or sheet.

A condenser is charged by connecting the two metallic coatings to a source of electricity so that one coating acquires a positive charge and the other a negative one. It is discharged by connecting the two coatings through a conducting wire.

The ability of a condenser to store electrostatic energy is termed its *capacitance* or *capacity* and is measured in *farads*. (After Michael Faraday, an

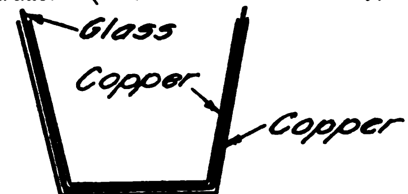


Fig. 3—Leyden Jar

English professor of the nineteenth century.) Since the farad is too large a unit, however, to be used practically, condensers are commonly rated in *microfarads, i. e.,* millionths of a farad.

The capacity of a condenser is increased by enlarging the size of its metallic coatings and by decreasing the distance between them. The capacity also depends upon the nature of the substance used as the dielectric. If mica or isinglass is employed, the condenser will have four times the capacity it would have if paraffine were used, and about eight times the capacity which would be obtained with air as the dielectric.

Condensers are used in both the transmitting and the receiving sets of radio stations. On account of the high voltages to which transmitting condensers must be charged, it is customary to employ glass or mica as the dielectric because of their greater insulating qualities, but for the low potentials encountered in receiving sets, air may be used. The latter is particularly advantageous where it is desired to change the capacity of a condenser at will. Condensers of changing capacities are called *variable condensers* and they usually employ air as the dielectric.

3. Due to the electromagnetic effect, the positive or north pole of a magnet is attracted and the negative or south pole repelled by a wire carrying a direct current flowing in the proper direction.

If the wire is wound in the form of a coil around a cylinder of insulating material, and a direct current is passed through it, one end becomes magnetically positive and the other end negative, according to the direction in which the current is flowing. The magnitude of this effect is increased by increasing either the number of turns of the wire, or electrical current, or both.

Continued on page 58

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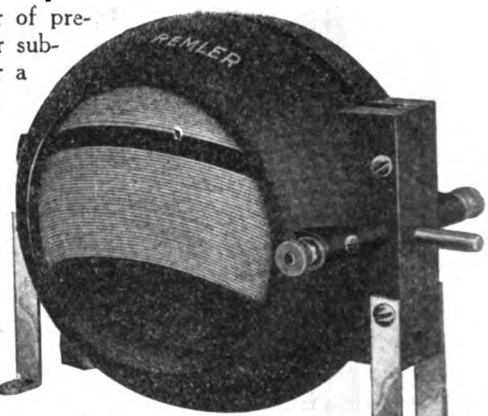
The publishers of RADIO hereby guarantee all apparatus on these pages to be exactly as represented. No rejected or used equipment will be supplied. These various premiums have been supplied to us by a number of the most prominent manufacturers of radio equipment and we fully guarantee that shipments of any and all premiums will be made from the offices of the Pacific Radio Publishing Co. on the same day that orders are received. This offer will be withdrawn on November 1st. No premiums will be awarded for subscriptions received after that date. Any number of premiums will be sent to an individual in return for subscriptions, but we cannot accept subscriptions for a period of more than one year for any subscriber.



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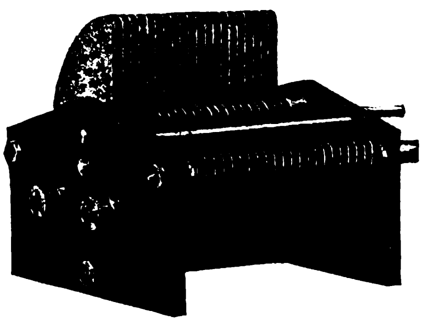
Free Detector and Amplifier Tubes

We have just received a big shipment of Cunningham Type C-300 Detector Tubes and Cunningham Type C-301 Amplifier Tubes. These Tubes are the standard, tested General Electric-Cunningham product. Every tube is fully guaranteed by the Publishers of RADIO to be in perfect operating condition. We will send you one of the Detector Tubes for three subscriptions to RADIO. If you send us four subscriptions, you will receive one of the Amplifier Tubes. Remember that we guarantee to ship these tubes on the same day that your order is received. 25c must be included for mailing charges.



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The 43 plate Variable Condenser illustrated above will be given to you for securing three subscriptions to RADIO. This Condenser is equipped with binding posts and a novel adjusting device for regulating the tension of the movable plates. We have a good supply of these Condensers on hand, ready for immediate delivery. Do not forget to include 25c for mailing charges when you send us the order.

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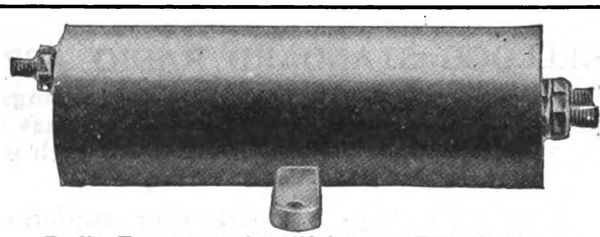

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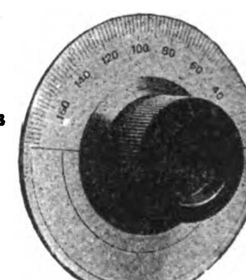

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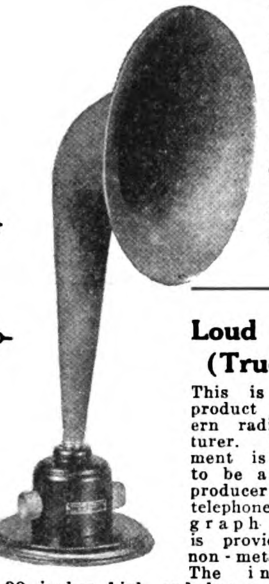

You get this Loud Speaker free with three subscriptions

This Transformer FREE WITH ONLY TWO subscriptions

Loud Speaker (True-Tone)

This is the latest product of a Western radio manufacturer. The instrument is guaranteed to be a perfect reproducer of radio telephone and telegraph signals. It is provided with a non-metallic horn. The instrument stands 22 inches high and has a twelve inch bell horn. It retails for $6.50, and will be sent to you free of charge for securing three subscriptions to RADIO. It will be necessary for you to include 60c for mailing charges, due to the heavy weight of the shipping carton.

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You get one of these Transformers for securing only two subscriptions to RADIO. The retail price is $5.00. It has a ratio of 3½ to 1, and the insulation resistance is above 10 megohms. The mounting is beautifully finished in blued steel. Mailing charges of 25c must accompany your order.

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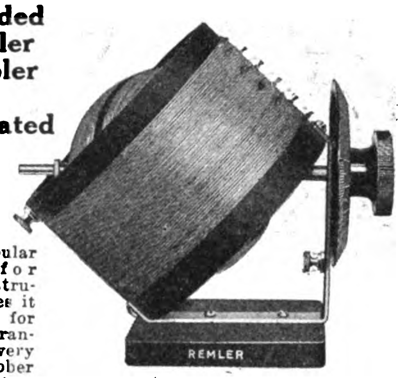

The popular demand for this instrument makes it impossible for us to guarantee delivery after October 15th. Better get your three subscriptions in our hands immediately, and we will send you one of these Couplers on the same day that we receive your order. The Coupler is furnished without dial. Mailing charges are 25c.

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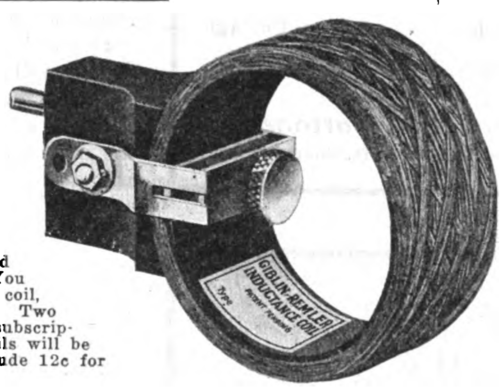

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Continued from page 54

The property of a coil of wire by virtue of which it stores up electromagnetic energy, manifested as we have just seen, is termed its *inductance.*

In the pioneer days of electricity it was discovered that a difference of potential would be set up or induced across the terminals of a coil if the coil were subjected to a changing magnetic field. This magnetic field might be that from an ordinary, permanent steel magnet in the form of a bar, or it might be the magnetic field generated within a coil carrying a direct or alternating current.

This phenomenon is termed *electromagnetic induction,* its essential feature being that the magnetic field inducing the electrical potential must be *changing,* not constant. With a permanent steel magnet, this condition can be obtained by thrusting the magnet into the coil and withdrawing it. If a coil carrying direct current is used, the effect is obtained by turning the current on and off. This latter condition may be realized by employing an alternating current in the coil, since, as we have seen, an alternating current is one in which the electrons flow first in one direction, stop, and then flow in the opposite direction. (The reversals of current are called *alternations,* and one-half the number of alternations per second is termed the *frequency* of the alternating current.)

The amount of potential generated by electromagnetic induction across the terminals of a coil depends upon the number of turns of wire in the coil, the strength of the magnetic field, and the frequency with which the magnetic field is changed. To double any one of these factors will double the induced potential.

If an alternating current is sent through a coil or inductance, the changing magnetic field which it sets up within and around the coil will induce a potential not only across the terminals of another coil brought near it, but also across the terminals of the first coil. This induced potential is not added to the original alternating potential, but is opposite in polarity and therefore opposes it. This opposing, induced E. M. F. is called "back" E. M. F. The effect of this back E. M. F. is to cut down the amount of alternating current flowing through the coil.

We have seen that the amount of induced potential depends upon the frequency of the magnetic change. With alternating current in a coil, the frequency of its magnetic field and hence the amount of the back E. M. F. depends upon the frequency of the current.

The property of a coil by virtue of which it tends to limit the passage of alternating current through it due to the back E. M. F. generated within it is termed its *reactance.* Reactance, like resistance, is measured in ohms. A coil offers no reactance to direct current be-

Continued on page 60

3 big advantages

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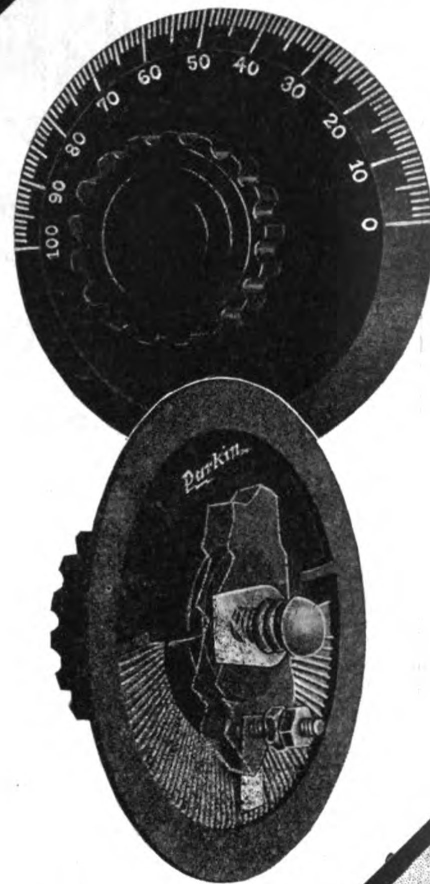

The Parkin dial type Rheostat

(*Patented August 1, 1922*)

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THE DIAL is moulded of black Bakelite, beautifully polished, and graduated from 0° to 180° for fine adjustment. Graduations read from right to left for clockwise rotation, and are filled with brilliant white enamel for easy reading. The knob is of moulded Bakelite.

THE RESISTANCE ELEMENT consists of a flat semi-circular core wound radially with non-corrosive resistance wire, and recessed in the back of the dial. Adjacent turns are slightly spaced, allowing single turn adjustment. Resistance 5 ohms, carrying capacity 1½ amperes.

TO MOUNT the *Parkin Dial-Type Rheostat* is extremely easy. Fasten the stationary contact to the panel with screw and nut furnished. Loosen the set screw behind the knob, remove the shaft, insert it through the hole in the panel, replace the dial on the shaft, and tighten set screw. That is all. Only two small holes are necessary in the panel; a 3/16 inch hole for the shaft, and directly below this, ⅝ inch from the center, a ⅛ inch hole for the screw which fastens the stationary contact to the panel.

Parkin Dial-Type Rheostat Order No. 100, price complete *$1.50* at your dealer. Write for *"Radio Buyers Guide"* No. 9, listing other Parkin *Peak of Perfection* Parts.

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Continued from page 58

cause the magnetic field set up by such current is constant; it does not change, except at the instant when the current is turned on or off.

When an alternating current flows through a coil it is thus subjected to the resistance of the wire itself and the reactance of the coil. The total limiting factor is called the *impedance,* being a combination of both resistance and reactance.

A condenser also offers reactance to an alternating current, but of a different type. We have seen that a coil offers no reactance to direct current. A condenser, however, offers tremendous reactance to direct current, so much so that no direct current can flow through it. A condenser, then, is really an insulator to direct current.

Since a condenser acts in exactly opposite fashion to an inductance, the reactance of a coil to alternating current may be reduced if a condenser is inserted into the circuit. In fact, if the condenser is properly designed for the particular coil in use, the reactance of the condenser can be made to neutralize or annul exactly that of the coil, so that the only impedance offered the alternating current is that of resistance, as if direct current were flowing through the coil. Such a condition is called *resonance;* the coil and condenser are said to be in resonance with each other, and the circuit is called a resonant one.

4. We shall discuss the phenomenon of radiation in the next assignment.

Before completing this assignment, we give in Fig. 4 some conventional symbols used in drawing electrical and radio diagrams.

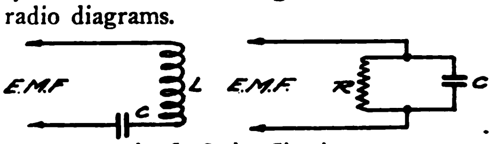

Fig. 5—Series Circuit
Fig. 6—Parallel Circuit

When current flows through one electrical device before passing through another in the same circuit, the devices are said to be in *series* with each other and the circuit is called a series one. If the current flows through both devices at the same time, they are said to be in *parallel,* or *shunt,* and the circuit is termed a parallel circuit. Thus, Fig. 5 represents a series circuit and Fig. 6 a parallel one.

Continued on page 62

Broadcasting a Message of Radio Reliability

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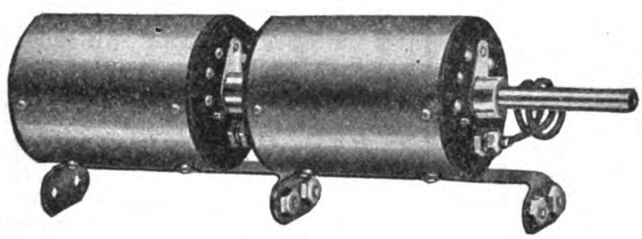

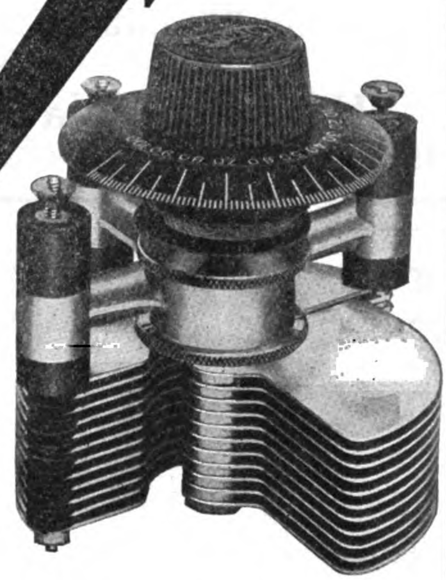

Cotoco Amplifying Transformer for Radio Frequency Makes Loop Aerials Practical

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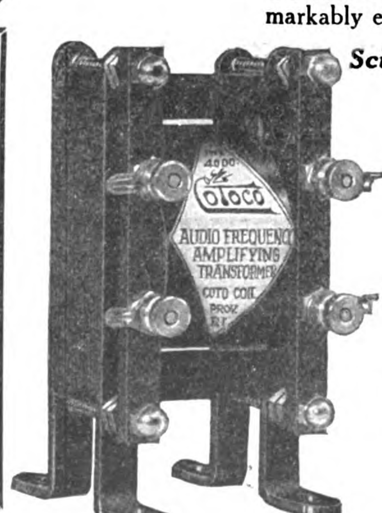

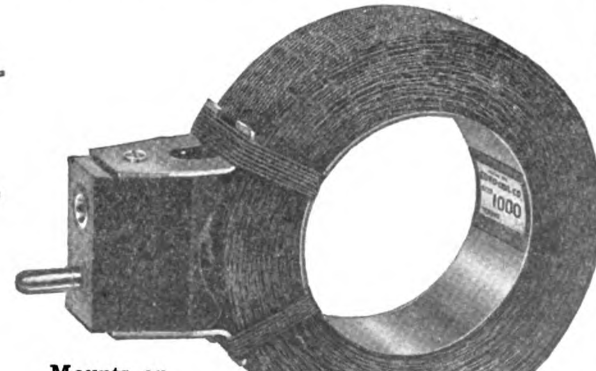

Mounts on Either Fixed or Trunnion Brackets

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RADIATION

WE observed in the first assignment that there are four phenomena accompanying the flow of a stream of electrons, or the electrical current in a wire, *i. e.,* the generation of heat in the conductor, the production of both electromagnetic and electrostatic fields around the wire, and radiation.

What do we mean by radiation? We mean the emanation or propagation of electrical waves away from the conductor, just as we say that an electric lamp radiates light waves and a hot iron radiates heat waves.

These waves are sent off from the conductor as a result of the building up and collapsing of the electromagnetic and electrostatic fields around the wire when the direct current flowing therein is started and stopped. In this respect, the radiation of electrical waves is similar to the electromagnetic induction of potentials from a direct current flowing in a coil, which we studied in the last assignment, in that this phenomenon is not observed unless the current is thrown on or cut off in the circuit. We also observed in the last assignment that an alternating current fills the requirement of an intermittent current in a coil for the electromagnetic induction of potentials in that coil, or in an adjacent one, in that the stoppages and reversals of the electronic flow within a wire are equivalent to a direct current which is thrown on and off by means of a switch in the circuit.

So it is with the phenomenon of radiation. Electrical waves are not radiated from a wire unless the direct current within the conductor is started and stopped or unless an alternating current is flowing within the wire. As in electromagnetic induction, this prerequisite of an intermittent or alternating current is very important.

Electrical waves are very similar to other types of waves, such as sound waves and waves on the surface of water, and in order that you may have a thorough understanding of them, we shall examine the latter type first.

If a stone is dropped into a pool of still water, ripples or waves spread out over the surface of the water in ever-increasing, concentric circles, the center of these circles being the spot where the stone struck the water and where the splash or disturbance occurred. It is significant that a *disturbance* of the water—the medium which conducts or transmits the waves, just as the ether which was mentioned in the last assignment, conducts electrical waves—is

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necessary for the radiation of these water waves. If the stone were simply suspended on a string so that it touched the surface of the water, and no motion were imparted to it, no waves would be set up. This stationary or non-disturbing condition is similar to a flow of *direct* current in a wire. It is only when a disturbance in the transmitting wave medium occurs that waves are radiated. The effect of a direct current in a wire is to produce an electromagnetic and electrostatic strain in the ether surrounding it, but this strain is only a passive or potential one (in the non-electrical sense), and a disturbance in the ether is not caused until the electromagnetic and electrostatic fields are built up or collapsed, due to the

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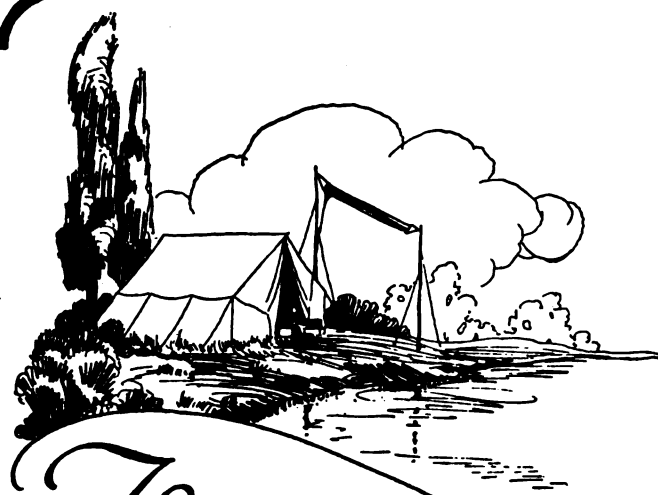
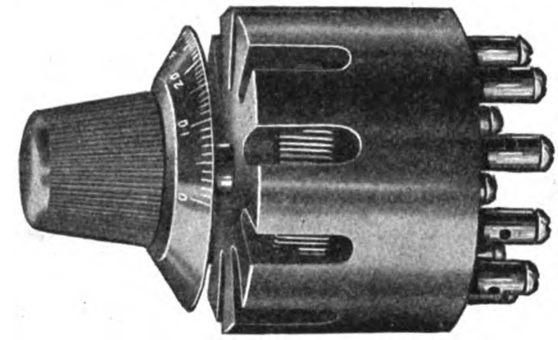


The ideal combination for VT control without the use of jacks or plugs.



Klosner Amplitrol
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THE long looked for has at last arrived. The new Klosner "Amplitrol" fills that long felt radio want—that of controlling the vacuum tube circuit without the use of jacks, plugs or any additional switches. A real radio necessity. Each of your amplifier tubes deserves one. No more plugging in from one stage to the next. Simply attach your phones or loudspeaker to binding posts and turn on any stage at will.

The "Amplitrol" not only adjusts the filament to its maximum efficiency, but it automatically controls the plate circuit at the same time, thus eliminating an extra operation. Unlike an automatic filament control, the "Amplitrol" does not put a sudden strain on your filament. It provides a gradual current increase for the filament, thus prolonging its life.

Made of moulded condensite. Contacts of phosphor bronze. Exposed metal parts highly nickel plated. New style tapered knob, and dial correctly numbered in white lettering. Price, $4.00.

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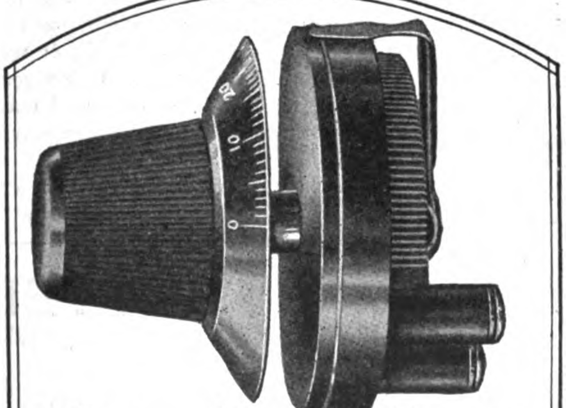
We are the inventors and sole manufacturers of the famous Klosner Vernier Rheostat Model 100, still being sold for $1.50.

Write for interesting literature on the "Amplitrol" and the Klosner Rheostats. Ask for Booklet OC.



Klosner Vernier Rheostat
Model 200
PAT. PEND.

Klosner Improved Apparatus Co.,
2024 Boston Road New York City

Continued from page 64

turning on or shutting off of the direct current or the employment of an alternating one.

Water waves consist of crests and troughs—the crests constituting the uppermost portions of the waves and the troughs, as their name implies, being the lower or depressed recesses between the crests. The crests are raised as much above the surface of the water as the troughs are depressed below it.

It should be noted that the entire body or bulk of the water around the scene of disturbance does not move outward in the form of waves. The only part of the water which actually moves outward in the circular fashion described is that part constituting the ripple or crest.

If a disturbance or noise is produced in the air, the air in the immediate vicinity of the point of disturbance is compressed and circular waves of compression travel outward in all directions from the center of disturbance, just as did the waves on water. There is one difference, however, between air waves and waves on water in that while the latter are limited to the surface of the water, except for the small amount by which they are raised above or depressed below the surface, as we have just seen, the waves in air, or sound waves, travel in gradually rising or mounting *spherical waves.*

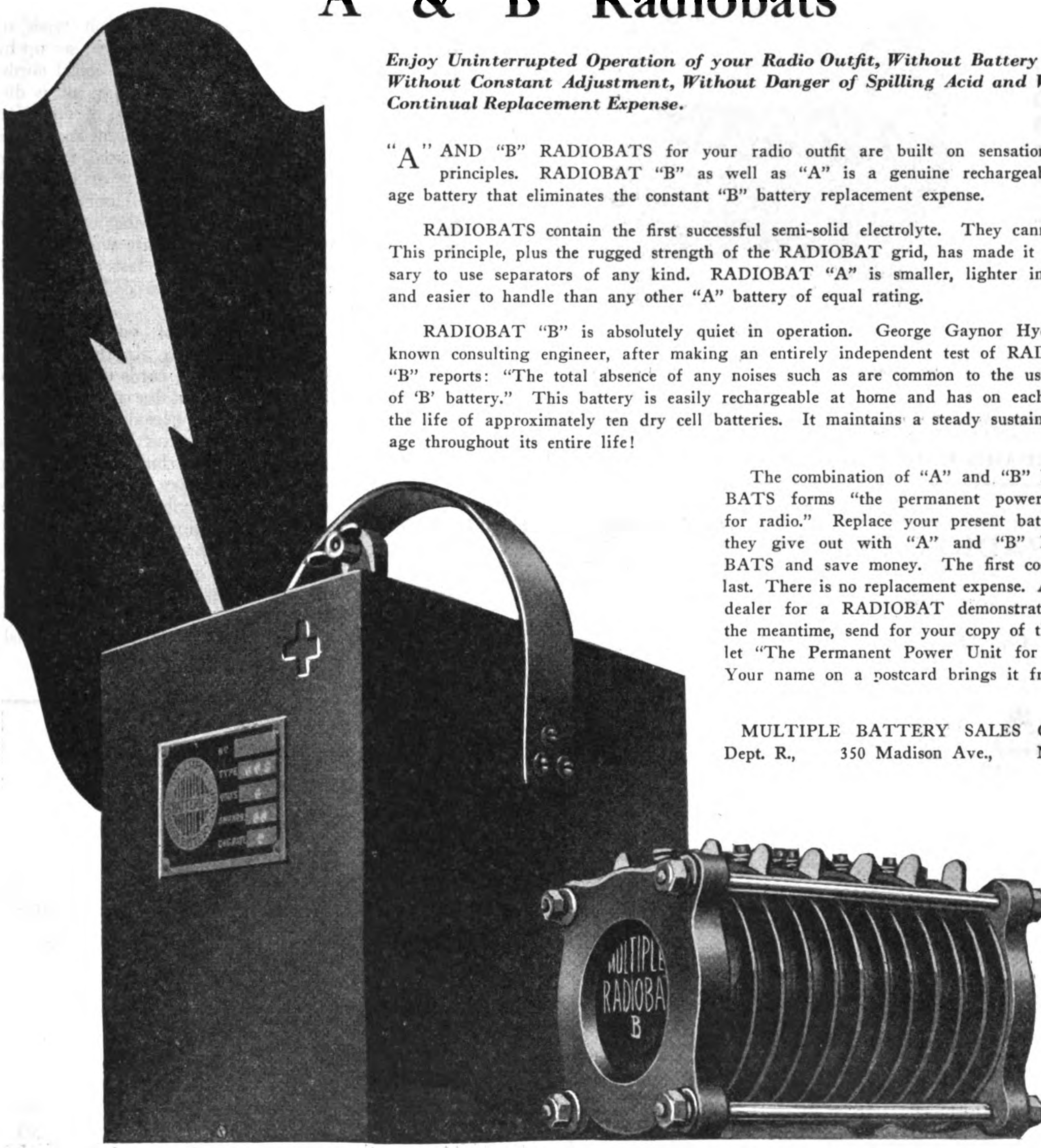
The Greek Theatre at the University is semicircular in shape, but if we should imagine it to be fully circular and should picture ourselves to be at some point above the center of our imaginary circular theatre, the view we should have of the circular, rising tiers of seats would be roughly similar to that which we should have of sound waves sent out in air—that is, assuming that sound waves were visible and were emanating from some point below us.

Radio waves—which, as we shall see later, are one form of electrical waves—are similar to air or sound waves in that they are not only circular but also spherical.

The distance between the crest of one

Continued on page 68

Hook your radio set to these sensational "A" & "B" Radiobats



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"A" and "B" RADIOBATS

The Permanent Radio Power-UNIT

Continued from page 66

wave—whether it be electrical, air, or water—and the crest of the next succeeding or preceding wave is termed the *wavelength.* Obviously, this distance is the same whether it is measured between crests or troughs.

One of the most common types of sound waves is that of speech, set up by the vibration of the human vocal cords. The oftener the surrounding air is disturbed due to the rapidity of vibration or the frequency of the vocal cords, the more waves will be radiated from the mouth in a given length of time. A complete wave consists of one crest and one trough and the number of complete waves or cycles (compare with the definition of *cycle* in the last assignment) which occur in one second of time is termed the frequency.

The frequency of waves—whether they are sent up in air from the vibration of the vocal cords or of a piano string, or on water due to the imparting of regular or periodic disturbances to its surface—is exactly the same as that of the disturbing or vibrating source of such waves. As we increase the frequency of vibration of the generating or disturbing source, as we have just seen, we cause more waves to be radiated in a given length of time. Since these waves follow each other with increased rapidity or frequency, it follows that they are more closely

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crowded together. The distance between any two waves is thus decreased; so we say that *as we increase the frequency of waves, we decrease their wavelength.*

The frequency of sound waves plays a very important part in our sense of hearing. Those sound waves which have a very low frequency of vibration are the low notes of the musical scale; or they have a low pitch, as we say. Those of higher frequency have a higher pitch. The ear can respond only to sound waves whose frequencies lie between certain limits. For example, the human ear cannot detect sounds of less than twenty complete swings or cycles per second. This is called the lower limit of audibility. Similarly, we cannot usually hear sounds of a frequency of more than ten thousand cycles per second. The upper limit of audibility, being in the higher frequencies, is not so clearly defined for different persons as is the lower, and as a consequence, there are some persons who cannot hear a cricket chirping, because some of the cricket's notes are above their limits of audibility.

In radio engineering those frequencies lying between 20 and 10,000 cycles per second have been termed *audio* frequencies, while those above 10,000 per second have been arbitrarily termed *radio* frequencies, since the frequencies of radio waves in common use fall in the region above the upper limit of audibility.

The speed or velocity of waves varies according to the media which conduct them. Sound waves travel in air at a speed of about one-fifth of a mile per second. Light waves—like the rest of the electrical waves of which they are but one type, as we shall later observe—travel at a much higher speed, approximately 186,000 miles per second. This great difference between the speeds of light and sound waves can be readily observed by watching a distant pile driver, for example. One sees, by means of the high speed light wave, the hammer strike the pile long before the sound of the blow, carried by the sound waves, is heard. The same phenomena are observed in watching and hearing the whistle of a steamer or locomotive some distance away.

The significant point about all waves, whether they be mechanical waves—such as sound waves or water waves—or electrical waves—such as radio or light waves—is that they are set up by some vibrating source. With sound

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waves, we have mentioned as examples the vibrating vocal cords and a vibrating piano string. With radio waves, a vibrating electrical circuit is required, or a circuit carrying a vibrating electrical current. Such a current, as we have seen, is termed an alternating current.

The Family of Electromagnetic Waves

If we take an iron poker and commence to heat it in a flame we shall find that it will radiate heat waves even before it begins to turn red from the applied heat. This radiation of heat waves, while invisible at first to the eye, can be detected by holding the poker near the face or hand. As a matter of fact, all bodies are continually radiating heat waves since all bodies are at *some* temperature, but their heat is not apparent to us until the temperature rises somewhat above that of the human body, which, as you know, is just a little below 100 degrees on the Fahrenheit scale.

As we learned in the last assignment, all substances are composed of atoms or molecules depending upon whether they are elements, mechanical mixtures, or compounds. These atoms or molecules, as the case may be, are constantly in a state of vibration or unrest. Due to the vibration of these electrical particles or charges, electrical waves or radiations are constantly being given off from all bodies and we call these radiations *heat* waves. Heat radiation, then, is a form

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of electrical wave just as are light and radio waves.

If the atoms or molecules of which a substance is composed were not vibrating constantly, no radiations or heat would be given off and we should say that the body was at absolute zero temperature—not the zero of any of the thermometer scales with which we are familiar, but a temperature infinitely lower. Needless to say, such a condition does not exist, but it is approached, and even then only by a wide margin, by bodies or gases at extremely low temperatures, such as liquid air.

The amount of heat which a body contains and gives off in the form of heat radiations or waves is determined largely by the rapidity or frequency of its atomic or molecular vibration. If we apply external heat to a body, as we are doing in the case of the poker, this external heat energy, which is really a form of electrical energy, causes the atoms or molecules to vibrate more rapidly and its heat content increases and the temperature rises. As more and more heat is applied, the atoms and molecules vibrate at increasing frequencies and the frequency of the heat or electrical waves which the poker radiates is also increased. When enough heat is applied, the frequency of the electrical waves becomes sufficiently high so that we can *see* them and we say the poker is now red hot. These electrical waves have thus been converted from invisible heat waves to visible light waves.

As still more heat is applied to the poker, the increasing frequencies of its electrical radiations cause the poker to assume simultaneously, one after the other, the colors orange, yellow, green, blue and violet—in fact, all the colors of the rainbow. Now, as you may know, these colors are called the primary colors of light and the combination of all of them gives us white light. So we see that the reason why a poker becomes white hot when we apply enough heat to it is because it is emitting light waves of all the colors of the rainbow.

All the colors with which we are familiar are simply light or electrical waves of different frequencies. Just as we have seen that the ear can only detect sound waves of certain frequencies, so also the eye has certain limits of responsiveness called its limits of visibility as distinguished from the limits of audibility of the ear. And just as there are certain sounds above the ear's upper limit of audibility which the ear cannot always detect, such as the notes of the cricket, so there are electrical waves of frequencies higher than that which produces the color violet and which are invisible to the eye. These are called ultra-violet waves or rays and can be obtained from bodies at extremely high temperatures—our poker

Continued on page 76

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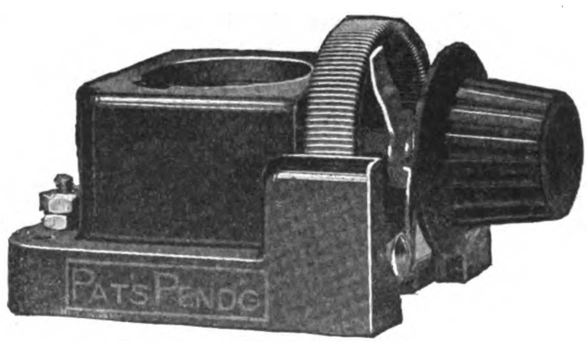

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Continued from page 74

will give off ultra-violet waves or rays if we heat it sufficiently—from the X-ray, from radium, and from other radio-active substances.

While these ultra-violet rays cannot be detected by the eye, they can be registered on a photographic plate, as is done in the making of an X-ray picture. Heat or infra-red waves, as we have seen, while not visible to the eye, can be detected by our sense of touch.

Below the infra-red waves is a great band of additional electrical waves which are also invisible to the eye. These are the radio waves with which we are especially concerned. Their frequencies are lower than those of any of the other electrical waves and they can be detected only by special electrical circuits called radio receivers, which transform their feeble electrical currents, sometimes only after they have been amplified many times at the receiver, into sound.

Starting with the waves of lowest frequency, there is reproduced below a

Continued on page 80

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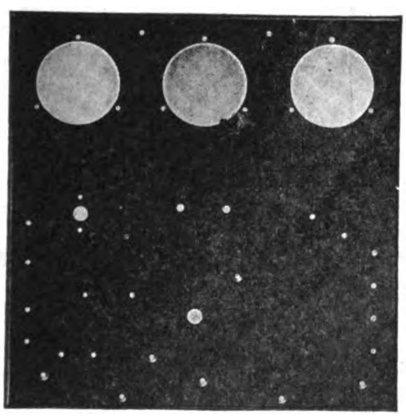

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Continued from page 76

table of the most important of the electrical waves:

Radio waves
Infra-red or heat waves
Red light
Orange light
Yellow light
Green light
Blue light
Violet light
Ultra-violet rays or waves
X-rays and radium emanations.

It should be noted, that while no gap exists between the frequencies of the electrical waves in the range from infra-red waves to X-rays, there is a considerable interval between the radio waves of highest frequency and the infra-red waves of lowest frequency. In this gap lie electrical waves of frequencies much higher than are encountered in radio practice, some of which have been produced in the laboratory but which to date have been put to no practical use. The rest have never been produced by man and so far, at least, have not been discovered to exist in nature.

You should clearly understand that the only difference between all the various types of electrical waves lies simply in their respective frequencies of vibration. It is this difference in frequency which determines whether the electrical wave shall be visible as in the case of light, and if visible, whether it shall be the color red or blue; whether it shall produce marked heating effects as in the case of infra-red waves; or whether it may be used to transmit intelligence by telephone or telegraph, as in the case of radio waves.

We have seen that air may be used as the conducting medium for the transmission of sound waves. The medium which serves to transmit or conduct the great family of electrical waves is shrouded in mystery. Formerly, it was considered to be the ***luminiferous ether,*** or simply the ether, a mysterious medium—neither liquid, gaseous nor solid—which fills all space. Light and radio waves certainly require no tangible medium on which to travel, because both can be sent with ease through a vacuum. A common example of this is the electric lamp in which the filament which radiates the light waves is completely surrounded by a vacuum.

As we learned in the last assignment, however, the publication and partial acceptance of the Einstein Theory of Relativity has led scientists to question the necessity for our conception of this mysterious ether. This phase of the subject is far from clearly understood by anyone and you need only concern yourself with those facts and phenomena in connection with electrical waves which have been indisputably proved.

For example, the velocity of all electrical waves has been definitely proved to be 300,000,000 meters per second. (A meter is about three inches longer than a yard.) This velocity is equal to 186,000 miles per second. It is this very high velocity of the light wave which explains why we can see distant occurrences long before the sound connected with them reaches our ears.

It is interesting to note that a light wave, or a radio wave, if the transmitting station be sufficiently powerful, will travel seven and one-half times around the earth in one second.

It is known that all forms of electrical waves exhibit both electrostatic and electromagnetic characteristics, as does the electrical current in a conductor. It is because of this that electrical waves are often called electromagnetic waves.

In the reception of radio waves we make use of the electrostatic and electromagnetic properties as well as the actual flow of electrons from one station to another through the earth. These phenomena we shall study in the next assignment.

In summing up this assignment remember that all vibrating bodies emit waves and that by means of vibrating (alternating) electrical currents or vibrating electrons, electromagnetic waves may be radiated. The frequencies of these waves vary according to the frequencies of their radiating sources. The frequencies of electrical waves determine whether they are radio, heat, light or ultra-violet waves.

The waves of lowest frequency, ranging from 12,000 to 1,500,000 cycles per second, are used for radio purposes; those of very much higher frequency comprise the heat and light waves occurring in nature.

LINKING THE AMERICAS BY RADIO

The Radio Corporation of America announces that it has received orders from the United Fruit Company and the Tropical Radio Telegraph Company for five radio stations, three for Central America and two for the United States, each with a sending radius of more than 2000 miles. The erection of these five stations will fill an important and essential gap in the radio communication system of the Americas.

The three Central American stations will be located on the corners of the triangle embracing Honduras, Nicaragua and Panama. The Tropical Radio Telegraph's stations will be located at Managua, the capital of Nicaragua, and at Tegucigalpa, the capital of Honduras, the city designated as the capital of the new Central American Union. These stations will connect with the United Fruit Company's station at Almirante, Panama.

The United States terminals of this communication system will be at New Orleans, La., where the present station of the Tropical Radio Telegraph Company is to be enlarged and new apparatus installed, and at a new station which the Tropical Radio Telegraph Company will erect in the vicinity of Miami, Fla.

ARMSTRONG CIRCUIT

Continued from page 15

amplification will probably do better work on distant signals than would be possible with the Armstrong circuit.

The principle of this circuit, put briefly in simple words, is this: Ordinarily, the coupling between coils *A* and *B* can only go so far when oscillations start and signals can no longer be heard. If coil *A* is then removed a certain distance, oscillations will stop and regeneration take place. With the new circuit coils *A* and *B* can be very closely coupled and the tube is prevented from oscillating continuously by the action of the second tube. This second tube is not used directly for detecting or amplifying the signals, but simply generates an alternating current of 15,000 to 20,000 cycles per second. This is applied to the first tube in such a way as to paralyze it 15,000 or 20,000 times per second and thus prevent it from continuing in the oscillating condition.

Since the tickler coil *A* is now coupled very closely to coil *B*, the regeneration is much greater than in the simple circuit.

This principle is not entirely new. The writer had a demonstration of such a circuit two years ago by Mr. Charles V. Logwood. Where Armstrong paralyzes the tube and thus prevents it from continuing in oscillation by an electrical means, Logwood did it by a mechanical means. Logwood's circuit was intended primarily for the reception of long wave arc stations and was probably better adapted to that particular purpose than the new Armstrong circuit.

BOOK REVIEW

"Elements of Radio Telephony," by William C. Ballard, 132 pages, 5 x 7, flexible cover. Published by McGraw-Hill Book Co., New York City, and for sale by RADIO, Pacific Bldg, San Francisco. Price, $1.50.

'Tis a relief for the reviewer who has been flooded with books on popular radio to read this book by Professor Ballard of Cornell University. The author knows what he is writing about and knows how to impart his knowledge to the reader. The book is intended to inform a novice what happens when messages are sent and received by radio. There is a minimum of mathematics, and that of the simplest. The treatment is confined almost entirely to the vacuum tube and its use as a generator, detector and amplifier of radio waves. The concluding chapter gives practical information for the experimenter who desires certain results but who does not know what apparatus is necessary.

The Radio Pathfinder, by Richard H. Ranger, with line drawings by Thomas E. Monroe; 155 pages, 5x7½. Published by Doubleday, Page & Co., New York City. Price, $1.50.

The how and why of radio, in the abstract, is difficult for the layman to understand. As a crutch to the understanding, the author of this interesting book employs an animated electron to explain what is taking place in a radio transmitting and receiving set. He does this in such simple language that any twelve-year-old should find it easy to understand what is actually going on in the set. The action of each part is explained in detail, the description of vacuum tube detector and amplifier action being especially clear. This book is highly recommended to anyone who wishes to gain a qualitative understanding of radio intricacies.

NOW that the problems of Radio broadcasting have been solved, the real pleasure and usefulness of wireless telephony is dependent on possessing the only perfected loud speaker—the Magnavox Radio.

Your receiving set only brings the message, while Magnavox Radio tells it clearly and in full volume to all within reach of its voice.

R-2 Magnavox Radio with 18-inch horn

This instrument is constructed on the electro-dynamic principle ("the reproducer with the movable coil") making it a most efficient converter of electrical energy into sound waves.

Type R-2 has very great amplifying power, yet requires only .6 of an ampere for the field.

R-2 serves the requirements of professional use for large audiences, dance halls, etc.

R-3 Magnavox Radio with 14-inch horn

Same in principle and construction throughout as Type R-2, but possessing silghtly less amplifying power. Requires one ampere field current from your filament battery.

R-3 Magnavox Radio is ideal for use in homes, offices, amateur stations, etc.

With either type Magnavox Radio the hookup is simple and no extras or adjustments are required.

Attached to any commercial receiving set, the Magnavox Radio makes it possible for you to hear all that is in the air as if it were being played by your phonograph.

Whatever your previous experience (if any) with Radio has been, a new world of enjoyment awaits you in the service of the Magnavox Radio.

Magnavox Power Amplifier—Model C

The Magnavox Power Amplifiers insure getting the largest possible power input for your Magnavox Radio. They can be used with any "B" battery voltage the power tube may require for best amplification.

Switching from stage to stage is made easy by master switches, as illustrated. *2 and 3-stage.*

More wonderful day by day grows the range of entertainment, recreation and information supplied by central broadcasting stations in all parts of the country.

It is the development of Magnavox Radio which has made these wireless programs fully enjoyable—removing the restrictions and limitations imposed by the telephone headset.

Full Information—Send For It

Every radio user (present or prospective) will be interested in reading this new folder on the Magnavox Radio.

It contains full information about this wonderful reproducer, with illustration, description and list price of the various instruments.

Even if you do not now own a receiving set you should learn how the possibilities of wireless telephony have been revolutionized by the development of Magnavox Radio.

On receipt of request we shall be pleased to send you free copy by return mail.

THE MAGNAVOX COMPANY

Home Office and Factory: **Oakland, California**

New York Office: 370 Seventh Avenue

RADIO DEVELOPMENT

Continued from page 40

both in the United States and Great Britain, indicate that his first triumph of communicating by electromagnetic waves was accomplished by an arrangement of two metal plates, elevated on poles in the picturesque fashion common to country tavern signs, the transmitting plate being connected through a spark gap to earth. This device consisted of insulated balls that were divorced by small air space which could include a vacuum compressed air or gas, or a liquid. To the terminals of the gap the leads from the secondary of an induction coil were connected, the primary winding having the common battery, key and interrupter, connected in its circuit. The interrupter functioned in making and breaking the circuit one hundred times a second. The receiving circuit passed from the plate, through the coherer, to the ground. The terminals of the coherer were connected to a relay which controlled the tapper, but in the absence of a bell, a sounder in parallel to the tapper coil, was employed. Departing from the experience of the vanguard of scientists who supplied him with his working materials, Marconi placed the circuits vertically instead of horizontally, and employed longer waves, more energy, larger radiating and receiving

Continued on page 88

Continued from page 87

antennae. He also designed an improved coherer.

J. A. Fleming discovered that rarified gas was an effective conductor of electric current. The U. S. Patent Office granted him protective right to a device bearing striking similarity to an incandescent electric lamp.

Continued on page 90

Continued from page 88

A metal cylinder surrounded the filament and the invention was employed in detecting wireless waves. His procedure in adapting this device to service was to employ the transformer coupling between the antenna and local circuit, connecting the metal cylinder to one terminal of the secondary winding and the filament to the other. Since, in the use of a device of this sort, the filament, when heated, gives off negative electrons which pass to the cylinder and out to render the space between the filament and the cylinder conductive, current can pass from the cylinder to the filament. The current will not readily pass the other way. Therefore, the Fleming progeny acts as a rectifier, and he dubbed it a "valve."

Lee De Forest, in 1905, made a notable contribution to the progress of wireless communication by introducing the "audion." It is a rectifier and a sensitive detector. It is a modification of the Fleming "valve." A metal plate, placed at one side of the filament, was substituted for the Fleming cylinder, and a third electrode of a perforated or grid-like design placed between the filament and plate. The universal popularity of this device and the reams upon reams of paper already devoted to describing and expatiating the virtues of this rectifier and detector render superfluous any attempts of elaboration in this article. May it be said, however, the modified audion, sometimes styled the thermionic amplifier, is the "heart and soul" of the modern radio outfit.

Edwin H. Armstrong and his regenerative

Continued on page 94

Duck's Radio Catalogue

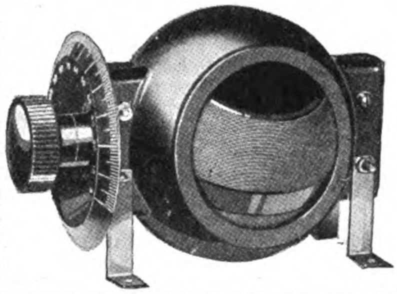
No. 16—256 Pages

Continuously since 1909 Duek's Radio Catalogs have never been equalled for completeness and great wealth of radio data.

Send 25c in coin, carefully wrapped, for your copy of this wonderful book, the most unusual and complete catalog ever put between two covers. Not sent otherwise. It is not only a catalog, but a wonderful text book on radio. Enormous cost and tremendous demand prevent further distribution at a less retainer.

Over 50 pages of latest hook-ups (wiring diagrams) and invaluable and up-to-date data and information on radio, including important instructions for building antenna.

***Our new moulded variometer* speaks for itself. For a comprehensive description of the design and radio thought back of our variometers, we invite** your attention to our exhaustive description in catalog. In prettiness of design, compactness and lightness of weight, we have not seen any variometer that we believe compares with ours. The forms, unlike many others, positively will not warp. *No. A900* plate variometer, with knob and dial $7.25. *No. A900* grid variometer, with knob and dial, $7.25. *Note.*—If knob and dial are not desired deduct 75c.



Duck Products have stood the test of time. The largest line in America—62 complete instruments—58 parts

Dealers

We want live, responsible dealers in every city and town in the United States, both for the sale of our extensive line of radio apparatus and all other worth-while lines of radio goods, on all of which we can quote attractive dealers' discounts. We can offer you facilities and advantages that no other radio house can offer.

THE WILLIAM B. DUCK CO.
248-250 Superior St.: - Toledo, Ohio

AUTOMATIC ELECTRIC
LONG RANGE
RADIO
HEAD SETS

Assure the clearest tones from your receiving set, whether you use a crystal set, amplifier or loud speaker.

The Automatic Electric HEAD SET is the perfected product of telephone experts of over thirty years' experience.

$10.00

Ask any up-to-date radio dealer.

With Plug attached $11.50

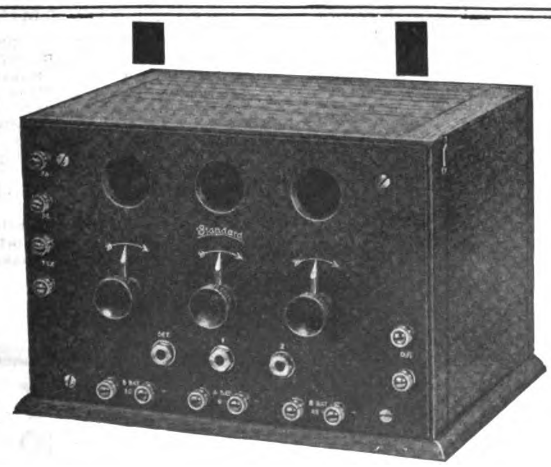
Automatic Electric Company

Engineers, Designers and Manufacturers of the Automatic Telephone in Use the World Over

HOME OFFICE AND FACTORY: CHICAGO, U. S. A.

The Standard Idea

Assembled—But Not Wired



BUY your radio instruments in this new way—*this cheaper way.* Adopt the popular STANDARD IDEA and purchase high grade instruments, including our Detector and Two-stage Amplifier and our Multiple Wave Tuner, completely assembled —*but not wired.* You do the wiring yourself, according to simple directions, and save at least 20% in cost.

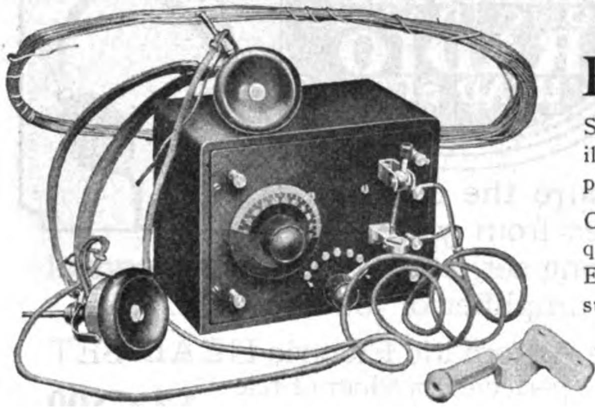
The wiring of instruments is the most expensive operation in our factory, but when you do the job in your spare time you eliminate this costly hand labor and enable us to sell you the instrument at a great reduction. Thousands of fans are now following the STANDARD IDEA.

Ask us today for literature and prices and information regarding our offer to send any instrument for inspection on receipt of one-third the purchase price.

STANDARD ASSEMBLING CO.
6 Stone St., New York, N. Y.

RADIO APPARATUS **CROSLEY** RADIO APPARATUS

Better—Cost Less



EFFICIENT, satisfactory and economical, Crosley Radio Units have become well and favorably known to the trade.

Several of the Crosley early units, greatly refined in finish and detail, are illustrated here, together with several new models which have recently been perfected.

Crosley prices are remarkably low. These prices are made possible by quantity production and up-to-date methods employed in our factories. Everywhere Crosley "Better—Cost Less" Radio Units are meeting with success.

CROSLEY CRYSTAL RECEIVER NO. 1

Beginners in Radio will find this a very efficient unit. With a range of from 200 to 600 meters, this set will receive broadcasting stations up to 25 or 30 miles, depending upon conditions and their power. Complete with head phones, antenna wire insulators ready to install without any additional equipment—$25.00. Crosley Crystal Receiver No. 1 is made so that the Crosley Audion Detector Unit, Crosley Radio Frequency Tuned Amplifier, and Crosley Two-Stage Audio Frequency Amplifier may be added if desired to increase the range and volume of sound.

CROSLEY AUDION DETECTOR UNIT

While this unit may be used with practically any type of tuner, we recommend it especially in combination with the Crosley Crystal Receiver No. 1. It is designed to be operated with almost any kind of hook-up. Panel finish in Adam brown mahogany cabinet. Without tubes, batteries or phones—$7.50.

HARKO SENIOR NO. V

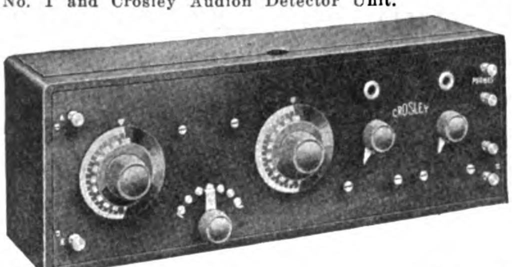
This instrument is a combination tuner and Audion detector, recommended for receiving broadcasting stations up to fifty miles. Under favorable conditions ships and stations on the Atlantic Coast are easily copied in Cincinnati, Minnesota hears Newark, Denver hears Schenectady and other distant points are brought in, except under adverse conditions. Formica panel, Adam brown mahogany finished cabinet, price as shown without tubes, batteries or phones—$20.00.

Crosley Harko Senior No. V is equivalent to **Crosley Crystal Receiver** No. 1 and Crosley Audion Detector Unit.

CROSLEY RADIO FREQUENCY TUNED AMPLIFIER (R. F. T. A.)

This unit can be used in connection with the Crosley Crystal Receiver No. 1 and Crosley Audion Detector Unit, or with the Crosley Harko Senior No. V. It can also be used with practically any other type of Audion detector outfit. The tuning feature means selectivity, elimination of static, and great increase in volume of signals.

In combination with the above **mentioned units, the Crosley R. F. T. A.** adds at least six times the **volume and range. Price, without tube or** battery—$15.00.



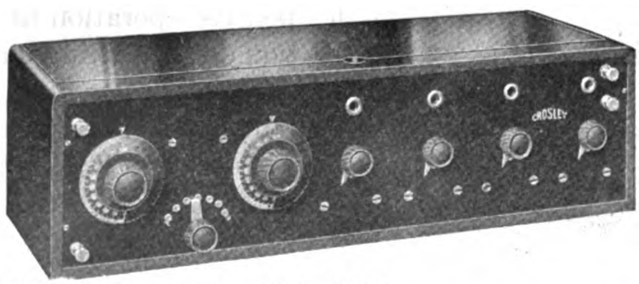
CROSLEY RECEIVER NO. VI

This Unit has approximately six times the range and volume of the Harko Senior. With it distant broadcasting stations are brought in loud and clear-tuned sharply. It also eliminates static to a large extent. The Crosley Receiver No. VI consists of tuner, one stage tuned radio frequency amplification and audion detector. Mounted on formica panel Adam brown mahogany finished cabinet, without tubes, batteries or phones—$30.00. Crosley Receiver No. VI is equivalent to the Crosley Crystal Receiver, Crosley Audion Detector Unit and Radio Frequency Tuned Amplifier or Crosley Harko Senior No. V and Crosley Radio Frequency Tuned Amplifier.

CROSLEY TWO-STAGE AUDIO FREQUENCY AMPLIFIER

With this unit two stages of audio frequency amplification can be added to any type of radio apparatus. Can be used in conjunction with the Crosley Crystal Receiver No. 1 and Crosley Audion Detector Unit, Crosley Harko Senior No. V, Crosley R. F. T. A., or Crosley Receiver No. VI. This unit increases the volume about one hundred times. Designed to match up uniformly with the above mentioned units, without tubes, batteries or phones—$25.00.

CROSLEY RECEIVER NO. X



In placing this receiver upon the market we are offering you a unit whose range, volume and selectivity are remarkable. Nothing can be compared with it at double the price. Developed in the Crosley laboratories, this unit combines tuner, one stage of tuned radio frequency amplification, audion detector and two stages of audio frequency amplification. As shown, without tubes, batteries or phones, solid mahogany cabinet—$55.00.

Crosley Receiver No. X is equivalent to Crosley Receiver No. VI and Crosley Two-Stage Audio Frequency Amplifier.

WRITE FOR CATALOGUE

Dealers and Jobbers who handle Crosley Apparatus, handle the best.

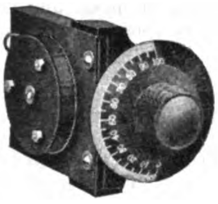
CROSLEY MANUFACTURING COMPANY

DEPT. R. 2 **CINCINNATI, OHIO**

RADIO APPARATUS **CROSLEY** RADIO APPARATUS

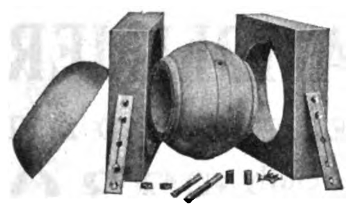
Better—Cost Less

CROSLEY R. F. A. T.



The Crosley Radio Frequency Amplifying Tuner is a new unit which takes the place of the Radio Frequency Amplifying Transformer and is much better. It makes possible sharp and efficient tuning over a broad band of wave lengths from 200 to 600 meters. The Crosley R. F. A. T. solves the radio frequency problem.

With instructions—**$4.00.**



CROSLEY VARIOMETER PARTS

These Variometer parts are made in our own large wood working plant on special automatic machinery, which enables us to not only offer them to you at a price reduction, but to make each part accurately.

Each Variometer set consists of two stators, one rotor and the necessary hardware, shown in the illustration.

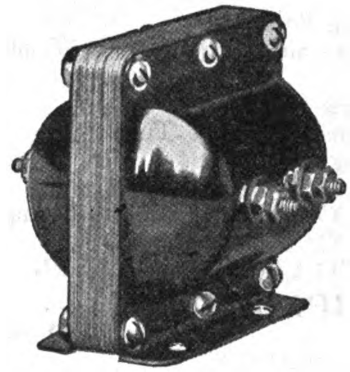
Made of poplar wood, well shellacked.. **$1.50**
Made of Mahogany.................... **1.75**
Winding form extra.................... **.30**

CROSLEY VARIO-COUPLER PARTS

The Crosley Vario-Coupler is made with the same accuracy as the Crosley Variometer, and is designed to function perfectly with it. Each Vario-Coupler set consists of a formica tube, rotor, and the necessary hardware for complete assembly.

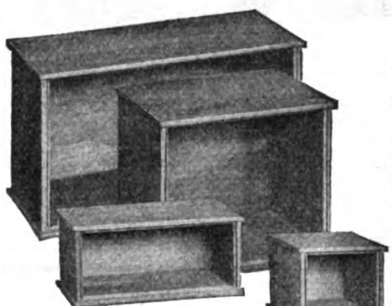
Complete as shown in illustration, ready for assembly—**$1.50.**

Also furnished completely wound and assembled complete with knob and dial "Better—Cost Less"—**$3.00.**



CROSLEY SHELTRAN

Incorporated in the design of the Crosley Sheltran are all the characteristics so essential and necessary to obtain the maximum amplification from the modern vacuum tubes used in radio work. These tubes, with their high amplification constant, operate most effectively at large fluctuations of the grid potential. The Crosley Sheltran is designed to accomplish these results, and tests have shown that the design is correct to insure maximum efficiency. Completely shielded—9 to 1 ratio. "Better—Cost Less"— $4.00.



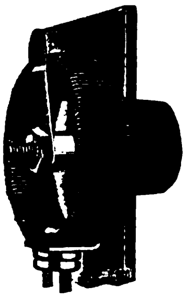
CROSLEY RADIO CABINETS

Realizing the demand for stock cabinets for those who build their own sets, we have developed a line of cabinets that are neat in design, attractive in appearance and finish, and of the best workmanship.

The Crosley Radio Cabinets are made of hardwood Adam brown mahogany finish.

Live dealers handle them—prices and sizes in our catalogue.

CROSLEY RHEOSTAT

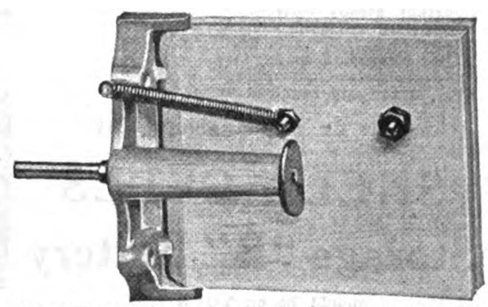


This rheostat permits exceptionally accurate and delicate variations of the filament current. With it the best possible results are received from expensive vacuum tubes.

Unique construction allows the Crosley Rheostat to be mounted on a panel of any thickness up to and including 3/8 in.

A special grade of non-corrosive wire forms the resistance and results in highly efficient service.

Furnished complete with newly designed tapering knob, pointer, etc.—"Better—Cost Less"—**$0.60.**



CROSLEY VARIABLE CONDENSERS

The Crosley Variable Condensers are unquestionably one of the most radical improvements in radio during the past few years. By using a Crosley Condenser, louder signals are obtained as it not only is simple and easy to tune, but also has less internal resistance and no body capacity effect.

Model A, .0005 Mfd. (Wood frame)...**$1.25**
Model B, as illustrated, .0005 Mfd...... **1.75**
Model C, .001 Mfd. (Porcelain Plates).. **2.25**

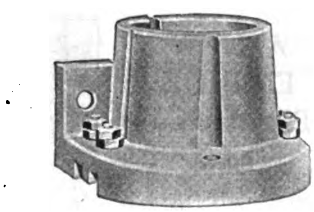
CROSLEY BINDING POSTS

These are made in three sizes—3/8 in. diameter, 7/16 in. diameter, and 1/2 in. diameter. They are all of the same design, however, as shown in the illustration.

No. 1.................. 5c each
No. 2.................. 7½c each
No. 3.................. 10c each

CROSLEY KNOB AND DIAL

Attractive and inexpensive. Crosley knobs and dials are extremely well made for all required purposes. The dials are made of solid hard rubber 2 13/16 in. in diameter with the letters and figures stamped into them and white enameled. Furnished Standard for 1/4 in. shaft or 3/16 in. shaft, optional —$0.40.



CROSLEY V-T SOCKET

This socket has been pronounced by many radio engineers the best socket on the market. Ever since its announcement its success has been phenomenal. Although the success has been largely due to the price, its real popularity is based on its high quality efficiency, service and practical unbreakability. Patents pending. Beware of imitators.

Made of porcelain for base, or panel mounting—$0.50.

WRITE FOR CATALOGUE

Dealers and Jobbers who handle Crosley Apparatus, handle the best.

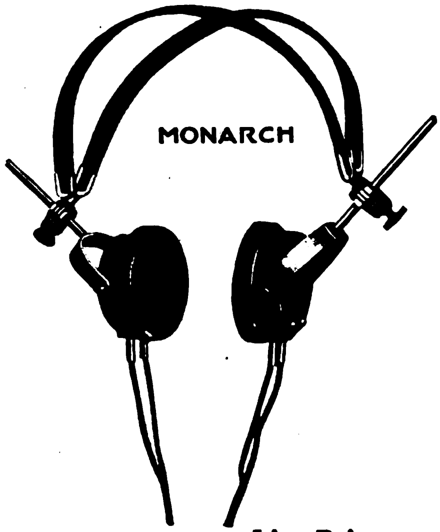
CROSLEY MANUFACTURING COMPANY

DEPT. R. 2 **CINCINNATI, OHIO**

Continued from page 90

feed-back circuit for the audion receiver, and Edwin H. Colpitts and his audion oscillator for generating modulated high-frequency waves, are inventors of more recent years than the ones previously treated in this manuscript. The luster of their contributions, however, is destined to be none the less brilliant than that of their predecessors. Already Armstrong is being heralded as the genius who made broadcasting of music and vocal speech by radio-telephony possible over the entire United States. The invention of Colpitts, for which a patent was granted in 1915, is designed to simplify the mechanism and strengthen the effectiveness of the apparatus required for the production of the modulated oscillations. The device consists of a repeater which acts as a generator of high-frequency oscillations, and also modulates these oscillations in accordance with the low-frequency signaling impulses to be transmitted.

"It Pays To Know Who Made Your Radio Head Set"



MONARCH
"Service"
RADIO
HEAD SETS

are built on the reputation of the Monarch Telephone Mfg. Co. and the experience of its Engineers who have spent over 25 years perfecting high quality communicating equipment. Dependability and your complete satisfaction are assured under these circumstances.

List Prices

Code No. 1-A 2000 Ohms—Bakelite.......	**$8.00**
Code No. 1-B 2500 Ohms—Bakelite.......	**10.00**
Code No. 1-C 3000 Ohms—Bakelite.......	**12.00**
Code No. 2-A 2000 Ohms—Composition....	**7.50**
Code No. 5-A 1000 Ohms—Single Head Set.	**4.50**
Code No. 15-A 100 Ohm—Watch Case Rec'vr	**3.00**

Jobbers Wanted in All Principal Cities

Monarch Telephone Mfg. Co.

Fort Dodge, Iowa

Dependable Equipment Must Answer Fall DEMAND

We distribute for

Radio Corporation of America
Murdock
Fada
Brandes
De Forest
Signal
Rhamstine
Clapp-Eastham
Cutler-Hammer
and others

The Radio Electric Co.

1427-29 LIBERTY AVE.
PITTSBURGH - - - PENNA.

RHAMSTINE*

Radio Frequency Transformer

Pat. Apd. For

$4.50

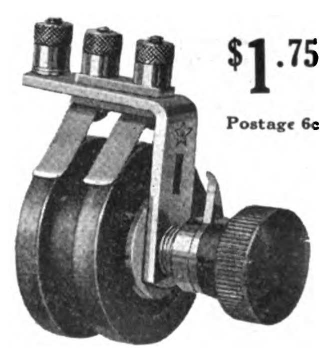
Postage 10c

The Rhamstine* Radio Frequency Transformer brings to the radio enthusiast a highly efficient unit, handsome in appearance, convenient in mounting and wiring, and surprisingly modestly priced.

The Type 1RF Transformer has a range of 200 to 500 meters—giving best results at the present broadcasting wave lengths. The transformer is fixed in the base with bayonet mounting, so instant changes of transformers for other wave lengths can be made.

In quality and performance, it leaves nothing to be desired; and its price makes it first choice in the field.

Carbon Element POTENTIOMETER



Pat. Apd. For

$1.75

Postage 6c

A Potentiometer in the circuit of a radio frequency set is necessary if full results are to be attained; and the Rhamstine* Carbon Element Potentiometer gives, we believe, a more uniform variation of potential than any other. It has all the advantages of the usual carbon element, yet it is unbreakable. Made for panel mounting.

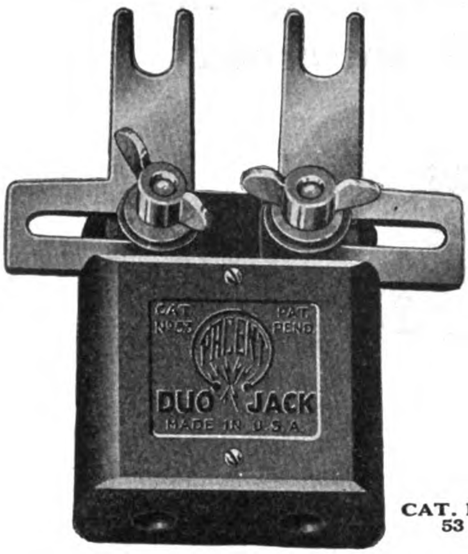
Send Today for Descriptive Folder

J. THOS. RHAMSTINE

2152 East Larned St. Detroit, Mich.

****Maker of Radio Products***

A New Member in the Pacent Plug and Jack Family



The Pacent Duo Jack

This new Pacent Radio Essential like all previous members of the Pacent Plug and Jack Combination, fills a definite existing Radio need.

The Duo Jack enables you to instantly convert an ordinary set equipped only with binding posts to a plug and jack set. It also facilitates connecting two pairs of phones or a loud speaker and a headset to your receiver.

The illustrations suggest many applications for this very ingenious device.

CAT. NO. 53 **LIST PRICE $1.50**

Showing Pacent Duo Jack with Two Plugs Inserted.

The Pacent Duo Jack will be in production by October 1. but dealers and jobbers are advised to place advance orders at the earliest possible date.

Outline of the Pacent Sales Plan upon request.

Pacent Radio Essentials Increase the Pleasure of Operating Your Equipment

Pacent Universal Plug
Pacent Twin Adapter
Pacent Audioformer
Pacent Radio Jack
Pacent Multi-Jack
Pacent Duo-Lateral Coils
Pacent Universal Detector Stand

Look for the Trademark

DON'T IMPROVISE—PACENTIZE

Send for descriptive bulletins

PACENT ELECTRIC COMPANY
INCORPORATED

Manufacturers and Distributors of Radio and Electrical Essentials

Executive Offices: 22 Park Place, NEW YORK, N. Y.

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PHILADELPHIA, PA. Bourse Bldg.
CHICAGO, ILL. 33 So. Clinton St.
WASHINGTON, D. C. Munsey Bldg.

Member Radio Section, Associated Mfrs. of Electrical Supplies

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FORMICA PANELS

CUT TO ORDER WITH SQUARE AND SMOOTH EDGES FROM HANDSOME, BLACK, POLISHED SHEETS 3/16" THICK

PRICE..........................021/2 PER SQUARE INCH

IMMEDIATE SHIPMENT—POSTAGE PREPAID

DAVID RADIO SUPPLY CO.

P. O. Box 596 REEDLEY, CALIF.

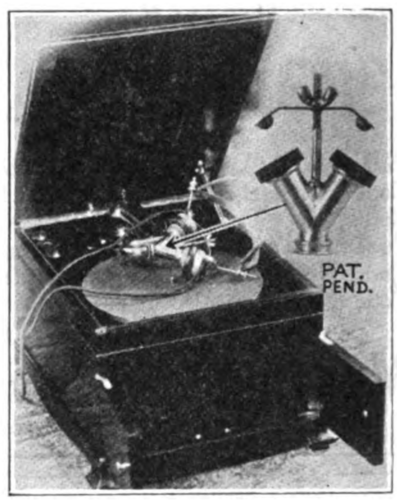
"BUILD YOUR OWN"

PHANTOM
CIRCUIT RECEIVER

This Marvel of Mystery, without aerial ground or loop, brings in Music instead of Static Showers. We consistently hear concerts on Magnavox from stations 100 miles distant, loud enough to be heard 150 feet from horn. The simplicity of this circuit will surprise you. Complete instructions, including price list of parts constants and photo of circuit sent prepaid for 60c. Stamps accepted.

VESCO RADIO SHOP
BOX 704 VACAVILLE, CALIF.

DUPLEX Victrola Attachment $5.00



An attachment of highest quality. Made for Victor, Sonora, Silvertone, Edison, Brunswick, Columbia and other machines having tone arms like the above. Holds any make of head phones firmly. The DUPLEX makes a fine loud speaker of your talking machine. Finished in highly polished aluminum and nickel. At your dealer or postpaid on receipt of price. W. B. McMASTERS
WHEELING, W. VA.

"SHAMCO PRODUCTS"

Amateurs: Send 5c in stamps today for our new Catalog L showing complete line of parts, raw materials and high grade apparatus.

Dealers: Write for our attractive proposition.

THE SHOTTON RADIO MFG. COMPANY, INC.
8 Market St. Albany, N. Y.

NEWS OF THE RADIO CLUBS

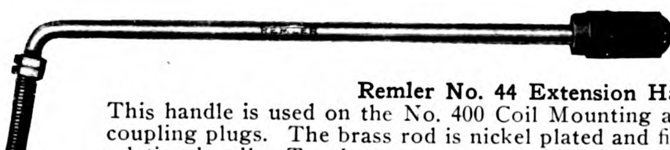
The Modesto Radio Club has published a new paper called *"The Oscillator,"* which contains interesting topics on radio. Laurance Babize (6APO) is in charge of a new phone set. The set is owned by Mr. R. G. Adams, dealer in Hudson and Essex automobiles, Fullerton, California. Three tubes (5 watters) are being used. The present radiation is 1.2 amperes on 200 meters. Anyone over 100 miles from Fullerton hearing 6APO on buzzer, voice or C. W., please QSL by radio or mail. All letters answered. The Club will not hold its regular semi-monthly meetings until late in the fall.

REMLER *Cunningham*

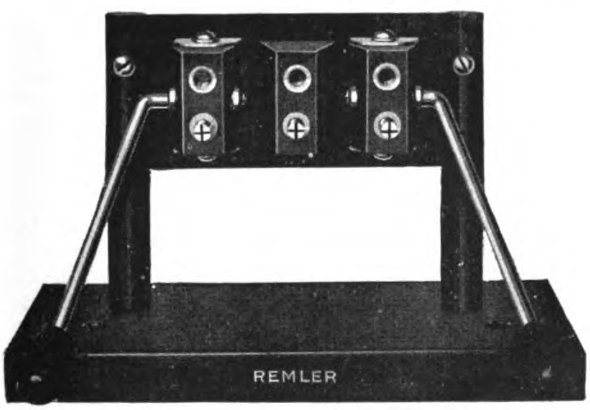
Remler No. 42 Bakelite
Panel Plug
Price 60c

Remler No. 43 Bakelite
Coupling Plug
Price 90c

Remler No. 46 Bakelite
Coupling Plug
Price $1.00



Remler No. 44 Extension Handle
This handle is used on the No. 400 Coil Mounting and fits No. 43 and 46 coupling plugs. The brass rod is nickel plated and fitted with moulded insulating handle. Two hexagon nuts provided for locking on plug. Length 5¼". **Price 30c**



Remler No. 400 3 Coil Mounting
The Remler No. 400 3 Coil Mounting is specially designed for the Giblin-Remler Inductance Coils, but is equipped with standard coil plugs and permits the use of any standard inductance coil. Bakelite Panel and Base. **Price $7.50.**

Specify Remler— It Radiates Quality

The Remler All BAKELITE 3 coil mounting is undoubtedly the most efficient coil mounting on the market. The special shape of the Plugs allows a coupling range from zero to 90 degrees. The use of the long, insulated handles for adjusting coupling keeps the operator's hands away from the coils and minimizes body capacity effects.

For those who desire to build their own sets Remler high quality BAKELITE panel and coupling plugs and Extension Handles are sold unmounted as listed above.

Send 10c for new 40-page Remler Catalogue just off press, containing circuit diagrams for Remler Apparatus and other useful information, including a table of inductance, capacity and wave length.

REMLER RADIO MFG. COMPANY

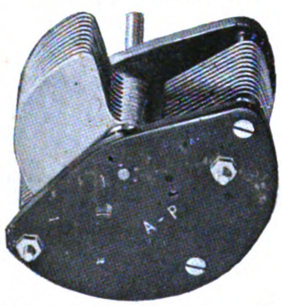
248 First Street, San Francisco, Cal. **154 W. Lake Street, Chicago, Ill.**

"Your final choice—why not your first?"

Radio Supplies A-P Receiving Sets

A-P Variable Condensers

"Your final choice—why not your first?"



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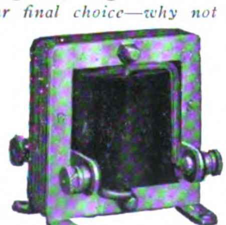

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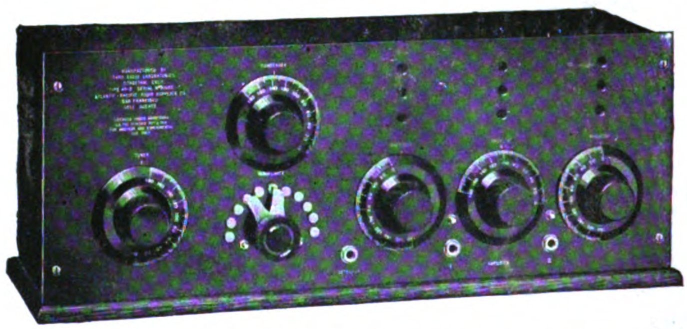

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Radio Supplies 646 Mission St. San Francisco Receiving Sets

RADIO

Established 1917 as Pacific Radio News

Volume IV *for* NOVEMBER, 1922 *Number 11*

CONTENTS *for* NOVEMBER, 1922

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Forecast of Contributions for December Issue

December RADIO will be the annual Christmas number and will consist of at least 116 pages of worth while information for the radio amateur. The Christmas spirit will be carried out in the story of "Sage Brush and Holly" by Earl Ennis, and in a dissertation on radio remembrances by S. P. Wright.

In the continuation of his excellent series on the practical radio operator, Volney G. Mathison takes up the wireless school, correspondence courses and the question of passing the examination for license. These helpful suggestions from an old-time brass-pounder have been hailed as the best of their kind yet written.

From the theoretical standpoint, A. Ford Greaves, engineer Federal Telegraph Co., has an excellent paper on "Simplified Theory of the Federal Arc Transmitter," which makes the subject clearer than does anything else yet published. Jesse Marsten has analyzed a universal formula for the design of inductance coils by which it is possible to figure the inductance of any closely wound coil with a minimum of calculation.

The next assignment of the University of California Extension Division correspondence course on Elementary Radio, prepared by Ellery W. Stone, will be somewhat more practical than the preceding lessons which were necessary to lay the theoretical foundations. They are concerned with single and double-slide tuners, variable condensers, loose-couplers, variometers and honey-comb coils, emphasis being placed on methods of operation.

Several articles will be of especial value to present or prospective owners of sending sets. Chas. K. Fulghum will discuss practical methods of obtaining high potential direct currents; Walter Emmett will try to answer the question as to whether shorter wavelengths are worth while and D. B. McGown will contribute on the subject of motor-generator sets. Mr. McGown is also writing a detailed description of how to make a two stage a. f. receiving set.

Some fine material will be presented on radio frequency application, including an announcement of the prize winners in the contest which closed on October 15th. Carlos S. Mundt will have a helpful article on the code and its difficulties. Donald K. Lippincott will analyze the use of auto-transformers for audio frequency. The usual departments and a host of other good articles will round out the issue to make it the best yet published. Because of the reported difficulties in getting copies from the newsstands we venture the suggestion that a personal subscription sent to your home will insure prompt receipt of all the good things in store during the year to come.

"Without going out of doors,"
said Lao Tzu,
"one may know the whole world!"
"Let a Grebe Receiver
bring the whole world to your evening fireside."
Doctor My.
GREBE RADIO

Paul F. Godley, designer of Paragon Radio Products, listening in

Godley Warns Radio Operators of Trouble This Winter

Paul F. Godley expects a chaotic situation in radio receiving this winter. Due to the delay in governmental regulation of broadcasting, operators of single circuit receivers are bound to have serious trouble. Mr. Godley says:—

"The coming season will see from ten to twenty times as many broadcasting stations as there were last year, all concentrating on one narrow band of wavelength. With a single circuit receiver, jamming and mixed messages are bound to result. Market reports, election returns, time signals, musical selections—all will be jumbled together in hopeless discord.

"The only way to cope with a situation like this is to use a three circuit regenerative receiver.

"For example, the Paragon three circuit receiver can select between broadcasting stations of about the same signal strength with less than one per cent differential."

The Paragon receiver is easy to operate. It provides a simple solution for an extremely difficult problem.

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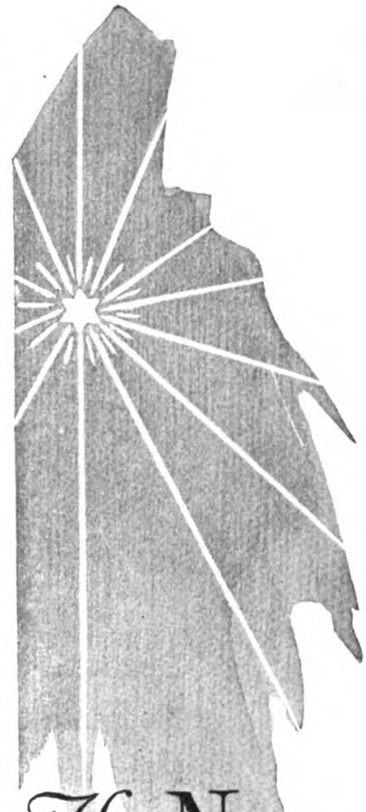
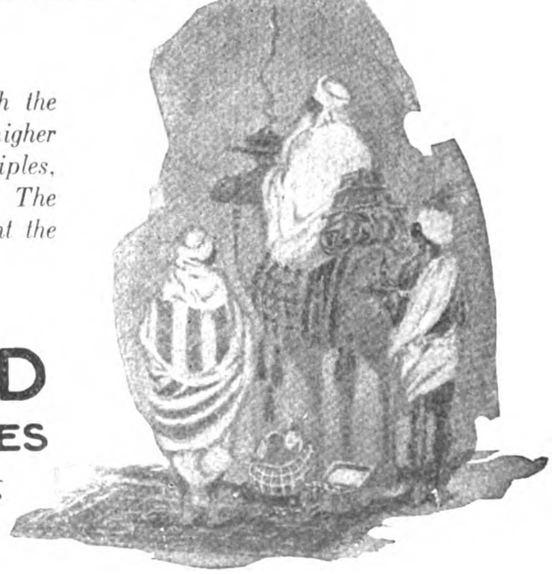


The New Star in the Radio World

LEADERS use the accepted rules and precedents, by which the majority bind their efforts, only as starting points for higher achievements. Mu-Rad Apparatus, embodying new principles, is the achievement of such a group of leading radio engineers. The very moderate prices of this apparatus makes the accomplishment the more noteworthy. Bulletin upon request.



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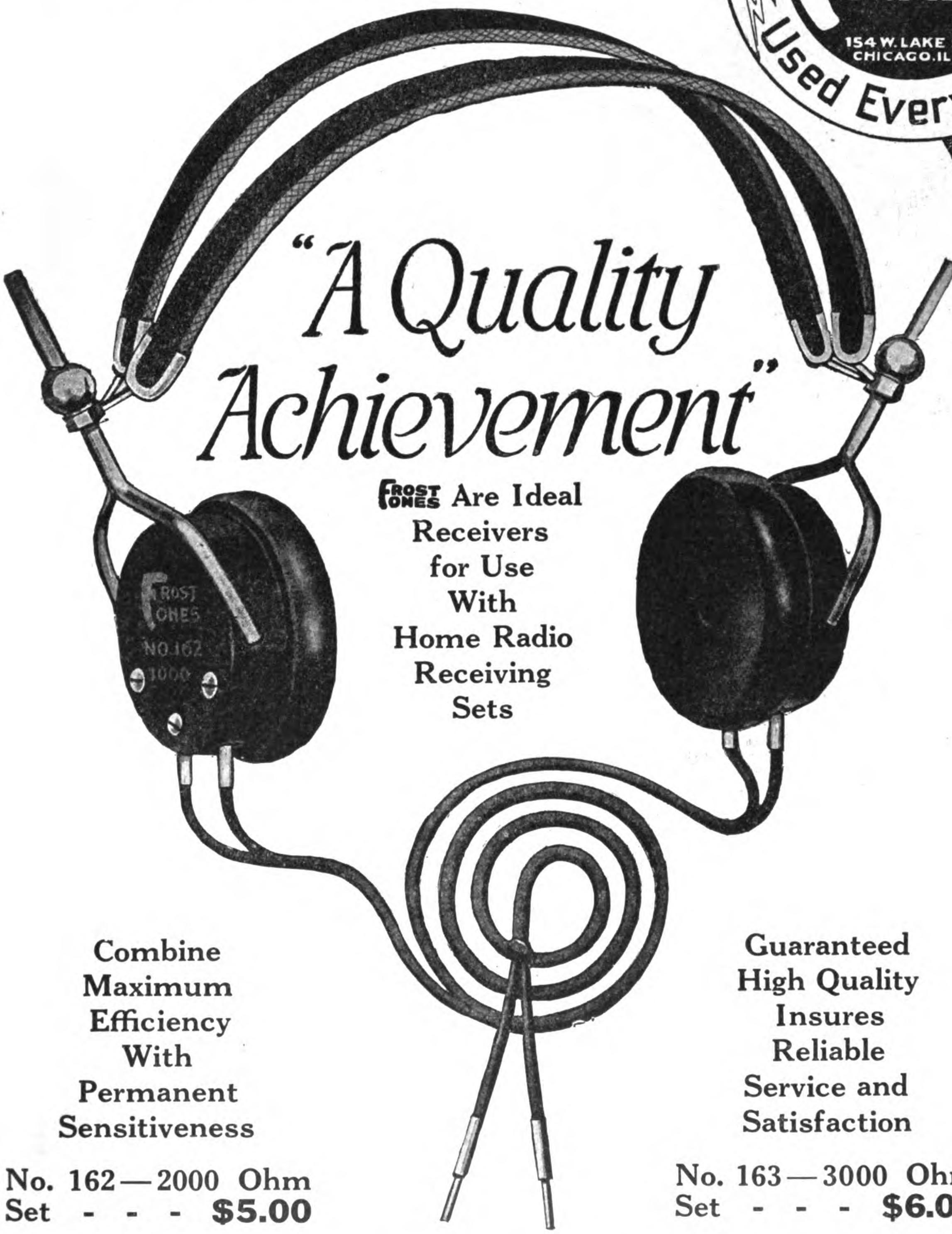

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Guaranteed High Quality Insures Reliable Service and Satisfaction

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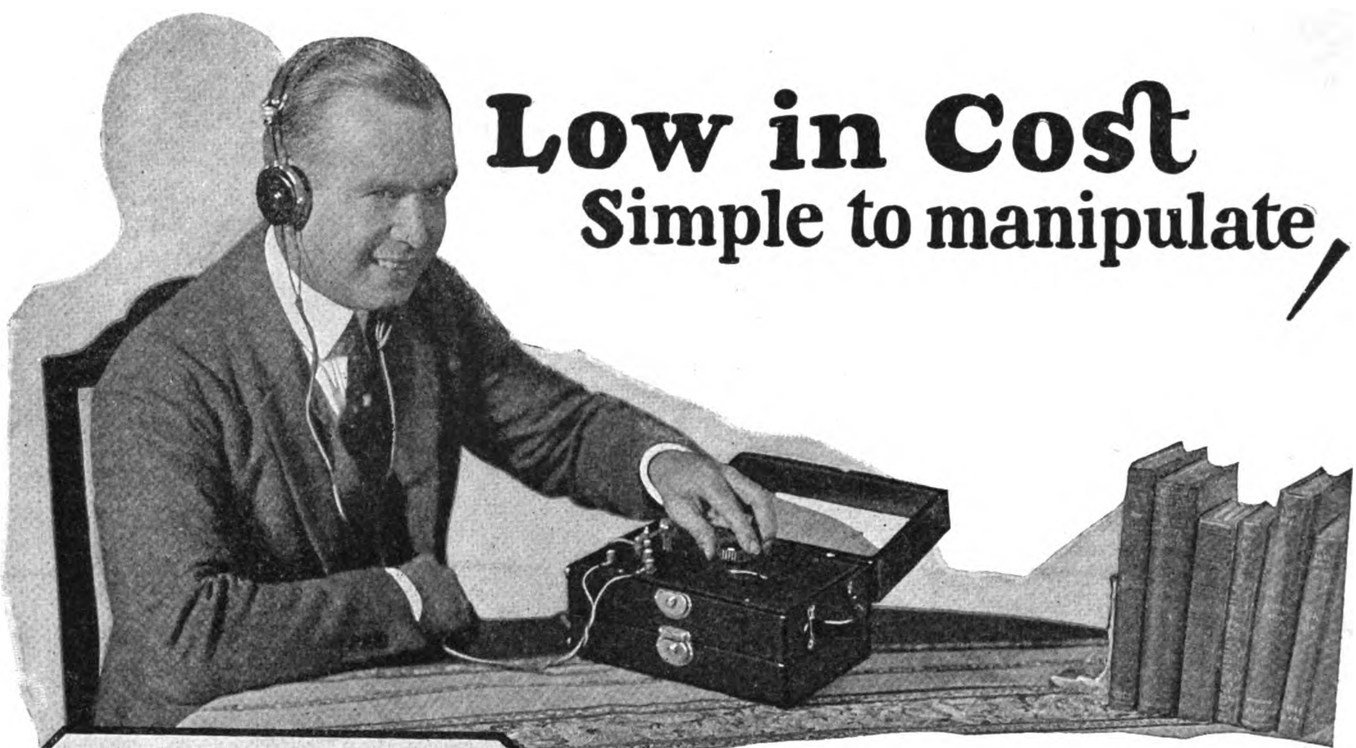

Opened like a book

Carried like a satchel

THE radio enthusiast who lives within ten to twenty miles of a broadcasting station has exactly what he wants in Radiola I (ER 753-A)—low cost, compactness, portability, and simplicity of manipulation.

Open the walnut cabinet, and on the front panel you find the tuning control, the crystal detector and the binding posts. In the body of the cabinet are the head-telephones. Tuck away the telephones, close the front panel, and you can carry the whole set as you would a satchel.

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For 35 cents you can obtain from your dealer or from us a copy of the book "Radio Enters the Home." It explains the principles, the fascination of radio in plain English. It describes Radiolas and their accessories. It contains the most valuable wiring diagrams ever published.

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November, 1922 | RADIO | Vol. 4 No. 11

Radiotorial Comment

THE encroachments of radio broadcasting on the privileges enjoyed by the amateur code operator are being met with a commendable spirit of co-operation by the amateurs. But the time is coming when an uninformed public will demand even greater concessions, unless steps are taken to impress the radiophone listeners with the value of the work that is being done by the amateur. To merit public consideration the amateur must serve the radio public to a greater extent than at present. How to do this is a problem worthy of the best minds in the amateur world.

A policy of aloofness, of grudging concession, and jealous backbiting will not accomplish the purpose. Better by far is it to welcome the novice into the radio ranks. Educate him to the amateur point of view. Get him interested by helping him.

A policy of aloofness, of grudging concession and jealous back-biting will not impress the radiophone listeners with the value of the work that is being done by the amateur. Better by far is it to welcome the novice into the radio ranks. Educate him to the amateur point of view. Get him interested by helping him.

Every amateur can do his individual part by being willing to help the novice install his set, by showing him how to operate it, and by telling him something about the theory of radio. Let him know of the amateur service in relaying messages free of charge, and in being prepared for national service in time of emergency. Collect and disseminate news in isolated communities. Hunt out the grouches, and find out if there is any reason for their complaints. If so, try to stop the cause. If not, tactfully show them where they are wrong. Let them know the amateurs are in the game to make radio a clean sport with no fouls and no hard feelings. Try to get people interested in better broadcasting and better programs. You can really get just as much fun and get far more for yourself in the form of information and friends by so doing than by asking Willie Jones, ten blocks away, how your signals are coming in. When you do transmit, ask Willie what he is doing to make the radio world safe for the rest of the people in it. By making your services invaluable to your neighbor, you can get anything you want from him.

All this can be better done collectively, than individually. Let the amateurs be the nucleus for radio clubs, whose membership shall be made up largely of novices. Every person who owns any kind of a receiving set will be the gainer by membership in such a club. The dealers will give you the names of all their customers if they know that the purpose is to help the novice. Call on these customers and invite them to the next club meeting. Make the meeting worthwhile by simple talks and demonstrations. Furnish tools for making sets, and stand ready to help the novice in making his own. Hunt up the "shut-ins" in homes and hospitals and lend them a club set to hear the news, concerts and church services.

There is no reason why the radio club should not be the largest and most influential club in town. The peculiar fascination of radio interests everybody. It provides a common topic that is the basis of good fellowship. We suggest that you read in this issue about what the "Round and Rounders" are doing in a small way at San Diego. The radio club room can well be the social center of a town or neighborhood. For radio is something that interests young and old alike.

Such an organized spirit of helpfulness will gain public approval and support. The churches, the Y. M. C. A., the Rotary, Kiwanis, Lions and similar clubs, and even the Chamber of Commerce, are glad to lend their aid to such a plan of boy-building. Let them know what radio is doing in keeping the boy off the street, and in keeping him busily engaged in improving his hand and mind.

Let the club be a leader rather than a follower in making and observing local regulations of the air. The Pacific Plan, for example, was initiated by the San Francisco Radio Club, and its members are the traffic officers in its enforcement. By stopping their sparks for a couple of hours nightly they are serving thousands of prospective radio fans, and incidentally the boys are getting a chance to prepare tomorrow's lessons and thus gain that parental approval which comes from good marks at school.

Talk and write about what you are doing. The local newspapers will be glad to publish it as human interest news, something that is making the town a better place in which to live. And when the time comes that you want something that votes or influence will get, you will have the backing of everybody.

In doing all this the amateur will be the gainer. He will learn two of the greatest lessons in life, that organized intelligent effort will get him further than by going it alone, and that "he profits most who serves best."

Radio Directs Big Construction Job

By Charles Heston Peirson

That radio is destined to win a commanding position as an industrial utility, besides its service as a home entertainer, is indicated in this story. What a boon would radio be in sustaining the spirits of imprisoned men in mine disasters as well as in supplementing the regular mine telephone service.

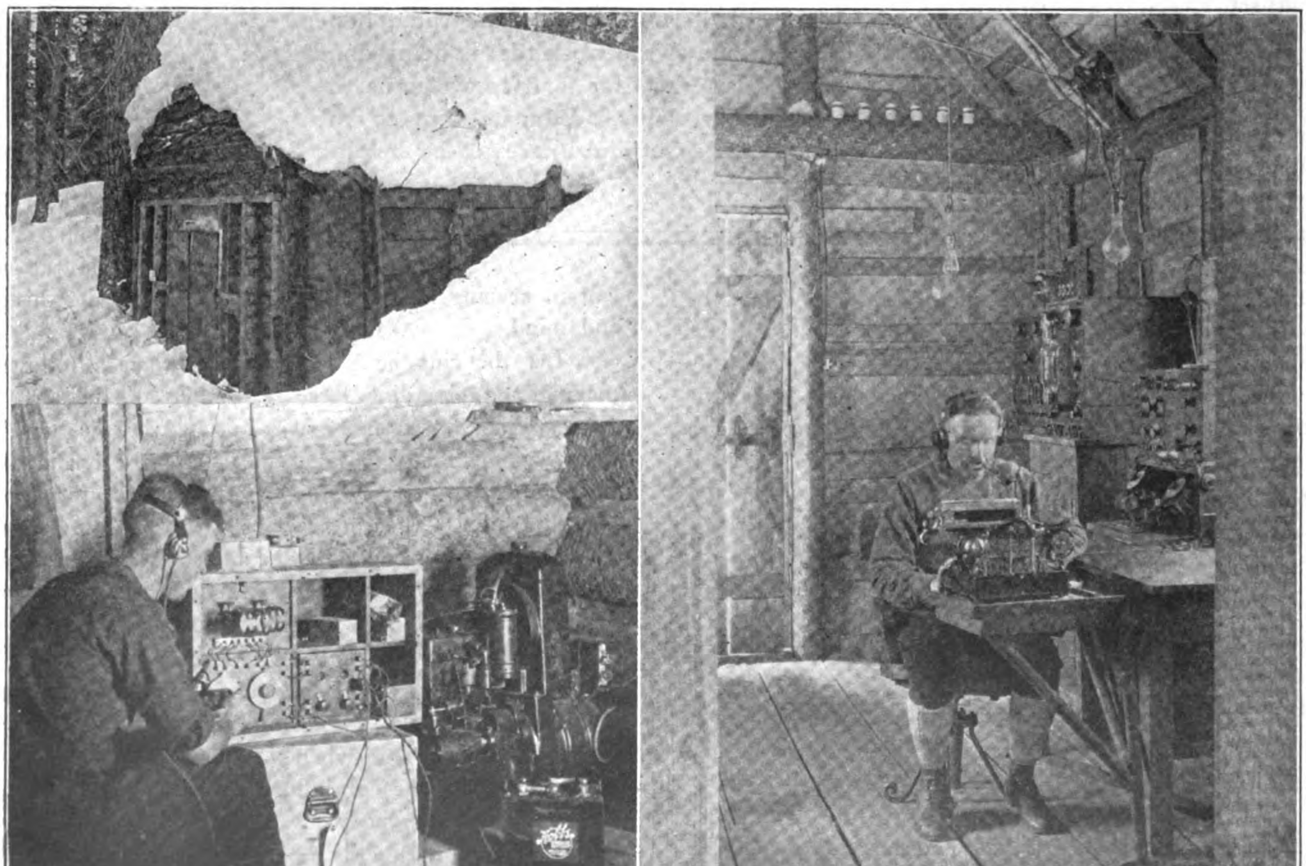
IN the dizzy altitudes of the high Sierra Nevada Mountains of Fresno County, California, radio will be used this winter to direct the activities of 500 men who will go into camp behind thirty miles of impassible snowdrifts to push forward during the winter the greatest piece of tunnel construction now in progress on the Western hemisphere. This tunnel is a part of the gigantic hydroelectric development project of the Southern California Edison Company, which is carrying on a program for the development of a million and a quarter horsepower of water power electricity derived from the San Joaquin River and Big Creek and other mountain torrents. One magnificent mountain lake over seven miles long has been impounded, and the program includes the impounding of water which will add three more mountain lakes to the chain which will be connected by the Florence Lake tunnel and a tunnel from Huntington Lake to Shaver Lake.

This winter over 5000 men will be on the job, including the 500 who will be marooned on the upper end of the long tunnel over the crest of the Kaiser Range. The direction of the marooned men will be entirely given by radio from the headquarters of the resident engineer at Cascada, the construction headquarters; much of the other work will be done under radio communication.

The success of radio was so thoroughly demonstrated during last winter, not only in directing the work of the men who are beyond wire communication, but in picking up and carrying on communication with the general offices of the Southern California Edison Company in Los Angeles, a distance of 270 miles from the outposts of operation, that facilities have been greatly improved in preparation for this winter's work and new and expensive apparatus put into service.

Due to conditions during the winter when snow and sleet storms are prevalent, it was found the telephone lines did not give reliable service. Therefore, the radio communication was decided upon and has proven satisfactory. There are now three combined radio, telegraph and telephone stations in operation and one more radio telegraph is being installed. The headquarters station at Cascada, is at an elevation of 5000 feet, in a canyon approximately 2000 feet deep, with abrupt walls on three sides. The second station is located at a construction camp on the shore of Florence Lake, which is the south portal of the great Florence Lake tunnel, at an elevation of 7000 feet, and about seven and one-half miles in an air line northeast of Cascada. The third is located at a construction entrance camp, over the Kaiser Range, which is about eight miles in an air line north of the south portal on Huntington Lake. This station is only about 300 feet higher than the portal station, but there is a mountain pass about 2000 feet high between them.

Continued on page 102



Views of radio stations in the high Sierra Nevada Mountains of Fresno County, California, where orders will be received for the direction of 500 men who will be marooned next winter, working on the Southern California Edison Company's great electric waterpower development.

How to Become a Professional Radio Operator

By Volney G. Mathison

Herein are practical directions whereby any boy from seven to seventy-seven can, with patience, learn to perfect himself at home in code sending and receiving. Many of the valuable hints given have not been published before. Even an experienced operator may gain some worth-while ideas by reading this article.

FROM the general discussion of commercial radio operating with which the preceding section of this series of articles has been occupied, it is purposed now to turn in a more distinctly instructive vein to a consideration of how to become a professional wireless operator by giving the reader a more detailed conception of the requirements which are to be fulfilled by the radio operator in the course of his daily work.

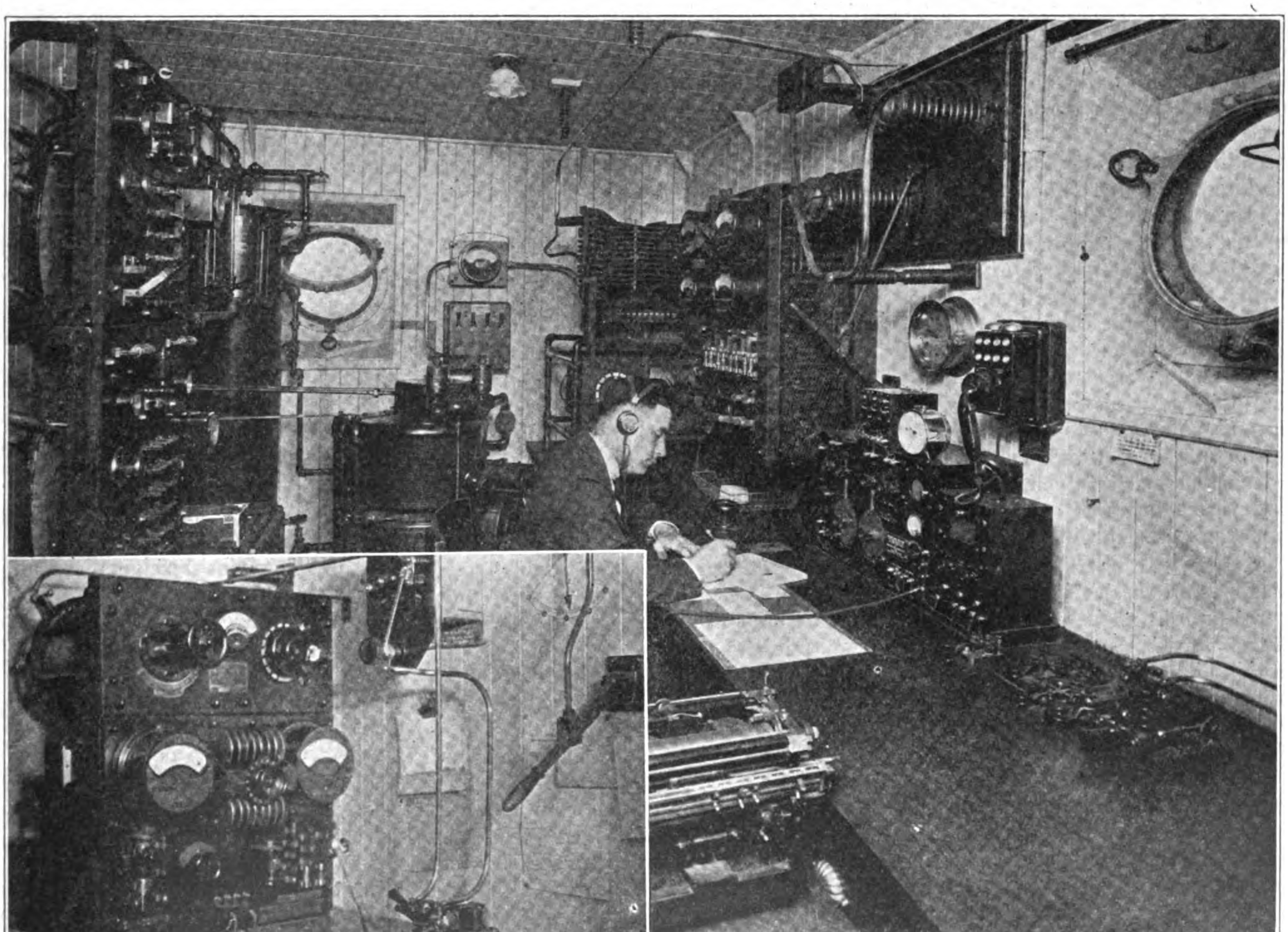
In conformity with this composite aim, the present section has been arranged, beginning with a view of the amateur set at home as a means for learning professional radio operating; consideration of the wireless school; a description of the procedure followed by the government in conducting the commercial radio-operators' license examinations, and some special information bearing upon the operator's proper conduct aboard ship.

The Amateur Set at Home

THERE is no better way to prepare to become a commercial radio operator than by experimenting at home with an amateur wireless outfit. By working with fellow amateurs a good sending hand is developed; receiving ability is rapidly acquired without tedious drill, and a certain ease and steadiness, an at-home-ness on the air, is attained. It is the lack of this last quality, it is that halting, stuttering, hesitating awkwardness, so exasperating to the old-timer who has to listen to it, that especially marks the operator trained entirely in a wireless school.

For this reason also—to gain a practical familiarity with commercial operating procedure—it is highly desirable that the prospective operator have a sending outfit as well as receiving apparatus. Where electric-lighting current is available, this is not a very expensive requirement. The experimenter, even though he feels that he can not well afford to buy ready-made apparatus, can nearly always manage to scrape together enough materials and parts to make up some sort of an outfit for himself at comparatively small cost.

As to the size of transmitter the learner should have, this depends upon his particular location with regard to other amateurs; to be able to work with a few fellow experimenters is all that is really necessary. When the student operator plans to spend more than forty dollars for his sending outfit, it is strongly recommended that CW or vacuum-tube apparatus be bought in preference to spark equipment. It is not in order here to attempt to detail the many advantages of the undamped transmitter, but one important point for the prospective operator to consider is



The elaborate radio room of a San Francisco-China greyhound. (U. S. Shipping Board "Lone Star State.") From left to right are audion and transmitter storage battery switchboards, five kilowatt arc, arc control panel, tuner, audion detector, and two-step amplifier. The inset shows a half-kilowatt auxiliary spark transmitter, which the cameraman had to stand in front of to get the big picture.

that a practical knowledge of vacuum-tube equipment is going to be valuable. Some home-made 10-watt tube sets costing hardly fifty dollars are working as many as a thousand miles.

For the learner, however, whose limited pocketbook obliges him to be contented with a very inexpensive outfit, and particularly for the country boy who has no electric current at hand, a small spark-coil set will be most suitable—provided, of course, that there are other amateur stations within its range. Where an audion detector and a one or two step amplifier is used at the receiving station, a quarter-inch coil, or a discarded automobile ignition-coil, will often cover twenty-five miles. Such coils are best connected directly across the aerial and ground, and if the aerial is short enough to permit the insertion of a small inductance (three to eight turns 6 ins. in diameter) in the lead-in, immediately next to the spark-gap, a sharp, legal wave will be obtained.

Desirable as is some sort of a sending set, however small, if the student's means are very limited, it may be dispensed with. But it is at least necessary to have a practice set, consisting of a buzzer, sending-key, and dry-battery, for drill in sending. Indeed, even when the operator has a transmitting outfit, he should not fail to practice conscientiously on a small buzzer set. Good sending is as hard, and for many operators much harder, to acquire than good receiving.

By sending, the writer does not mean the jerking, limping, hopping, miss-spaced, spluttering shower of dots and dashes that some "operators" fatuously imagine to be sending. During the war, when any sort of radio operators were scarce and the license examinations therefore relaxed, some of the stuff on the air was a maddening combination of a St. Vitus dance and a hen-cackle, and when an old shellback had the misfortune to get tangled up in a mess of it, he generally emerged in a frenzied frame of mind suitable to an assassin or a bomb-thrower.

It is true that there is much less poor sending on the air now than there was three or four years ago. The present slump in shipping has resulted in the weeding out of most of the war-time makeshift operators, but the improving quality of the "stuff" on the air is especially owing to the fact that since 1920 the government has required transmitting as well as receiving tests in the commercial license examinations. I have been informed by one radio inspector that in his office more candidates for commercial licenses fail in the sending than in the receiving tests.

There is only one way to acquire a good sending hand—by practice. Take a book, a magazine, any printed matter, and send it on the buzzer set; send it by the page. About one hundred thousand words transmitted painstakingly and accurately ought to develop a respectable sending hand.

The student should never attempt a display of speed in sending; nothing else will ruin his style so quickly and so irretrievably as too much haste. It has been asserted that the learner should not send any faster than he is able accurately to receive—a better rule is to send no faster than can be done without breaking or making a mistake oftener than once in every fifty or one hundred words.

A great deal of mediocre sending is also due to an excessive sending-key tension and an incorrect grip on the key-knob. The proper position of the hand over the key is with the first finger on the center of the knob, the second finger resting also on top of the knob or against the right-hand edge, the two remaining fingers unused and gently relaxed, and—most important of all—the thumb resting underneath the rim on the left-hand side of the knob. This position of the thumb against the under side of the knob rim is essential; without it the sender has no true grip on his key. It is not material whether the third finger be kept lightly against the side of the key-knob or relaxed with the little finger, but I think the latter position is the easiest and fastest. If this key control feels awkward, it indicates that the operator has adopted an incorrect grip in the beginning, and if the correct position is maintained for a short time, it will become most natural.

The arm should never be held up in the air; it should lay on the desk, absolutely relaxed, and the key must be held with an easy firmness and with never the slightest straining of any muscle. The key tension, too, should always be light, the thumb under the rim of the knob being depended upon to bring the key up after each depression. A stiff key means not only stiff sending but a strained wrist, and this is possibly a cause of telegraphers' paralysis.

Some operators send readable stuff with only one finger on the key knob and without using the thumb under the rim, but this almost invariably results in a style of sending that has been aptly described as "tapping." It lacks the accuracy, the masterful smoothness, the full-rounded dots and dashes of the expert.

Another important point in sending, too, is to maintain an even speed and an even spacing between consecutive letters. The practice of spacing some letters too far apart and jamming others too close together, combined with a constantly varying speed, produces that unpleasantly manneristic "oil-tank swing" of which some operators who have been in the game long enough to know better are inordinately proud. Really good sending flows along with the steady precision of a smooth-running machine.

The Receiving Set

THE novice will naturally employ his buzzer practice set in memorizing the code, but beyond that, unless he has some one to send on it for him, the buzzer outfit is of no value in the acquirement of receiving ability. There is but one way to learn to receive, and that is by listening to some one else's sending. The best way to do this is with an amateur receiving outfit.

The student, after memorizing the code, will begin by listening to those amateurs within range of his receiving instruments who send most slowly, or —and this is incomparably better when the necessary apparatus can be afforded —to some of the slow speed high-power arc and alternator stations engaged in trans-oceanic work. As the learner's receiving speed approaches twenty words a minute, he may gradually turn from the slow senders to faster, and it will especially be worth his while then to listen in on shipboard stations, as by doing so he will become familiar with the procedures followed in handling the various classes of commercial traffic.

It is not necessary for the student to have a large and expensive receiving outfit, and, in fact, if he is a beginner in radio, it is best for him to commence with a simple set. The novice unaccustomed to handling wireless instruments—unless he has an experienced radio amateur friend to help him—is liable to have a great deal of trouble getting a complicated outfit to work. Beginning modestly, the experimenter with increasing knowledge can install additional units from time to time, and in this way gradually elaborate his set to whatever extent he desires.

For the student who lives in or near a coastal city where there are many commercial and amateur stations at close range, a double-slide tuning coil, or preferably a small loose-coupler, a fixed condenser, silicon detector, and a pair of telephone receivers are all the instruments necessary.

With the exception of the telephone receivers, this equipment may be constructed by the learner himself, but there is so much good apparatus on the market at reasonable prices that the student will effect no appreciable saving in making his own instruments. The apparatus mentioned above can be purchased in the radio stores for less than twenty-five dollars, and unless the student is an exceptionally good mechanic, the factory-built equipment will work and look better than anything he can make for himself for the same amount of money spent on materials and parts. The tuning-coil or loose-

Continued on page 46

Transmitters, Receivers and Tuning

By Ellery W. Stone

This constitutes the third and fourth assignments of the correspondence course in Elementary Radio being conducted in co-operation with the Extension Division of the University of California. Question sheets, corrected papers and supplementary data are supplied to students enrolled in the course. Full information may be obtained by writing to the Extension Division at 301 *California Hall, Berkeley, Calif.*

IN our last assignment, we studied the great family of electromagnetic waves and observed that for the production of waves of any type—whether electrical, such as radio, heat or light waves, or mechanical, such as sound or water waves—it is necessary to have some vibratory or oscillatory source which, by virtue of its own vibration or oscillation, sets up a vibratory motion, or waves, in the medium which that particular oscillatory source can disturb. In the case of water waves, we have seen that it is only necessary to disturb the surface of a body of water by dropping a stone into it or by producing a similar disturbance. With sound waves, we disturb the air, which is the medium for transmission of these waves, by the vibration of the human vocal cords—in the case of speech—or by some similar action.

With electromagnetic waves, it is helpful to use the conception of the ether as the conducting medium, although, as we have seen, there is some question as to whether this mysterious ether really exists; and we have observed that for the production of waves in this medium it is necessary to have a vibrating electrical circuit or a circuit carrying a vibrating or alternating electrical current.

In the transmission of radio waves, then, we must generate electrical currents within the range of the frequencies which are necessary for the efficient propagation of radio waves, because the frequency of the waves is exactly that of the vibratory source which produces them. We learned in the last assignment that radio frequencies are those between approximately 10,000 and 1,500,000 cycles per second, so that our radio transmitter or transmitting station must contain electrical circuits capable of producing currents of frequencies within that range.

In the first assignment, we learned that a Leyden jar or condenser has the property or *capacity* of storing electrostatic energy: "A condenser is charged by connecting the two metallic coatings to a source of electricity so that one coating acquires a positive charge and the other a negative one. It is discharged by connecting the two coatings through a conducting wire." It is the nature of this *discharge* of a condenser which is of especial interest to us.

As early as 1842, Joseph Henry (after whom the unit of induction was named) discovered that when a condenser is discharged, the discharge current is not direct current, like the current which is used to charge the condenser, but *alternating* current. Furthermore, the frequency of this a. c. discharge, with condensers and conductors of average dimensions, is within the range of radio frequencies specified above. The discharge of a condenser, therefore, is suitable for the generation of radio waves and we shall find that this fact forms the basis on which all radio transmission is conducted.

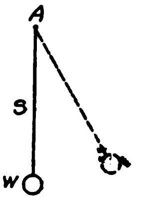


Fig. 7. Vibrating Pendulum

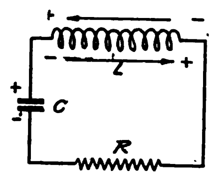


Fig. 8. Condenser Discharge

Before proceeding further, however, let us examine the nature of this oscillatory discharge of a condenser.

You are familiar with the fact that when an ordinary pendulum, simply a weight, *W*, suspended by a cord or stick, *S*, which is supported or pivoted at one end, *A*—see Fig. 7—is drawn to one side, it acquires potential or static energy by virtue of its displacement from the vertical. In other words, when the pendulum is pulled to the position shown in the dotted lines, the force of gravity tends to pull the weight back to its original vertical position at rest. This is similar to charging a condenser with *electro*static energy. The condenser may be considered at rest when it is uncharged but it acquires static energy when it is charged.

Now if we release our displacement pendulum, the weight or bob does not slowly settle down to its normal, vertical position, but vibrates back and forth, each swing becoming a little shorter in length, or *amplitude* as we say, until finally all of its energy is dissipated and it comes to rest. The pendulum would swing forever, giving perpetual motion, if it were not for the resistance or friction offered by the air to the bob and stick and for the lesser friction at the point of support, *A*.

The inertia of the bob and its support thus tends to carry the pendulum past the vertical position on its first and subsequent swings, so that a vibratory motion of the pendulum results. If the pendulum were dipped into a heavy oil or light grease, however, the additional friction offered it would cause the pendulum to settle down slowly to its normal position—it would not oscillate.

Let us suppose that we charge a condenser and proceed to discharge it through the circuit shown in Fig. 8, consisting of the condenser, *C*, in series with an inductance, *L*, and a resistance, *R*. Consider that the upper plate of the condenser is charged to a positive potential, as shown, and that the lower plate is charged negatively. Now, since there is an inductance in the discharge circuit, the momentary flow of current through it in the direction of the lower arrows, induces a back E.M.F. across its terminals (see first assignment) which is represented by the positive and negative signs at each end of the inductance, *L*, and above it. This back E.M.F., as we learned in the first assignment, tends to oppose the flow of discharge current as it builds up in the circuit by means of a counter current, whose flow is indicated by the upper arrow. The direction of the discharge current flow from positive to negative is indicated by the lower arrow. The reduction of the condenser charge and the dropping of the discharge current toward zero are equivalent to the pendulum's approaching the vertical position on its first downward swing, in which position the pull of gravity (so far as causing motion is concerned) is zero. As the condenser charge is reduced and the discharge current drops toward zero, the back E. M. F. reverses to the polarity shown by the positive and negative signs *below* the inductance. This new induced E. M. F. tends to set up a current flowing in the circuit in the same direction as the discharge current of the condenser, indicated by the lower arrow, so that the current in the circuit instead of stopping when all of the positive charge has left the upper plate of the condenser, continues until the induced E. M. F., indicated by the lower positive and negative signs, is dissipated.

The property of an inductance, therefore, by virtue of which it stores up electromagnetic energy and restores it to the circuit, as evidenced by the above, may be likened to the inertia of the pendulum. In fact, it is sometimes called the electrical inertia of such a circuit.

Due to the fact that the induced E.M.F. across the inductance maintains a current in the circuit, after the initial positive and negative charges on the condenser have been dissipated, toward the lower plate and away from the upper one, the lower plate now acquires a positive charge and the upper plate a negative one. If it were not for the resistance of the inductance and the resistance of the circuit, represented by *R* in the figure, the new, reversed charges on the condenser plates would have the same values as the original charges. As a matter of fact, however, they are a little less, depending upon the resistance in the circuit, just as the pendulum on its first upward swing does not rise quite to the height of its original displacement. The resistance of the inductance and of the circuit is similar to the joint resistance or friction of the air and at the pivot in our pendulum experiment.

Now that our condenser has acquired a new charge, but of opposite polarity, it discharges again, but in the opposite direction. The whole process of charge and discharge of electromagnetic energy then repeats itself, and the current in the circuit continues to oscillate back and forth, similar to the swings of our pendulum, until the resistance of the circuit finally brings the circuit to rest—the oscillating current to zero.

We say that the friction of the air and the bearing checks or *damps* the vibrations of the pendulum, and it swings are called *damped vibrations.* If there were no friction offered to the vibration of the pendulum, or if fresh impulses were continually imparted to the pendulum at the end of each swing to compensate for the effect of friction, as in the case of a clock, the pendulum would swing constantly, with its vibration *undamped.*

The same terms are applied to the oscillatory discharge of a condenser. If an initial charge is imparted to a condenser and the condenser is then allowed to discharge itself fully without receiving additional charges before its original energy is dissipated, we call its oscillating discharge current a *damped* alternating or oscillating current. But if the condenser receives a fresh charge after each *cycle* of discharge current, without waiting for the electrostatic energy originally stored in the condenser to become completely dissipated, the discharge circuit will continue to oscillate as long as these recurring and properly timed fresh charges are imparted to it. The oscillations in the latter case will be similar to the swinging of a clock pendulum. The clock "works" give a fresh impulse to the pendulum after each *complete* swing (both directions); since there is no decrease in amplitude, the oscillations are *undamped.*

We have seen in this assignment that the frequency of the electrical current set up by the oscillatory discharge of a condenser "is within the range of radio frequencies specified above" (10,000 to 1,500,000). The frequency of the oscillatory discharge of a condenser is given by the formula:

$$f = \frac{1}{2\pi\sqrt{CL}} \qquad (2)$$

where *f* represents the frequency, π the numeric 3.1416 (the ratio of the circumference of a circle to its diameter), *C* the capacity, usually measured in microfarads, and *L* the inductance, measured in centimeters or milli-henries.

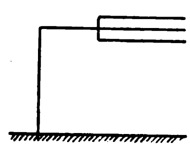


Fig. 9. Antenna

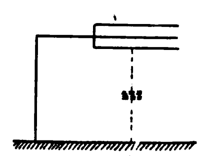


Fig. 10. Capacity Effect of Antenna

Thus, the resistance, *B,* of Fig. 8, is seen to have no effect upon the frequency of the discharge current of the condenser *C.*

We observed in the first assignment that the inductive reactance in an alternating current circuit can be neutralized or annulled if the capacitive reactance of a condenser in series with the inductance, as in Fig. 8, has the same value of reactance, but of course of opposite sign.

In the first assignment, we learned that the property of an inductance by virtue of which it tends to limit the passage of alternating current through it, is due to the back E.M.F. generated across its terminals. Since, as we have also seen, the induced E.M.F. depends upon the frequency of the alternating current generating it, it follows that the inductive reactance of a given coil increases with the frequency. Conversely, capacitive reactance decreases with the frequency.

In Fig. 8, in which the condenser is allowed to discharge itself after receiving an initial charge, the circuit is called a "freely *oscillating*" circuit. That is, the charging source having been disconnected from the condenser, the current in the circuit oscillates until the original energy is completely dissipated. It is interesting to note that the frequency of the discharge current, as given in equation (2), is that which automatically, we might say, gives equal values of inductive and capacitive reactance, so that in a freely oscillating circuit, the combined inductive and capacitive reactance is zero and the impedance of the circuit is equal to its resistance. (See first assignment.)

In the above, we have seen that electrical currents of radio frequency can be generated by the oscillatory discharge of a condenser in a circuit containing inductance. As a matter of fact, however, the discharge current will not oscillate if the resistance of the circuit, *R* in Fig. 8, is greater than a certain value, just as the pendulum will not oscillate if it is immersed in a very heavy liquid. It is necessary, therefore, to have a condenser or capacity in all radio circuits in order that these radio frequency currents may be set up or may flow therein with minimum impedance. At the transmitter, the device or circuit which radiates the electromagnetic waves is simply an enormous condenser whose discharge gives rise to radio frequency currents in such a way that waves can be most efficiently generated. We call this large condenser the aerial or antenna.

The Antenna-Ground Circuit

WE learned in the first assignment that a condenser or capacity consists simply of two metallic surfaces, separated by an insulator or dielectric. We have learned in this assignment that the oscillatory discharge of a condenser through a circuit containing an average amount of inductance is of the proper frequency, anywhere between 10,000 to 1,500,000 cycles per second, to give rise to radio waves.

As shown in Fig. 9, the antenna or aerial in a radio transmitter consists of an elevated metallic portion, consisting of from one (in the case of receivers) or two (in the case of transmitters) wires to four or more. These are stretched between two supports some distance above the ground. In addition, the antenna comprises a wire leading down from the aerial wires and called the *lead-in,* and a connection to the earth. The elevated wires thus constitute one plate of the condenser, the ground is the other plate, and the air between the two acts as the insulator or dielectric. The capacity effect of the aerial is represented in Fig. 10, as shown, by a condenser drawn in dotted lines.

Under the subject of radio transmitters, we shall learn in a later assignment how energy is supplied the antenna circuit, the equivalent of charging a condenser, and how the oscillatory, discharge current sets up radio waves. Before considering the actual imparting of energy *to* the antenna, however, we shall consider that the aerial has been charged and is now oscillating with a current of radio frequency flowing therein, and shall examine the phenomenon of wave radiation and propagation.

Continued on page 60

A 200 to 20,000 Meter Radio Frequency Amplifier

By H. E. Parsons, Can. 5 E. H.

This is one of the entries submitted in the radio frequency amplifier contest which closed Oct. 15th. For originality of design and construction it is an excellent model. The excellent results reported may be due in part to the author's use of French valves. This and the other entries are now in the hands of the judges, whose decisions will be published in December RADIO.

THE main question confronting the amateur who desires to build a radio frequency amplifier is what type to use. From the point of view of wavelength range, the resistance coupled radio frequency amplifier would seem to be the best. Unfortunately, this type is of little use on short wavelengths. A little calculation will show the reason for this. Suppose, for example, we use a plate resistance of 100,000 ohms and that the stray capacity of the set, that is the capacity between the plate and the rest of the output circuit, is about .000011 mfds. The effective impedance at a wavelength of 6000 meters is then 76,100 ohms—a reduction of 24% as compared with the value of the plate resistance alone. At 200 meters the effective impedance would be 9697 ohms, a reduction of 90%. We find also that doubling the plate resistance will not increase this value by much, besides necessitating an increase in the B battery voltage.

The only other choice is either a transformer coupled or a tuned impedance coupled amplifier. Either of these types will respond to short wavelengths, but personally I prefer the transformer coupled type. Unfortunately, however, the transformer coupled amplifiers at present on the market will respond only to one narrow band of wavelengths.

If, however, we can design a radio frequency amplifier with as wide a range as the resistance coupled type, and including the short waves, we have an instrument which would combine advantages of both types.

The instrument to be described is a transformer coupled amplifier with a range of from 200 to 20,000 meters. Thus it combines the wide range of the resistance type and, in addition, the short waves, with the advantages of greater sensitiveness and selectivity of a transformer coupled amplifier. This desirable result is accomplished by means of a special type of detachable air core transformer.

As the transformers are perhaps the most important part of the amplifier, I will take up their design and construction first, and then show how they can be incorporated into a set. They can be seen in Fig. 4. The center one is in place and the others have been removed and put on top of the cabinet to show the mounting. As can be seen from Fig. 1, I use standard R valve sockets for the transformer mountings. If these cannot be obtained, any other style of four pin mounting could be used—say two honeycomb coil plugs mounted side by side, or an American valve socket, though in this case the plug on the transformer would be a little harder to make.

The bobbins, which may be made of bakelite, maple, or other hard wood, are all 2½ ins. outside diameter and ½ in. thick. Turned in the periphery is a groove varying from ⅛ to ¼ ins. wide and from ⅛ to ½ ins. deep, depending on the wavelength. The primary and secondary are wound in this groove. Two methods of winding are available—first, the two wires may be wound in at once, or, and this is the way I prefer, the primary may be wound on first and then a few turns of varnished paper, followed by the secondary. The size of the wire may be from No. 38 to No. 40 enameled or single silk-covered. After the transformers have been permanently adjusted, a strip of thin fiber ½ inch wide should be shellaced over the groove.

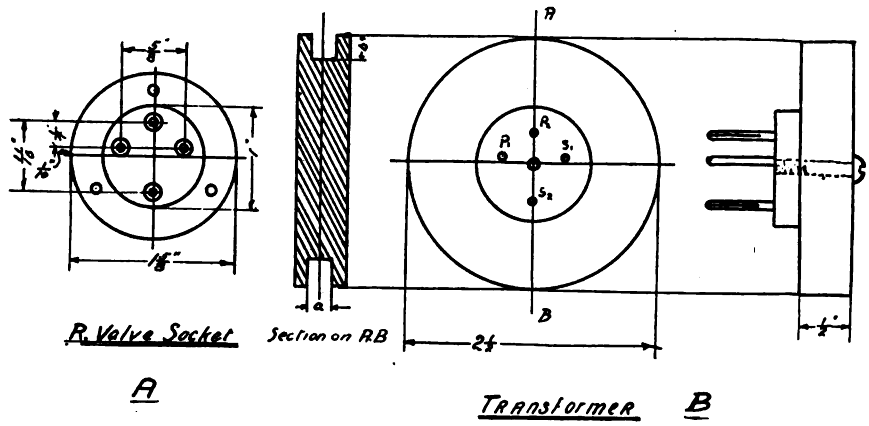


Fig. 1. Details of Transformer Mounting and Construction.

In order that the point of maximum amplification may be shifted over a band of wavelengths, the primary is shunted by a variable condenser of about .00025 mfds. The condensers may be made of five semicircular fixed plates 3½ ins. diameter and four movable plates 2⅜ ins. diameter. If you do not care to, or have not the tools to make these variables, a 21 plate "Tresco" with half the plates removed and two spacers between each plate will be about right. If these condensers are not used the winding of the transformer must be adjusted accurately to the required wavelength and the amplification will fall off rapidly at each side of the maximum point. With the condensers the point of maximum amplification can be shifted over a band of about 200 meters. When the point of maximum amplification is adjusted in this manner so as to coincide with the wavelength of the signals to be received, there is, of course, a marked gain in selectivity, since signals on other wavelengths will not be amplified to the same extent.

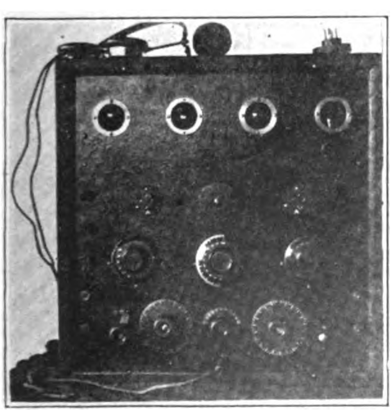


Fig. 4. Front View of Panel.

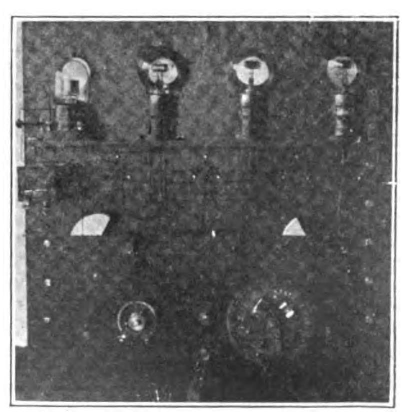


Fig. 5. Rear View of Panel.

Accurate details of the number of turns of wire for any particular wavelength cannot be given, as several factors influence this. The thickness of the paper between the coils and the tension on the wire, as well as the quantity of shellac on the winding affect the electrostatic capacity between primary and secondary and any change in the spacing of the two windings will alter the wavelength at which maximum amplification takes place. It is therefore impossible to give winding details which will without question, give any desired wavelength for maximum amplification, and so the final adjustment must be made experimentally. For around 300 meters I use 50 turns of No. 38 on the primary and the same number on the secondary, for 600 meters and 1000 turns of No. 38 on the primary and secondary. Other transformers have 200, 400, 650 and 1,000 turns each on the primary and secondary. For the very long wave stations, like Lyons and Bordeaux, 2500 turns of No. 40 are about right for each winding.

The wavelength of an individual transformer can be measured by the following method. Connect up one winding of the transformer across the grid and negative end of the filament of a valve and leave the other winding open. In the plate circuit of the valve connect the telephones and B battery. Place a buzzer actuated wavemeter near the transformer and pick up its signals. Adjust the wavelength of the buzzer signals for the maximum sound in the phones, weaken the coupling and retune till there is no doubt about the point. The wavelength indicated by the wavemeter is the approximate natural wavelength of the transformer. When the transformer is mounted in the set the wavelength will be slightly different due to the capacity of the leads. On the shorter wavelengths the natural wavelength of the complete set will be considerably higher owing to the effect of the tickler coil. If no wavemeter is available the set will have to be tuned by experiment when completed by tuning in a station of known wavelength.

When the set is completed there is a fairly simple method of measuring the natural wavelength and the amplification constant, but it is rather beyond the scope of this article.

Figures 2, 4, and 5 give an example of these transformers applied to a four-valve set consisting of 3 radio frequency amplifiers and a detector, which, with eight or nine transformers to a stage, will cover all wavelengths from 200 to 20,000 meters. A wiring diagram is given in Fig. 3, and the layout, including the principal dimensions of the 18 in. by 18 in. by 3/8 in. panel in Fig. 2. The valves for which this set was designed are French "metal" type for the amplifiers and an A. P. or Radiotron for the detector. The only change necessary to adapt the set for all American valves, would be to change the sockets on the valve shelf. Across the top of the panel are the four observation windows for the valves. The edges may be either beveled as is the case with this set, a brass ring 1/4 in. wide may be turned up and screwed to the panel. The valve sockets are mounted on a shelf 17 in by 2½ in. by 1/4 in., which is fixed to the panel by brackets made of ½ in. by 1/8 in. brass strip. Mounted on the front of the panel and below the shelf are the three transformer sockets. No dimensions for these are given in Fig. 2, since the position of the mounting holes will depend on the type of mounting used. Fig. 1A, however, gives the dimensions of a standard R valve socket which is what I use. Directly below the transformers are the three tuning condensers C_2, C_3, C_4. The dimensions given in Fig. 2 are for "Tresco" condensers remade as previously mentioned.

The filament rheostats, of which two are required, are R_1 for the three amplifying valves and R_2 for the detector, being mounted as shown in Fig. 2. These should be the usual type of filament rheostat; my only reason for using the large one shown in Fig. 5 is that it was the only one I had to spare when I made the set. Of course, whatever rheostat is used on the radio frequency valves, it must be of sufficient size to carry the combined current

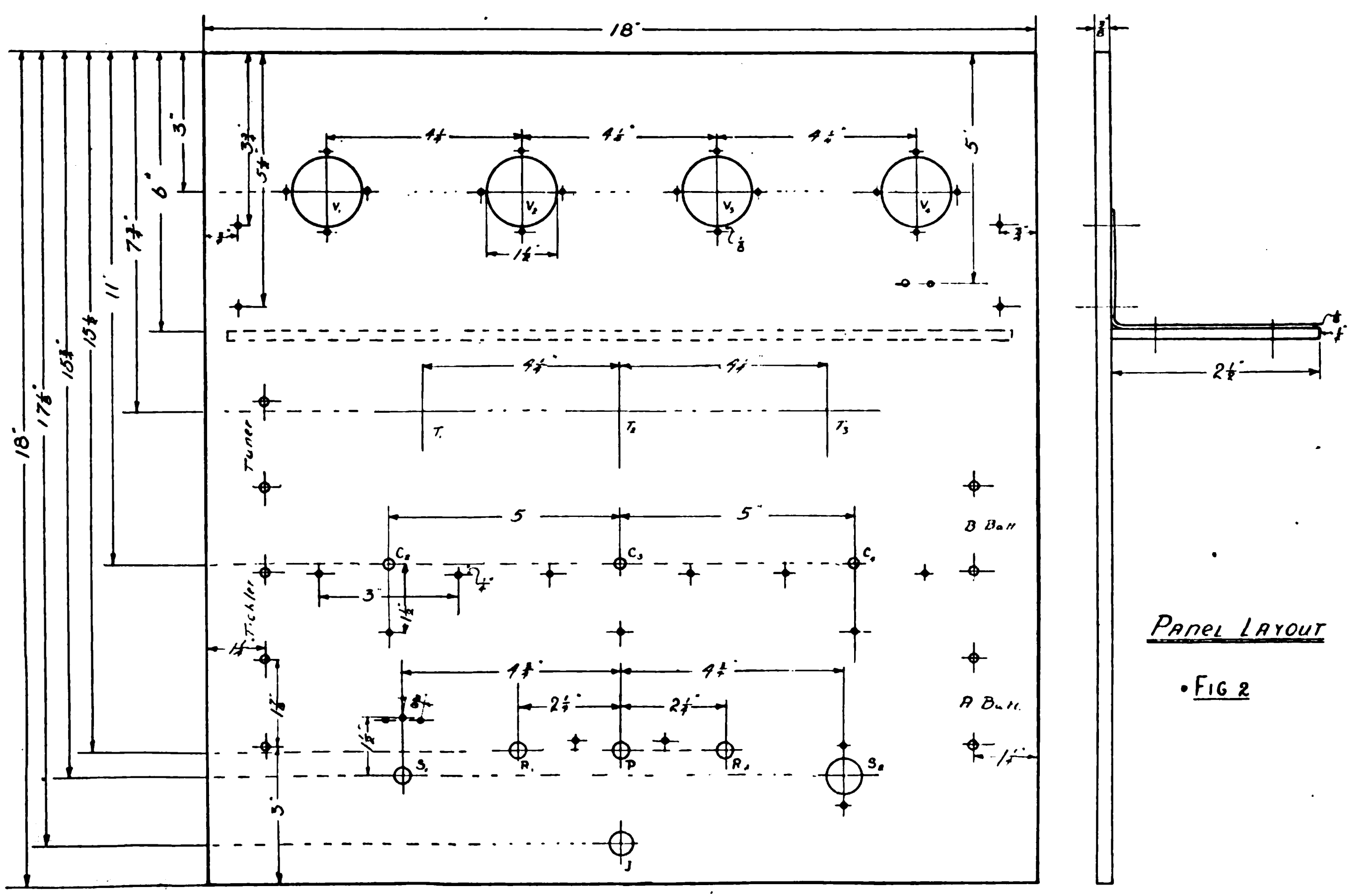


Fig. 2. Panel Layout for Transformer Coupled Radio Frequency Amplifier.

of the three valves. Since control of the self-oscillating properties of the amplifier is obtained by the grid potentiometer P, which is mounted between the rheostats (Fig. 2). This potentiometer, which is a Remler, is fed from the filament battery, or, if desired, a separate battery can be employed, but the former is usually sufficient, since positive grid voltages are generally all that is required to stop the set oscillating. The small snap switch S_2 is in series with the A battery circuit and is used to switch the set on and off. If this switch is not fitted the current will be left flowing through the potentiometer even when the set is not in use. The three-point switch S_1, is to change the tickler coil from the second to the detecting valve or to cut in the electrostatic reaction condenser C_6. The grid leak is of the pencil-line type, fitted below the detecting valve observation window. It, and the grid condenser C_8, should be of a type suited to the valve being used as a detector.

One of the disadvantages of a radio frequency amplifier is the great tendency to set up sustained oscillations by reason of the unavoidable reactions between the various coils and circuits. To limit this tendency to self-oscillation, the condenser C_7, is shunted across the B battery. This condenser should be as large as possible—1 microfarad at least, as this will tend to prevent magnified high frequency potentials occurring in the last valve of the series from being handed back to the earlier valves by reason of the potential drop in the resistance of the B battery. The presence of this condenser provides a path of low impedance to high frequency currents and hence reduces the effective high frequency potential difference between the common plate lead and the filament lead to a very small value.

As can be seen in Fig. 5, I use an ordinary telephone condenser of 1.5 mfds. for this purpose.

Directly under the potentiometer is mounted the open circuit jack J, for connecting in the phones or a loud speaker, as required. On the left hand side are five binding posts. The top pair go to the tuner, the next pair to the tickler and the bottom one to one side of the reaction condenser. The upper two on the other side are the B battery terminals and the lower two the A battery.

Some little difficulty may be experienced at first when operating this set from oscillations. After a little practice, however, one can control the set just as easily as an ordinary audio frequency amplifier, and indeed it is much quieter in operation than an audio frequency set with an equivalent number of valves. After a little experience one can judge where to put the tuning condensers, C_2, C_3, and C_4, for any desired station. When I first used a set of this type, I logged the stations heard together with their wavelength, when known, and also the transformer used and the condenser dial reading. After a little practice at this one can put the condensers very near the point of maximum amplification very readily, and a few slight adjustments when the required signal is brought in will enable it to be made as loud as possible.

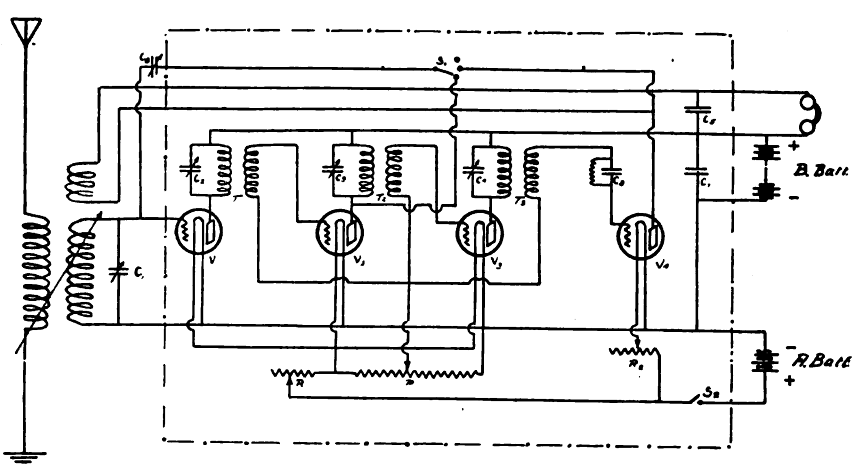


Fig. 3. Wiring Diagram for Three-Step Radio Frequency Amplifier.

WHEN THERE'S AN "R" THERE'S RADIO

Oysters are now in season—and so is radio. Curiously, the two seasons coincide; if there is an "R" in the month, radio transmission is good. The radio season opened officially on September 1st, and is now in full blast. The radio season may be said to begin in in September and close in April in the United States, according to W. D. Terrill, the Chief Radio Inspector.

The E. D. Manufacturing Company, Philadelphia, has been organized to sell radio equipment manufactured by the Electric-Dental Manufacturing Company. The officers of the company are E. W. Sprankle and R. W. Brown. The E. D. Company is offering to the market panel mountings and switches of new and unusual mechanical design. The unit design of the E. D. panels is particularly interesting as the set can be increased from time to time.

THE LIMITATIONS OF RADIO

By FRANK B. JEWETT

Vice-President and Chief Engineer Western Electric Co.

Radio is the latest practical application of scientific research in the physical laboratory. It is not the result of inventive creation, just out of somebody's imagination, but it is the step by step building up from physical researches which, when they were made, had practically no application to any existing thing. It is almost pre-eminent as an example of the commercial development of a thing which started in the research to determine the ultimate structure of matter, and to answer the question, "What is electricity?" With that kind of a background and with the results that have been obtained up to the present time, no man with any sanity would dare to predict what the future has, or has not, in store with regard to radio.

But at present there are certain very decided limitations on the use of radio, and unless these can be overcome by further discoveries, it is clear that the commercial use of radio is certainly bound to be restricted in certain directions.

In the first place, unlike electric power transmission and telegraph and telephone communication, where you direct the power or the communication from a given point to another specified given point or points, radio is essentially a broadcasting method. It is essentially a method of one-conductor distribution. It is as though we tried to do all of the communication and power business of the world over one pair of wires. So it is clear that the only way in which you can have a multiude of non-conflicting services wholly depends upon the character of apparatus at the sending and receiving ends. That being so, and because of the fact that so far as our knowledge goes to date, there is a limited range of wavelengths in the ether, means that there is a very distinct limit to the use of radio.

This might not be so bad were it not for the fact that there are certain commercial uses of radio which are paramount in the world's economic needs, and which are certain to take precedence over any other needs in the future. Radio is the only known method of communicating to places and things where you cannot run wires—ships at sea, airplanes, distant points on land, where it is impracticable to run wires, or distant islands. Thus it takes a first place in the national defense of every country.

Then there is a field of commercial use for radio, where weather reports or news bulletins can best be spread by broadcasting, even where wires can be run.

Scratchi Joins the Cluster

By David P. Gibbons

To Editor "RADIO" (Magazine which dish up thought-food with pleasant, nutty flavor).

Dear Mr. Ed:—

I beg to acquire from you small amount of advice of a confident nature. Could you be kindly enough to recommend me to some reliable insane place where I may insert my Cousin Scratchi for brief period until he recover himself back again to normality? He are going around about, Mr. Editor, with dangerous signal light in both eyes, and mightbe should be confined up before he become quite bolshevicky. He are suffering sharp attack of new epidemical disease which are now spreading its fatally germs amongst all species of radio bugs. Mightbe you have been slightly touched yourself, Mr. Editor, with this affliction which are called the "Farmstrong Stupor Generator," and so you can emit brotherly-loving feelings for my poor cousin.

He return home about 7 evenings ago with armful of all latest-out radio magazines, which are now crowding Sloppy Stories and Fizzlebangs off the news boxes back into gutter.

"At last it have came!" my Cousin hoop with election-time banzai. "Most terrific discovery since Hon. Marconi got born. This are grand invention which the more or less intelligent public have been expecting for almost six months. It are now here freely to all and you cannot make mistakes if you follow after diagram number A1 on page 13. Send no money. We trust you. Cut out and sign——"

I see he are rapidly flapping pages of 4 or 5 magazines at same time, Mr. Editor, and when he hesitate to grasp some more breath, I stick in with don't-know expression.

"Are this magnificent invention worth something at all?"

He look several daggers at me and snap over—"Should be worth one million cold dollar bills!"

"Should be, mightbe," I quack back with Charlie Chaplin movement of eyebrow, "but it are quite oddish happening for giant corporation to donate away one million fish whether hot or cold."

My Cousin shoot me pitiful glance and are too proud to argue against such silly remark.

"Observe these, my dumb relative," he go on, showing me numerous sketches, photos, black prints, green prints, outlines and diagrams of the marvelous Stupor Generator. "These all should prove how simple it are to construct by even amateur with hardly any experience and experts who furnish written accompaniment to these are all highly agreed that results are only very slightly beyond belief. For an instant, this week-end magazine with fancy red-color topcoat say that their expert have amplificated some very inaudible signals 4 billion times and for aerial all he use are two razor blades in serious. He report tuning quite sharp, also. Other weekly paper, which issue out without any coat like beach beauties, say that their trained scientist use only 2-inch

loop and bring in concerts 12 times more louder still than their 8 step self-geterofine."

"That are sufficient of that," I rupt him up, "but are not lofty degree of skill necessary to compose those many parts into work condition?"

"Not so," he talk back, "and if Colonel Farmstrong can induce such startled result, there are no reason that I cannot bring fourth similar success. Both two of us were in the glorious army." He add on, but my Cousin forget to inject that whilst the Colonel were wireless champion of A. E. F. he were only dog-robber champion of S. O. S.

I then detract his attention to strange-looking fact that each diagram are exactly different from all others, but he say "That are mere trifle matter as it are principle of thing which are important."

I desire to know what are this principle, but my Cousin have become quite busy making up mathematical list of pieces which he must have to slap together trial set, and are subtracting from this such pieces which we now have on hands. New stock must include 2 or 4 oversize coils with 2 or 4 powerful tubes and 2 or 4 dozen additional dried cells for the B, C, and D batteries according to simplest uphook which he pick out. Several other various ends and odds are also necessity and Scratchi find, when he figure all upwards, that he will be enable to leave single cash dollar with wealthy banker gent to keep old saving account from total loss. He then make shopping expedition amidst radio dealers and come back in late p. m. with full arms and empty pockets. I ask him if he have gathered up all the selected parts which he need with assistance of friendly clerical people in wireless store, and he say he have grabbed them up in spite of such resistance. One smartish little boy behind counter, where he hunt out some long-coiled honeycombs, tell my Cousin that honeycombs are year ago out of date, and what he must buy are spider's leg deductance or at least casket-sleeve veryometer. Scratchi require from other brite little fellow, in apartment store radio sector, some fixing condensers and griddle licks which he need to construct filtration serkit, and this highly priced saleman wrap him up one Hadley's Cat and 2 cat's mustaches.

My Cousin then unrobe those bundles and spread whole shooting matches on kitchen table and direct me to chop up flexy wire into sorted lengths for connecting purposes. For five or so hours, Mr. Editor, he follow diagram with one finger and one eye, while with other eye he tell me where to hook very loose ends around binded posts. At last he give the complete mess the General Dubblo and he mutter at himself, "Now we hook in the fones and we see."

We hook in both pair of cans but we don't see any more than formally and hear less than that. Scratchi shake up table and make new connection some place he don't think about, and at once come thick purry noise, very displeasant to the eardrums, like German airplains on foggy night.

My Cousin throw me victory look and say in careless tone, "See! Old vacuum! Works charmingly. Only need some adjusting now to arrive at proper point of degeneration."

Then he start adjusting. This are five days back, Mr. Editor, and he are

Continued on page 80

The Original "OW"

By Major Lawrence Mott

Many readers who noted Volney G. Mathison's opinion in October RADIO that the woman operator can not make good in real life will be interested in this tale of a maid who covers herself with glory in fiction. Read it and weep, ye woman-haters.

"MISS MONTGOMERY, I compliment you on the excellence of your examination papers. You are marked 100%—perfect—and I took the liberty of asking you to come here today that I might have the pleasure of congratulating you in person!"

Thus spoke Radio Inspector Major Dirron, Signal Corps-Reserve, in charge of the 6th Radio District, with offices in San Francisco—and he looked at the girl in very evident admiration.

Neat, in well-fitting tailored frock, a wealth of chestnut hair caught up under a smart sailor straw hat, with big frank eyes, whose lids had most wonderful curling lashes, and with a complexion of creamy softness — Dorothy Montgomery was a charming picture—at which more than one man looked—in the busy marts of men.

"Radio has always been a hobby, and now — that" — she searched for the word that she wanted—"I must earn a living, owing to the unfortunate condition of Dad's affairs—at his passing on—I might as well turn that which I learned by the generosity of his gifts to me, in the way of apparata—and so forth—to good account. I wonder, Major, if you could give me a letter to anyone who might be of service to me in my quest—in N. Y.? I have some money, and I think that the chances of getting a billet there—are better than on this Coast."

"Hmmm!" the tall, kindly man pursed his lips thoughtfully—"hmmm; now let me see—. Have you considered this matter seriously, young lady? I do not wish to intrude myself in your private affairs, but for one so—so very—er—attractive as you, there might be annoyances—and—er—so forth, as a ship operator, supposing that we can land you in the berth of one."

"That does not worry me in the least! The average man of today is rather much of a clean-thinking sort—Americans are, at any rate—and I am well able to take care of myself. But I am grateful to you for the considerate thought, good friend"—she put out her hand, impulsively. He took it, and from his six feet, two inches—looked down at the trim figure—strangely moved at the courage in the delicate, oval face.

"You shall have a letter to the Radio Inspector in New York—and to one or two others—friends of military days. Where shall I send them?"

"By God, old as I am, Ill show them that a sailor's duty is to protect to the last ditch," he stammered—put his hands to his head.

She gave an address and, with a cheery wave of hand, left him standing in the middle of the floor, as though rooted to it.

"By George, if I were not——well, if I had not a home, family, and more summers over my head than I care to count, I undoubtedly should . . . ! However!"—he coughed sharply to hide his embarrassment, as he saw that the stenographer was watching him—curiously. "Take some letters, please!"

* * * * * *

AN unusually hot day was coming to its sweltering end—in New York. The reflected heat of the pavements beat against the hurrying crowds—that jostled and elbowed and fought to reach the subways, the elevated trains—means all of getting out of the fetid, humanity-reeking atmosphere of the lower parts of the city.

With white, wan face, Dorothy Montgomery wearily pushed herself in a small corner, where she might gain a moment's respite from the selfishly hastening throngs. The big eyes were tired, and there was a pathetic droop to the corners of the exquisite little mouth. She was dizzy—from the terrific temperature—and because of the fact that she had eaten nothing since morning.

Ever since her arrival in that which undoubtedly is the most cruel city in the world—from a sheerly business point of view—she had gone from one shipping company to another. At first—with heart full of courage and sublime in her faith in herself—as an operator of far more than average education and radio knowledge. And pardonable pride and ambition of youth—had wanted to "go it alone"—without using her letters of introduction. But the incredulous amusement with which she was met, when her desires were known and, in some cases, the broad hints of lesser employes, in outer offices, sickened her, and she tried the smaller lines. So far, with but the same result: nothing.

The stereotyped: "We are very sorry, but all of our vessels have full complements of operators"—became as a ceaseless, monotonous dirge in her ears—much as the eternal rumble of a breaking sea on the shingle. The brief utterance of an office boy, in one of the last places that she had tried—haunted her: "G'wan !—the likes o' *youse*'ll never git a berth poundin' brass ! If youse was to ship on a vessel there'd be murder—inside o' a week! Nix—girlie! Get a job on the roof gardens—wit' 'at face and shape! Take it from me! When you land one—slip me its name and I'll come up—some night!"

These well-intended words careered through her mind with startling vividness, and—grimly enough—that dread grey Thing—despair—croaked dismally in her ears:—*"Failed!* Go home and get a position in a shop—or become stranded in NY, and . . . !"

"No! No! "—she exclaimed it aloud — unconsciously — and hastened from her shelter into the throngs—there to escape that which tormented her from within.

ARTHUR, Jr.,—only child of Arthur Carroll, owner of the famous Carroll & Carroll Line of steamships—whose boast was that they *"Carried Anything — Anywhere — at Any Time—for a Reasonable Price";* that operated passenger as well as freight ships; whose house flag was known in every port of the world—Arthur Jr., who was rapidly following in his father's tracks—much to the elder's keen approbation—came hurrying down Broadway in his big runabout. Matters had delayed him at the offices and he was late for an appointment at Hempstead, Long Island.

A muscular, up-standing and entirely self-reliant young American was Carroll Jr.—with quick eyes for charms feminine—but with an exceedingly level head set firmly on his square shoulders.

"Darn the luck!" he ejaculated, as the traffic semaphore swung against him —at Broadway and 14th Street. After a seemingly endless space—it swung again and the big car shot forward. Thinking to get out of the jam, Carroll turned East—for 4th Avenue—speeding toward it as the side street was clear.

He did not see the slight figure until it had stepped directly in front of him —from between parked cars, half way down the block.

With a gasped—*"My God!"* he thrust on the brakes. But it was a physical impossibility to stop within the short distance. He saw the beautiful big eyes look beseechingly at him—in terror—as he swept on. And two little white hands were held out in pathetic effort to ward off the blow. He heard the faint—*"O-o-hhh!"*—as the flaring mudguard struck the soft body.

NERVOUSLY he paced up and down the big hospital's waiting room. He could see nothing but those eyes, with their expression of frightened appeal. And the lifting of her in his arms to his car—the supine passiveness of her slender body against his—the memory of these things moved him—strangely.

"She is strong enough to see you—and has asked who brought her here."

So quietly had the nurse approached that he started—nervously—when she spoke. "There is no serious damage done!" she added, quickly, seeing the set look on his face.

He followed her, unconsciously noting the grim spotlessness of everything. Up three flights in the elevator—then along a corridor that shimmered whitely in subdued electric lights. The nurse gently pushed open a door and stood aside. He entered. The door closed behind him—and the nurse went away.

So white that the pallor of her almost merged in the hue of the pillows, Arthur Carroll saw her face again—and it vividly flashed across his consciousness that it was the loveliest he had ever seen!

As he awkwardly approached the bed and began to say how sorry he was—she interrupted him softly:

"It was all *my* fault! I should have known better than to try and cross there—but I—I am a stranger in the city—and I was confused. It is I—who ask forgiveness, for having caused you all this trouble and annoyance."

He drew up the staid, white chair—and sat beside her—"

"Miss . . . ?"

"Dorothy Montgomery of San Francisco full-fledged commercial radio operator, 1st class, in New York—looking for a berth"—and she smiled wistfully.

He stared at her—incredulously—*"You?*—commercial operator—?"

She nodded—"Yes, I am the original 'OW' of the Pacific Coast—at least the first to pass the required examinations for a first class—commercial."

"The—er—'original OW'—"?

She laughed outright—at the puzzled look in his fine eyes.

"Why, yes! In radio vernacular—of the air—'OM' is the abbreviation for 'Old Man'—as operators always call each other. Now that the —sex feminine has projected itself in the profession—its members have the title of 'OW'—meaning 'Old Woman' "!

But in your case, surely—'YG' would be more appropriate!"

"Very prettily said, Mr. . . . I do not yet know who——"

"Ran you down"!

"Don't put it that way—please!" She reached out a little hand—that he instantly took.

"I am Arthur Carroll Jr."

"Not the—the shipping firm?"—she asked with a catch in her voice.

"The same—but why the surprise, Miss Montgomery? Do you know of us?"

"I went there—this morning—looking for a position." But she did not tell him that in those offices she had seen the ugly side of life—that a pretty woman sometimes sees—when seeking employment.

"And—they turned you down?"

"With definite brevity! In fact it was the—last place that I tried, and I was on my way to my room, when——." She stopped.

"What are your plans—now?" he inquired, gently.

She turned her head from him and looked out of the opened top of the window, through which the clean, bright stars peeped, and in which poured the muffled noises of a great, garish city.

"I— suppose that I shall have to go back to San Francisco—when I leave here. The nurse says that it is only bruises—nothing broken—and a matter of a week or so. But I hate to admit that I am—beaten! I hate to—to give up! Just because I am a girl—the world thinks that I have nothing to give it—save to—to marry—somebody—maybe—and to increase the population! But I have brains, and I think that the world owes me at least a chance to use them!"

"Have you any friends in the city?"

"None. I have some letters of introduction to people here, but I wanted to make good—alone! Dad"—she bit her lips—"Dad always said—'walk on your own two feet! If you can't walk crawl! And if you can't even crawl—stay home!' And now—" her lips smiled, but her eyes did not—"now I cannot even 'crawl'—home."

"Please . . ." he began impetuously, holding her hand more tightly—"please let me . . ."

The door opened—the nurse came forward—"You will have to go, Sir. She needs rest after that shaking up. Fortunate for all concerned that it was no worse."

He leaned over and gently kissed the hand that he held—she looking at him wonderingly—but without the least alarm. There was something big and fine in Carroll Jr. that made for confidence.

"I shall be here the first thing in the morning—on my way downtown!"—he called to her.

And in the quiet of the hospital room she fell to recalling everything that he had said—the color of his eyes—the intonations of his voice—until consciousness slipped from its human shell—and she slept.

"HAD an accident today, Pater!"

Carroll Sr. and Jr. dined together at a club. Arthur's mother had passed on, in giving him birth, and neither he—nor his father—got on at all well with "the 2nd Mrs. Carroll" as the great shipowner's next venture on the matrimonial sea was generally known to intimates.

A beautiful, brilliant, domineering woman—intent on bending—or breaking—to her will everyone within reach. Those who sought the favors that she could bestow—fawned about her. But Carroll Sr.—and her stepson—took the course that water follows: the easiest—and maintained a semblance of peace by keeping out of her way. As Carroll Sr. was wont to remark—when especially

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Unusual DX for Hot Weather

By Major Lawrence Mott, Radio 6XAD, Associate Editor

IT has always been supposed that summer heat precluded any possibility of satisfactory long-distance work—either transmission or reception.

In order to thoroughly test this theory, certain investigations were made at 6XAD—on two consecutive nights—and the hottest that have been experienced on Catalina Island, off the coast of Southern California, this summer. It will also be remembered that the heat has been severe all over the United States. And I would call attention to the fact that these extraordinary results were attained with the use of a special Western Electric tube, used as *detector only!* At *no* time were any stages of amplification employed!

Herewith the list, that speaks for itself;

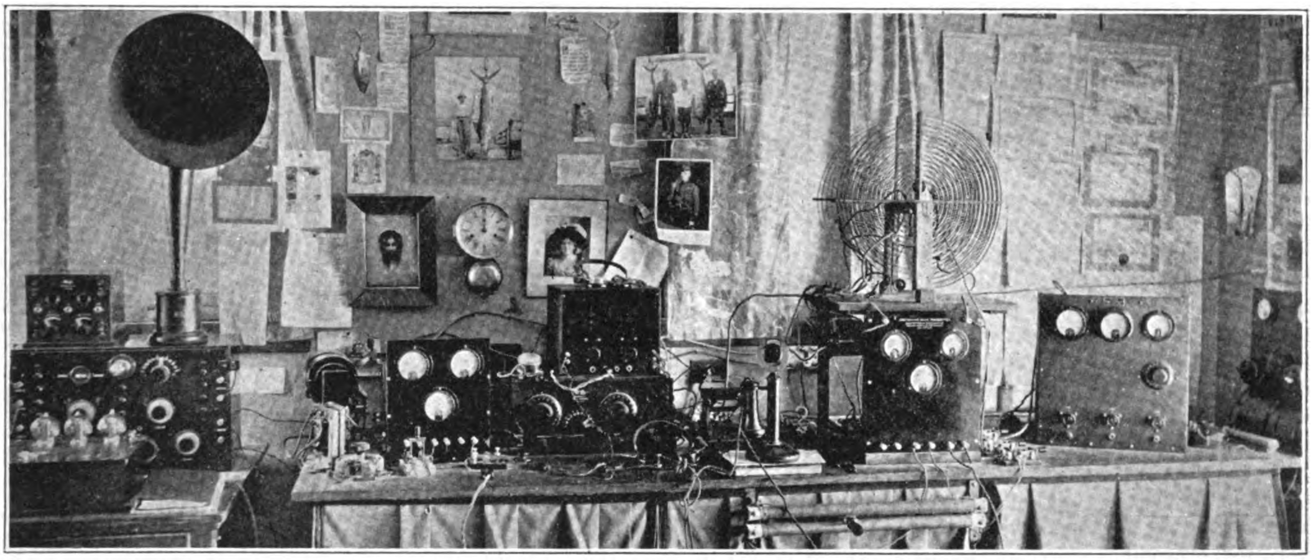
On the nights of September 13th and 14th, this year, between the hours of 6.57 p. m. and 12.34 a. m.—the following stations were clearly heard by me:

2kf, 8ot, 5uo, 6awt, 7afh, 8czn, 8cef, 8vy, 9bhd, 9cdv, 9fv, 7mf, 7afw, working 5cy, 5px working 9dte, 9cns, 6bko worked 6xad, 6alu worked 6xad, 6up worked 6xad, 7iy working 7lu, 9cns working 5ek, 7lu worked 6xad, 9ps-cq, 9aon working 7lu, 9dug-cq, 9bzi working 8bda, 8aio-cq, 9anq-cq, 8aqf working 8agy, 9ps working 6ka, 8bzi-cq, 9dpl working 2fp, 9aio worked 6xad, 9fk working 6abx, 9dpi working 9anz, 8aio working 5za, 9dpl working 9aon. 6xad on that night handled traffic with 6bko and 7lu 9ays-cq, 7ty-cq, 8aqf worked 6xad from 10:16 p.m. to 10:46 p.m., and is in Marietta, Ohio! (He was qsa, and reported 6xad the same.) 9aps-cq, 9ays working 5es, 9ps working 5za, 9ayi working 9bds, 9yaj-cq, 5be-cq, 8aim working 9aig, 9dmh, 9dte.

At 12.17 a. m.—September 15th—6XAD *effectively worked* 4BF, who is located at St. Petersburgh, Florida. Three messages were successfully handled—4BF coming in very QSA, on detector only! ! 8IU-CQ, 9APS working 8WR, 5XD-CQ, 9AGO working 9AYS, 5UO worked 6XAD, reporting me as "vy-vy-vy QSA." His station is at Wichita Falls, Texas. 9APW working 3OT.

The entire list is a good deal longer. I give this much of it in order to prove that DX results CAN be obtained in the extreme heat of summer. Doubtless the owners of the stations that I have logged will be pleased at the efficiency of their transmission! My compliments to them all! I hope to work them during the coming winter!

May I call attention to the fact that *6XAD* will be officially open after November 1st—the same nights and hours as last year; Tuesday—Thursday—Sundays—from 10.30 p. m. until 3 a. m.—or later, if tests from the East are desired.

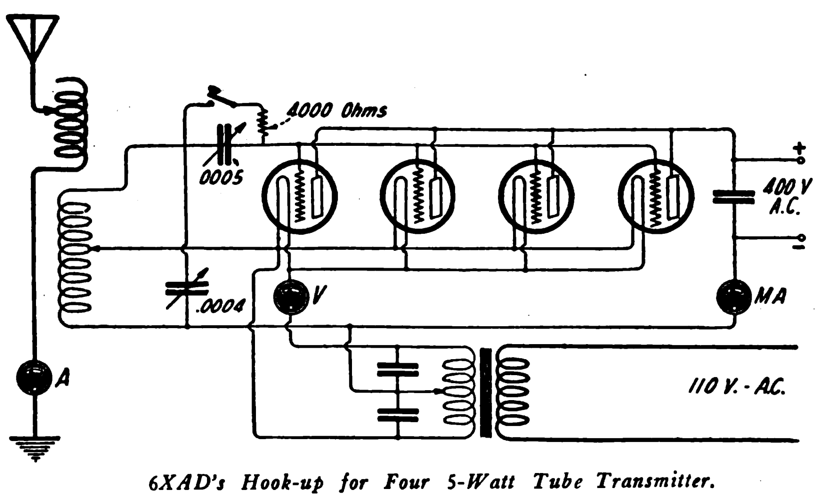


Radio 6XAD, Avalon, Catalina Island, California. Kennedy Long Wave Receiver, Grebe 2-Step Amplifier and Western Electric Loud Speaker at Left. On the Main Operating Table are ICW Transmitter Using Two 50-Watt Tubes Radiating 6.1 Amp. on 240 meters. Grebe CRS with Special Western Electric 2-Step Amplifier, CW Transmitter Using Four 50 Watt Tubes Radiating 7 Amp. on 370 Meters, and ICW Transmitter with Four 5 Watt Tubes Radiating 2.9 Amp. or 220 Meters. At the Right is a Motor-Generator Set Delivering 1500 Volts dc to 200 Watt Transmitter.

The most remarkable result of all those given above was undoubtedly that of so effectively working 4BF—with whom communication was carried on almost as though he were in the 6th District. I was using my new transmitter, employing 2-50 watt, Western Electric tubes-ICW throughout, on 225 meter.

It is my intent, shortly, to install still another transmitter, using two of the British-1000 watt tubes—also employing ICW. This new set ought to be in operation by November. I shall be glad to have reports on it! This together with a new 250 watt tube will give me five complete transmitters for the winter's work, there now being in operation two sets of two 50 watt tubes each and one set of four 5 watt tubes.

After November 15th Mr. S. Dalton,



6XAD's Hook-up for Four 5-Watt Tube Transmitter.

Continued on page 82

Theory and Design of Amplifiers

By Louis Frank

BEFORE the advent of the electron tube the only amplifiers available were the Brown relay and Telefunken sound intensifier. At the most, these produced amplification insufficient to make any material difference in reception. The electron tube has large amplifying properties which can be used so that the amplified output of one tube can be still further amplified by succeeding tubes. In this way enormous amplifications result. At the same time the tube fulfills one of the most important conditions of a good amplifier: *amplification without distortion.*

It will be assumed in this discussion that the general features and characteristics of the vacuum tube are known, so that we can immediately take up the problem of the amplifier.

Single Stage Amplifier

When a voltage is applied to the grid of an amplifier tube a large current will flow in the plate circuit as a result of the relay action of the valve. This large current may be made to flow through a resistance or inductance placed in series with the plate, across which inductance or resistance a voltage will be developed which may be many times greater than the original grid voltage. Or from the point of view of energy a considerable amount of energy will be available in the plate circuit for operating a loud speaker, for example:

A good amplifier must fulfill one important condition: It must produce in the output circuit an *enlarged and exact copy* of the original signal impressed on the grid. This will be the case if the plate current is directly proportional to the grid voltage. From the general shape of the grid voltage-plate current characteristic of the valve, Fig. 1, it will be seen that this condition of direct proportionality obtains over the small range where the curve is a straight line, between points *A* and *B*. Operation within this range can be accomplished by adjusting the grid potential to a value midway between that of *A* and *B*. Under such conditions the amplification is directly proportional to the grid voltage and the proportionality factor is called the "theoretical amplification factor," μ_o.

This theoretical amplification factor μ_o is one of the most important constants of the tube, for all true amplifications obtained in any amplifier depend upon it. It can be shown mathematically that E_g volts in the grid are equivalent to $\mu_o E_g$ volts in the plate. This factor then represents the theoretical quantitative effect of the grid voltage on the plate; and is the theoretical maximum amplification which the tube is capable of giving. It is dependent on the arrangement of the elements in the tube. The finer the grid wires and mesh of the grid, and the closer the grid is to the filament for a given separation of grid and plate, the greater will be μ_o.

In contradistinction to the theoretical maximum amplifications there is the true amplification when the plate circuit is loaded, namely μ. This is always less than the theoretical μ_o. This is due to the fact that part of the amplified voltage must be consumed in the internal resistance of the tube, thus leaving the balance as available amplified voltage, which is therefore less than the theoretical maximum.

Single Valve Amplifier with Resistance in Plate Circuit

In this case the amplified voltage is obtained across a plate circuit resistance, Fig. 2. The true amplification depends upon the amplification constant and the plate resistance R. If the internal valve resistance (plate) is R_p, then the total plate circuit resistance is $R_p + R$. It can then be shown that the true amplification increases as R increases. When the external resistance R equals the internal valve resistance R_p, the true amplification will be given by one-half the theoretical maximum, μ_o. As the value R decreases the true amplification also decreases, and vice versa. The theoretical maximum amplification is obtained when the external resistance R is infinity. The relationship between true amplification and load resistance is shown in Fig. 3. It is seen that the practical maximum amplification, where the curve gets flat, is obtained if the load resistance is higher than the internal resistance of the valve.

In this discussion we have assumed that the plate battery has a definite voltage V. It should be noted that since the plate resistance of the valve depends upon the battery voltage, the true amplification will also depend upon this voltage. As soon as an external resistance is used, the d. c. through it results in a lower voltage being applied to the plate. Hence the valve resistance will be less than expected and calculations of amplification will be in considerable error. Therefore, in designing resistance amplifiers compensation must be made by using "B" batteries of sufficient voltage.

As R increases the amplification increases, but at the same time the plate battery must be made larger to overcome the drop across the increased R. It therefore is costly to increase the "B" battery and a limitation must be placed on the value of R. From Fig. 3 we see that after point A is reached further increases in R produce only small increases in amplification. For these reasons in actual design it is not practical to exceed the value of R beyond point A.

Single Valve Amplifier with Impedance in Plate Circuit

In this type of amplifier the voltage is developed across an inductance L,

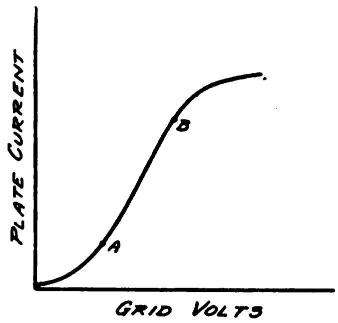


Fig 1

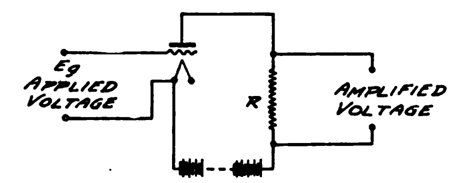


Fig 2

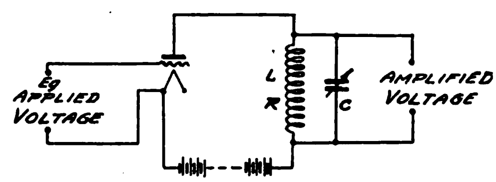


Fig 5

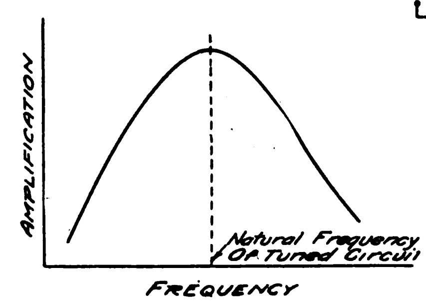


Fig 6

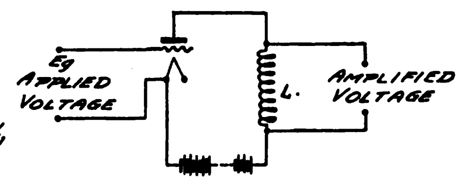


Fig 4.

Fig. 4. In general, the resistance of the inductance is much lower than its reactance and may therefore be neglected. Mathematical analysis shows that the true amplification is directly proportional to L. By making L very large the true amplification can be made to approach the theoretical maximum μ_0. This type of amplifier will give higher amplification than the resistance type, since L can be made very large and R is so small that there is no resistance drop across it, thus making the entire "B" battery voltage effective on the plate.

SINGLE VALVE TUNED CIRCUIT AMPLIFIER

In this type of amplifier a tuned r. f. circuit is used, as in Fig. 5, and the amplified voltage developed across it. The impedance of this circuit can be shown to be a maximum to currents having its own natural frequency, hence the maximum voltage will be generated across it for currents of this frequency.

The amplification curve for this circuit at different frequencies is shown by Fig. 6, which shows that maximum amplification occurs at the natural frequency of the r. f. circuit. Such an amplifier is different from the others, therefore, in that it is a "selective" amplifier. Hence this system will involve to some extent a so-called critical adjustment.

If amplification is desired solely on one wavelength or over a very narrow band of wavelengths, this circuit has a great advantage in that other frequencies will not be amplified much. The following conditions, in designing such an amplifier, must be met: (1) The resistance of the inductance must be very low, and (2) the tuned r. f. circuit must be designed so that the ratio L/C is small, *i. e.,* capacity in this circuit must be predominant. These are the conditions for minimum damping and maximum selectivity. If, on the other hand, a non-selective tuned circuit amplifier to tune equally well over a wider band of wavelengths is desired, the following design conditions must be met: (1) The resistance of the inductance should be high, and (2) the ratio of L/C should be high, *i. e.,* inductance should predominate.

This system possesses great importance. For while we have thus far considered the tuned circuit to contain lumped inductance and capacity, it will be seen that this need not be the case. Thus we may have an apparent inductance amplifier, which in reality is a tuned circuit r. f. amplifier, due to the distributed capacity of the inductance acting as tuning condenser. This also holds for transformer coupled amplifiers.

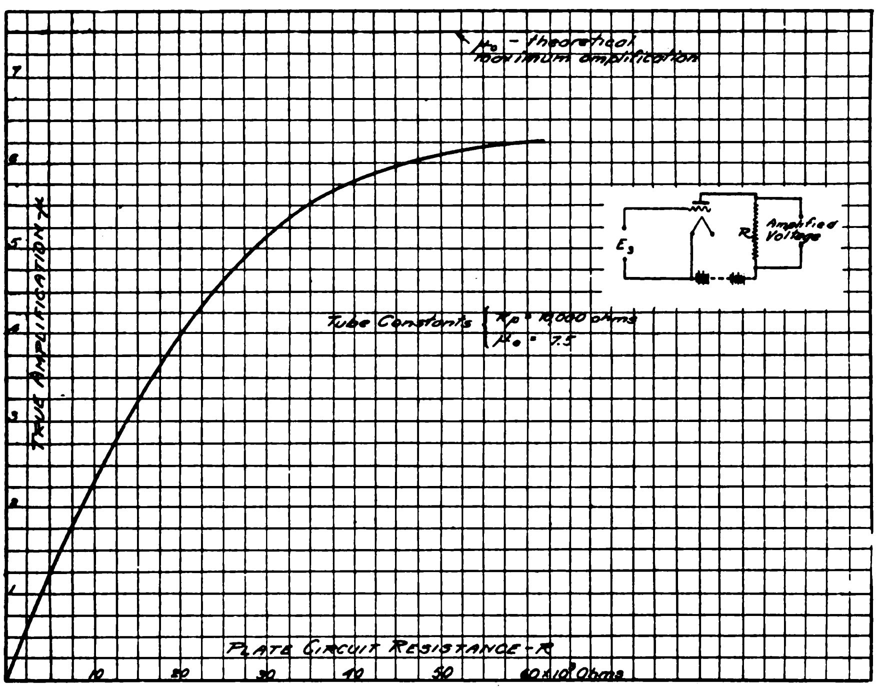


Fig. 3. Relation between Tube Amplification and Resistance

MULTI-STAGE AMPLIFIERS

When a number of tubes are placed in cascade the amplified output of one tube being further amplified by the succeeding tubes, we have a multi-stage amplifier. It is obvious that with such an arrangement enormous amplifications may be secured. In fact, the resultant amplification will be given by the expression μ^n, where μ is the amplification per tube, and n is the number of tubes employed.

We may have a multi-stage resistance, inductance, transformer or tuned circuit amplifier. These further may be used for either radio or audio frequency amplification. Radio frequency amplifiers will be found to be more difficult to build than audio for reasons which will be given later. However, radio amplification has important advantages over audio. First the detecting action of tubes is proportional to the square of the radio frequency voltage applied. Hence a r. f. amplifier which will increase the magnitude of the r. f. voltage before being applied to the detector is more advantageous than the audio amplifier. Second, atmospheric disturbances which result in audio currents, will be less amplified by r. f. amplifiers. For these reasons r. f. amplification is preferable to a. f., although limitations which will be mentioned restrict its use.

AUDIO FREQUENCY MULTI-STAGE RESISTANCE AMPLIFIERS

Such a two-step amplifier is shown in Fig. 7. Similarly any stage amplifier may be made. In each case it will be observed that a grid condenser is necessary, even though rectification and detection are not the object. The reason for this is unless this condenser is used the positive potential of the "B" battery will be impressed on the grids of the tubes through the resistances R, with harmful results. Since the condensers are used it is necessary also to use the leaks, r_1, r_2, etc., in order to prevent negative charges accumulating on the grids, thus blocking the tubes. As soon as one stage of a multi-stage amplifier is blocked, the entire amplifier is useless. The grid leaks function by discharging this negative potential on the grid, preventing blocking and permitting operation of the amplifier.

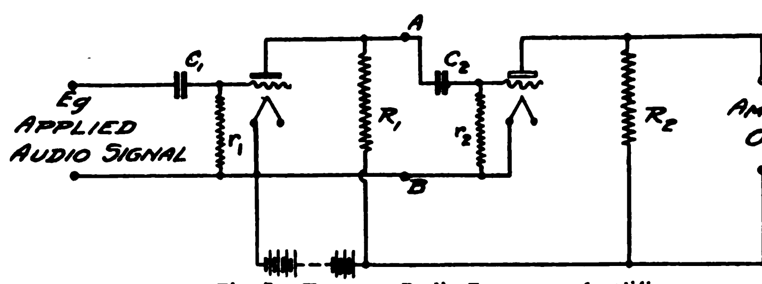


Fig. 7. Two-step Radio Frequency Amplifier.

The values of plate resistance and true amplification in multi-stage amplifiers are determined by exactly the same conditions as for single stage. For practical results the plate resistance should be about two or three times that of the valve resistance. The plate resistance in each of the stages is therefore the same.

Since the present valves usually have a resistance of about 10,000 ohms, the plate resistances will usually be between 20,000 and 30,000 ohms. These resistances must satisfy certain conditions. They must have a minimum of distributed capacity, since this capacity is in shunt to the resistance, thus reducing its impedance, which will result in reduced amplification. It must be able to carry the plate current without overheating, since overheating will alter its resistance and thus alter the amplification. But worse than that, if the resistance alters regularly with passage of current, the current will also be altered, thus producing objectionable tube noises.

The values for grid condensers and leaks are determined by definite considerations. In Fig. 7 it will be seen that the grid circuit of the second tube is in parallel with the plate resistance of the preceding tube, between points *A* and *B*. The impedance of the grid circuit must therefore be much greater than that of *R* in order not to affect the amplification. The impedance of the grid circuit depends upon the internal grid-filament impedance, which generally is of the order of a million ohms or more, and on the grid condenser and leak impedance, which depends mostly on the leak resistance. Since this is also of the order of a million ohms or more, thus showing that the grid circuit at *audio frequencies* is sufficiently high in impedance so as not to affect the amplification. Since the amplified voltage across *R* is applied to the next grid through condenser *C*, the reactance of this condenser must be low enough not to take much of a drop in voltage across it. Since the effective resistance of the grid-filament circuit is of the order of a few hundred thousand ohms, the grid condenser may have a reactance of a few thousand ohms without altering the voltage applied to the grid very much.

Radio Frequency Multi-Stage Resistance Amplifiers

The same type of circuit and the same considerations apply in the resistance amplifier for r. f. as for a. f. circuits. The difficulty in the case of r. f. amplification is that the impedance of the grid-filament path is extremely low, and therefore alters the amplification adversely. The reason for this low impedance at r. f. is that the reactance of the tube capacity is much lower at r. f. than at a. f. Assuming that the capacity of grid-filament path is about 30 mfd., its reactance will be at 600 meters about 3000 ohms, which is so small that it would practically short-circuit the plate resistance and so destroy all amplification. It is therefore necessary to increase the value of the plate resistance, and for best results the wavelength worked on must be higher. In general, using this amplifier on low waves will not yield good results and the over-all amplification will be much less than for a. f.

Impedance Coupled Multi-Stage Amplifier

The impedance coupling is similar in both action and connections to the resistance coupled amplifier, the only difference being that iron cored chokes are used instead of resistances (audio). This type of amplifier has the advantage that, since the resistance of the choke is small compared to its reactance, there is very little resistive drop in it and the full voltage of the battery is applied to the plate.

The amount of amplification obtained in each step is the same as was given for the single stage. The curve showing the amplification thus obtained is similar to the resistance curve, except that it is steeper, and hence, for a given ohmage the impedance amplifier will give greater amplification. No advantage is obtained in exceeding a value of two or three times the resistance of the valve for the reactance of the choke, for above that limit the amplification curve flattens out. For tubes generally used, such as the UV 201, the choke should be about 3 or 4 henrys in inductance, which would give reactances between 20,000 and 30,000 ohms at 1000 cycles.

In designing such an amplifier for radio amplification an important difficulty arises. Calculating on the same basis as for a. f. the necessary inductance to give 20,000 ohms reactance at a wavelength, say, of 1000 meters, is approximately 0.004 henrys, which is extremely high for a r. f. inductance. This would require, in order that it be built compactly, a large number of turns, resulting in high distributed capacity. The result would be a maximum amplification at the natural wavelength of the coil, which may be very different from that for which the amplifier is meant. This type of design is therefore to be avoided, unless means are available for adjusting the wavelength of the circuit, as for example the use of a variable condenser across the choke coil to tune it to a given period.

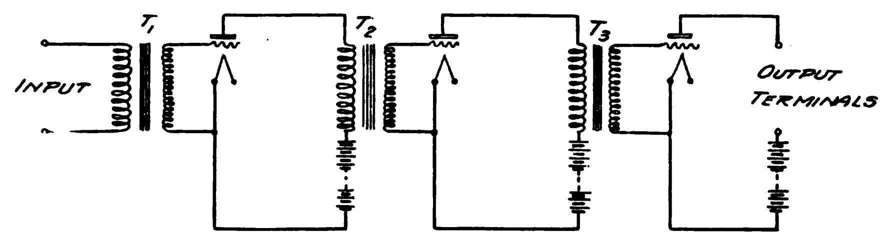


Fig. 8. Three Stage Audio Frequency Amplifier.

Audio Frequency Transformer Coupled Multi-Stage Amplifiers

In Fig. 8 is shown a three-stage a. f. amplifier. Each stage is coupled to the following one by means of a transformer. There are two amplifying processes in this type of amplifier. First the voltage is amplified by means of step-up transformers; second, amplification takes place in the tube itself, since repetitions in the plate circuit are magnifications of the variations in the grid circuit. Now the tube amplification will inevitably take place if the tube has no defects. But unless the transformer is properly designed, not only may amplification *not* take place in the transformer, but if it is poorly designed *the amplification of the tubes may be destroyed.* The importance of considering the proper design of transformers is therefore clear.

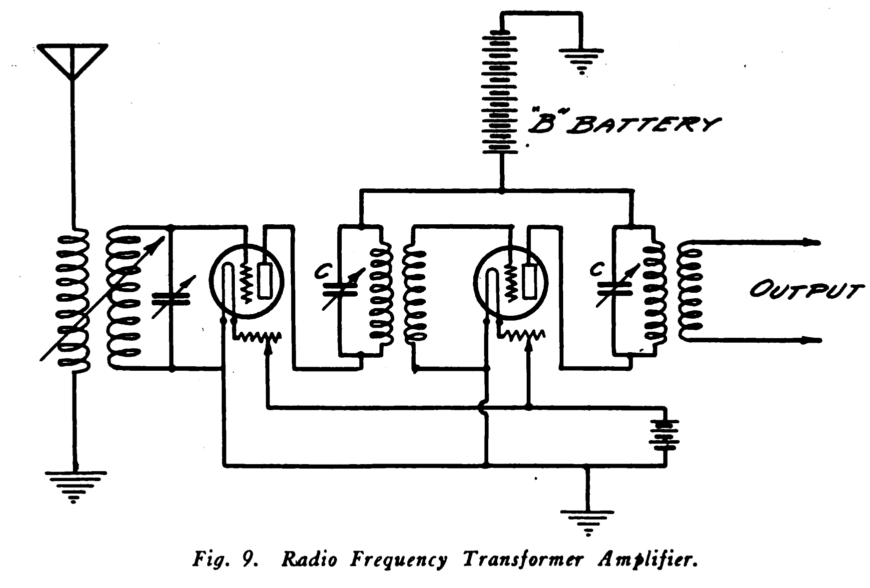


Fig. 9. Radio Frequency Transformer Amplifier.

Without going into the mathematics of the problem, it can be proved that the true amplification is directly proportional to the amplification constant of the tube, μ_o. Hence, all other factors being equal, the larger this is the greater will be the actual amplification obtained. The amplification also increases as the grid-filament resistance increases and as the plate-filament resistance decreases. For maximum amplification the grid-filament resistance should be made as large as possible, compared to the plate-filament resistance.

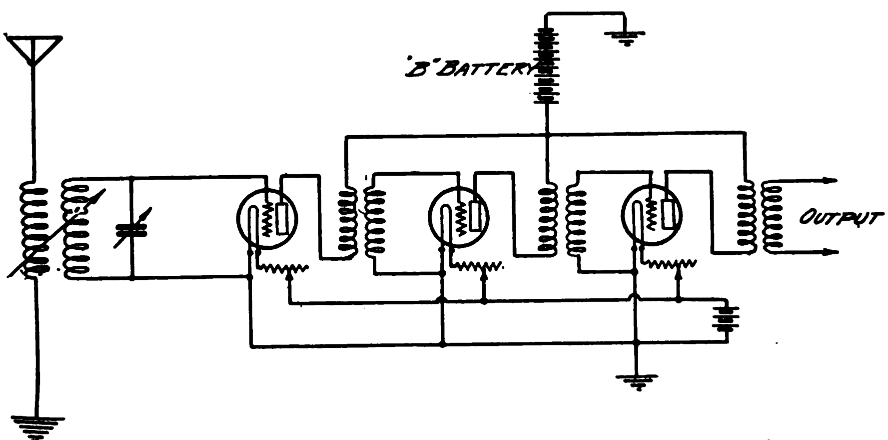


Fig. 10. Transformer Amplifier with Variable Condenser Across Primary

The plate-filament resistance is determined by plate voltage and current for normal operation and is usually given by the manufacturers of the tube. The grid-filament resistance, theoretically, should be as high as possible, this being obtained by using a negative potential of suitable value. The theoretical conclusions and the resulting mathematical equations for the transformer ratio are based on the assumption of an ideal transformer having no leakage, no losses and no distributed capacity. Since no transformer is ideal, these factors will enter and alter the conclusions. Leakage can be minimized by building the transformer around a closed iron core, losses can be minimized by using proper size wire, by using good high-grade, low loss transformer steel, laminated and shellacked. The distributed capacity must be kept a minimum by using the minimum number of turns which will give the required ratio and transformer reactance.

An analysis further shows that the greater the transformer ratio is the greater will be the amplification. There is, however, a limit to the transformer ratio which can be used. Increasing the ratio means increasing the secondary turns, resulting in increased distributed capacity and leakage. This results in lowered amplification. Experiment shows that amplification in any given case increases with the ratio, but a point is reached when further increase in ratio does not bring further increase in amplification. This is the point where leakage and distributed capacity begin to play their role. Practice shows that the limit for transformation ratios should not be greater than 8 or 9.

RADIO FREQUENCY

The circuit and connections are the same here as for a. f. and are shown in Fig. 11. Transformers are air core, in order to eliminate eddy current and hysteresis losses at high frequencies. The design of these transformers cannot be considered on the same basis as for audio frequency because leakage plays a prominent part, since the lines of force travel through air. It can be shown that maximum amplification is obtained when the reactance of the transformer primary is equal to the plate-filament resistance.

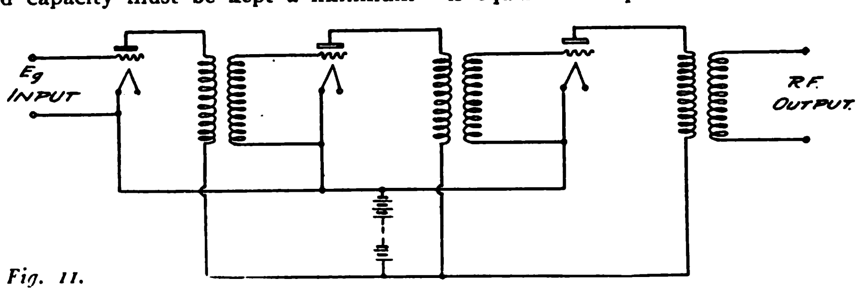


Fig. 11.

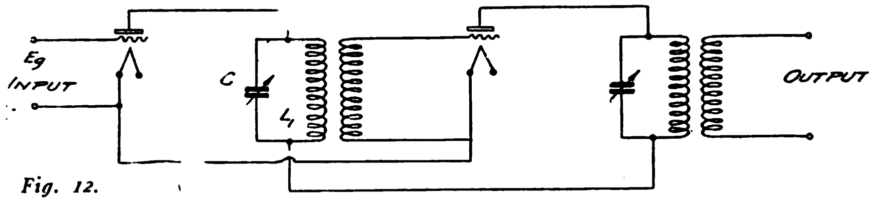


Fig. 12.

If L_p is the reactance of transformer primary then the condition for maximum amplification is $2\pi f L_p = R_p$. It will be found that in most cases the inductance so calculated will be so high that it will be impossible to build the coil without high distributed capacity. Hence the primary coil will have a natural wave length which may fall within the ranges to be amplified. Amplification will be high at this wavelength, but may be very poor at the others.

In order to take care of this contingency there is but one alternative, and that is to modify the r. f. transformer coupling into a combination transformer and tuned circuit coupling. This can be done as shown in Fig. 12, by shunting the primary with a small variable condenser to permit tuning to various wavelengths. Thus, by tuning the circuit to the incoming wave the effective resistance is always adjusted to the best value and high amplifications are secured at each wavelength. This has certain advantages which will be evident from the following. Analysis shows that the amplification is inversely proportional to the primary inductance, hence the lower its inductance the greater the amplification. This means that capacity is preponderant, and since inductance is low, distributed capacity is low and losses are decreased. On the other hand, amplification is directly proportional to secondary inductance. Here the disadvantage is that building a high secondary inductance means high distributed capacity, which may result in destroying amplification. It is therefore advisable to keep the secondary inductance low. This means that amplification will therefore also be kept low, but this is preferable to destroying amplification, on account of high distributed capacity. It is for this reason that a. f. amplifiers invariably give much higher amplification than can be secured with r. f. transformer amplifiers.

One final consideration in this connection: Across the secondary of the r. f. transformer is the grid-filament path of the succeeding amplifier tube. The grid-filament circuit has in all tubes an appreciable capacity. At radio frequencies this capacity will have a very low reactance, and since it is directly in shunt with the applied voltage across the transformer secondary it acts as a short circuit. As already shown, a tube capacity of 30 mfd. at 600 meters has a reactance of about 3000 ohms, which would be an absolute short circuit on the applied voltage. This is the great bugbear in r. f. amplifiers, and no matter how well the other parts are designed, the tube capacity may destroy all the amplification. For this reason it is always best to make an audio frequency amplifier, as it will give better results and is somewhat easier to operate.

A Concert Direction-Finder

By Stanley E. Hyde

FOR receiving broadcast stations a "direction finder" or coil antenna is especially desirable, in that it eliminates interference from other stations operating at the same time. When the coil is turned so that its plane is in the line of direction toward the transmitting station the loudest signals are received. When the plane of the coil is at right angles to this direction no signals are received, or at least they may be very weak.

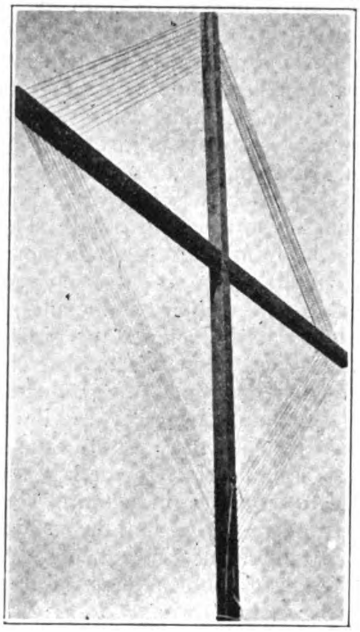


Fig. 1. Ten Turn Loop.

This makes it possible to receive from any one station even tho another may be transmitting on the same wavelength. If both stations are in a direct line with the plane of the coil they can not be tuned out; however this is not very apt to be the case.

For receiving on coil antennas it is desirable to employ an electron tube detector with one or two stages of audio frequency amplification.

Fig. 1 shows a concert direction finder constructed by the writer which works quite satisfactorily in eliminating interference from amateurs and other stations operating during the broadcasting period. It consists of a 6 foot wooden cross made from two pieces of wood 1½ in. x 1½ in. x 6 ft. Both pieces are "slotted" at the center and held together with a 2 in. stove bolt. It will be found that the pancake type coils have sharper directional properties than the flat-top coils. This is illustrated in Fig. 3. The face of the flat-top coil gives a greater receiving area from the distant transmitting station *T*, shown at *A*, than does that of the pancake coil shown at the right, which presents only the width of one turn of wire. For a given size of loop, signals may be received louder with the flat-top type, but this is compensated for in the greater sharpness of tuning, using the pancake coil.

Fig. 1 shows a ten turn loop. Later experiments, have shown that 4 or 6 turns are better for the short waves employed in broadcasting. The holes that the wire passes thru on the cross arms are drilled 1 in. apart, care being exercised that they are properly spaced. Seven No. 22 stranded antenna wires (bare) make up into a loop with little trouble as it is quite flexible and pulls taut upon the completion of the work.

Fig. 4 shows the method of securing the free ends of the coil to the frame. *D* and *E* are wood screws with brass washers, under which the ends are held. To these connections are also led the lead-in wires to the receiver.

This coil antenna in question is placed 6 feet above a sloping roof, is connected with a shaft which passes thru the roof, thru the ceiling and ends with a steering wheel handle (Ford type). Two small holes in the shaft are made to pass out the lead wires to the receiver. See Fig. 2. Fig 5 illustrates this procedure. The shaft consists of a 10 in.

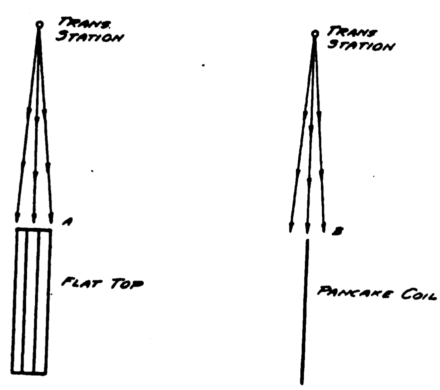


Fig. 3. Comparison of Flat-Top and Pancake Coils.

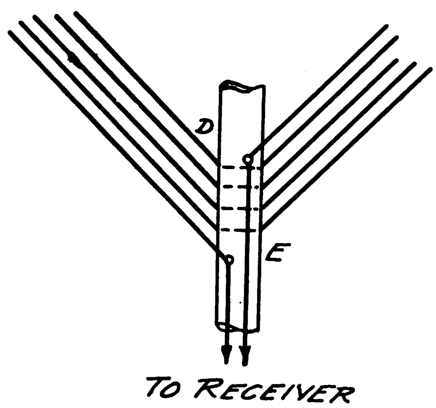


Fig. 4. Method of Securing Coil Ends to Frame.

length of black enameled ½ in. conduit. A ¾ in. hole is drilled in the bottom of the cross arm for a distance of about 8 in. Into this is forced one end of the conduit. Two holes are then drilled in the wood diagonally so that they come out at the entrance of the conduit. See *H* Fig. 5. Another hole is drilled thru both wood and conduit for a ¼x2½ in. stove bolt, shown at *S*. This bolt prevents the shaft from slipping around inside the wood

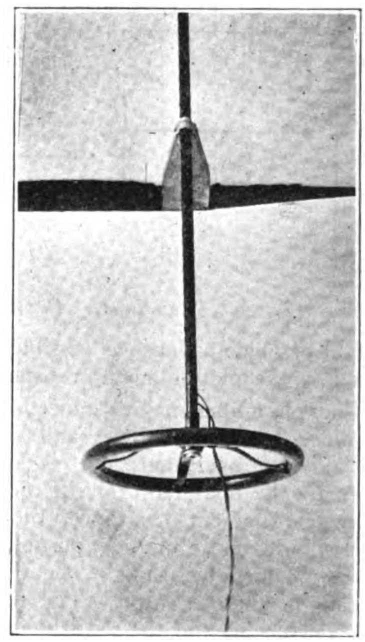


Fig. 2. Control Wheel for Loop.

arm. Untwist about 14 in. of flexible lamp cord and "fish" both of them thru the conduit, by first pushing two small copper wires thru the two holes into the conduit and out the bottom end. Connect the two leads of lamp cord to these fish wires and pull them out the holes and connect to the brass wood screws.

A hole is then drilled or bored thru the ceiling over the radio table or instruments, care being taken not to break the plaster. Then with a plumb-bob find the place to cut the hole thru the roof. The hole thru the ceiling is preferrably bored in the center of two joists. The iron flange, which is secured to the conduit by the set screw, rests and turns on the piece of hard wood, supporting the entire weight of the coil antenna, shaft and handle. *P* is a brass or nickel plated pipe collar that conceals the hole in the plaster and keeps particles of plaster from falling onto the instruments or table.

Before slipping the shaft thru roof, a funnel shaped piece of tin is slipped on. This, with the addition of roof-ing tar or paint, makes the arrangement water proof.

Fig. 6 depicts the method of securing the hand wheel to the end of the

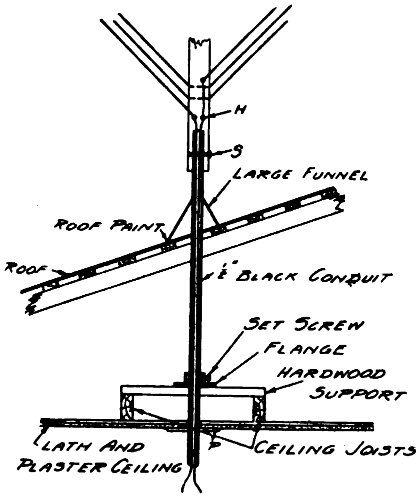


Fig. 5. Connection Through Roof.

shaft. A ½x3 in. expansion bolt butts the hand wheel center flange onto a ½ in. coupling. Tightening up this bolt securely holds the wheel tightly to the end of the shaft. Previous to this

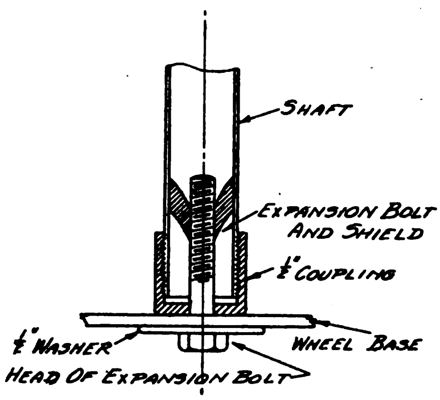


Fig. 6. Method of Fastening Wheel to Shaft

operation the lead wires are fished out from the shaft thru two holes as shown in the same figure.

A little lubricating oil placed under the supporting flange will make a shaft turn easily and prevent frictional noises. Fig. 7 shows a simple regenerative or feed-back circuit that works well with

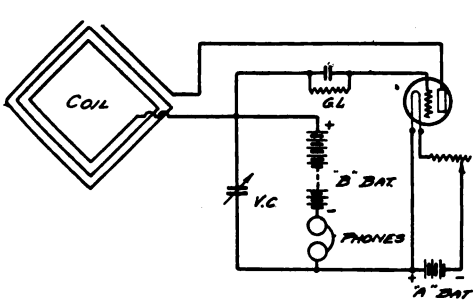


Fig. 7. Feed-Back Circuit for Loop Antenna

a coil antenna. In such a circuit a variable condenser should always be used in series with the loop, otherwise the "B" battery will be shorted out thru the telephones. Any circuit that employs such a condenser may be used successfully with the loop antenna.

It is found advisable to have a shaft as short as possible and to connect it to ground. The only reason for having the coil on the roof is that it was rather too large to have in the room, and the space in attic was very limited for a 6 foot coil.

If the leads from the coil are too long they in themselves act as an antenna and spoil the directional effects of the loop. No doubt such an arrangement would work equally well if placed on the outside of a window with the shaft geared to a horizontal piece coming thru the wall.

RADIO COMMUNICATION AT PAN-PACIFIC COMMERCIAL CONGRESS

Rear Admiral H. J. Zeigemeier, Director of Naval Communications, who has been designated to represent the Navy at the First Pan-Pacific Commercial Conference at Honolulu, October 25-31, will speak there on communication and transportation, giving special attention to a survey of the present cable and radio activities, and will discuss the establishment of lower special rates, fixing responsibility and granting improved facilities for the press.

CARLTON SAYS RADIO WILL NOT HURT CABLES

The rapid growth of radio communication has led to considerable speculation in financial circles as to just what its effect might be on the future of the cable business. An analysis of the situation was sketched recently by Newcomb Carlton, president of the Western Union Telegraph Company, which created wide interest in Wall Street because of the authoritative position which Mr. Carlton holds in the telegraph industry.

"The Radio Corporation of America is today transmitting from 12 to 14 per cent of the eastward and westward business between the United States, Great Britain and Continental Europe," said Mr. Carlton in describing the relative positions of the two forms of communication, radio and cable. "While a considerable part of this business would no doubt have gone to the cable companies, an important part is newly created traffic. The radio rate from New York to London is 18 cents a word, competing against a cable rate of 25 cents. In other words, with rates 30 per cent cheaper, the radio is doing from 12 to 14 per cent of the business.

100,000 WATT VACUUM TUBES

In the telephone laboratories of the Western Electric Company has been developed a vacuum tube capable of supplying 100,000 watts. The essential feature of the new tube is that the "plate" is a copper cylinder forming the outer wall of the tube. In the customary tubes used in radio sets, the "plate" is an actual plate or small cylinder of thin metal enclosed in a glass tube. If even a small fraction of an ampere is passed through the plate circuit of one of the small tubes, the plate will become very hot. In the larger "power" tubes this heat becomes so great that some means other than radiation must be provided to carry it off, or the tube will collapse. This is easily done when the plate is the outer wall of the tube, for it can be put into a tank of water which circulates through a radiator. The tube is then water-cooled just like an automobile engine.

This sounds easy enough. The real difficulty was to make the whole tube air-tight and to get the wires for the filament and grid into the tube while keeping them insulated against about 20,000 volts. After much study, the problem was narrowed down to finding a way to make an air-tight joint between the heavy copper tube which forms the "plate" and the glass of the upper part of the tube, and to bring the heavy wires through this glass. Credit for the answer is due to Mr. W. G. Housekeeper, a Western Electric engineer, who discovered a way to seal copper to glass which would make an air-tight joint that would not crack at any ordinary working temperature.

The anode, which is made of a piece of seamless copper tubing closed by a copper disc welded into the end, is 14 in. long and 3½ in. in diameter. The filament is of tungsten and is .06 in. in diameter and 63.5 in. long. The current required to heat it is 91 amperes and the power consumed in it 6. The filament leads are of copper rod ⅛ in. in diameter and are sealed through 1 in. copper disc seals. The grid is of molybdenum and is wound around three molybdenum supports.

One of these big tubes stands three feet high and is 3½ inches in diameter at the bottom. To heat the filament, for which in radio receiving tubes a single dry-cell or a small storage battery is enough, this tube used 6,000 watts. For the plate circuit, instead of the familiar "B" battery, a high voltage direct-current generator is used, or an alternating current rectifier. The combination of vacuum tube and its current supply, it is expected, will be less costly, more rugged and more easily adapted to various wavelengths than any other source of radio power now in use.

LETTERS TO THE EDITOR

Scraps About Scrapping Sparks

Sir: Upon reading the Radiotorials of October RADIO I came across the article about radio dealers furnishing CW apparatus to amateurs at wholesale prices in order to do away with spark transmitters. The reason for their actions is that amateur spark transmitters interfere with the broadcasts.

In regards to this so called interference, I am in possession of a short wave regenerative set and one step amplifier and on it I have heard the concerts from all the principal radiophone stations on the coast, and on no occasion have I been interfered with by amateur spark sets. In fact I have very seldom heard one when I had my set tuned to 360 meters with the detector oscillating, and when I did they were so faint that they caused no interference, in spite of the fact that they were only about a mile away. The cause of the interference that broadcast listeners experience is caused by antiquated apparatus, such as tuning coils, loose couplers, etc; and modern apparatus that does not tune sharply, such as single circuit tuners.

So much for interference. In regards to junking the spark for CW. If you listen to the amateur stations that are handling relay traffic after 10 o'clock you will no doubt notice that the major portion of the relay messages are sent via spark stations. In fact I would say that three fourths of messages are handled by "sparks," and if the spark stations were closed down the messages would have to be sent via lowpower CW sets, and I claim that this is unreliable for nearly all the long distance work that is done by CW is one-way only; i. e., the sending station being "reported" by some distant listener and not "worked."

In regards to these relay messages (which, by the way, are the principle reason why most amateurs sit up after midnight) the majority of broadcast listeners do not know that any amateur is only too glad to relay a message for them or anyone else absolutely free of charge.

The gist of this proposal of the dealers is to eventually do away with amateur radio in order to enjoy a selfish monopoly of the air, which is the gracious thanks we get for making radio what it is today.

Sparks forever,

A BELLIGERENT HAM.

Alameda, Calif.

Radio Frequency Amplification

Sir:—I have before me the September issue of "Radio" and I find that both the editorial comment and Mr. Lippincott's article on Radio Frequency Amplification are particularly interesting and are none the less so because I am so strongly in disagreement with many of the statements made. On hasty perusal of the editorial comment, I was left with a sense of the utter hopelessness of ever being able to devise successful radio frequency amplification. The effect of your editorial on me is due in a large way, I suppose to its being exceptionally well written, so much so that the fallacious statements or inferences were wholly submerged by the sense of futility with which it left me. I must, however, take this opportunity of expressing my disagreement, if for no other reason than to regain for myself, my complete confidence in radio frequency amplification as the means for making available to the nation, the tremendous amount, both in effort and in dollars that is being spent on radio broadcasting today.

You would infer in your third editorial paragraph that the possibilities of amplification at radio frequencies are practically nil, since no gain in voltage can be secured in the intervalve transformer, and while I must agree that with the tubes that are available to the amateur and novice today, any worth-while voltage step-up in the transformers of the system cannot be secured I know, as do you, that the vacuum tube even at frequencies well in excess of a million cycles gives a very useful power amplification and that this power amplification is not of a degree to be on the verge of uselessness, but, on the contrary, can actually be taken advantage of to the extent of making possible degrees of amplification which would probably be impossible of attainment without the use of radio frequency amplifying transformers. I believe that you would be fairer to the radio frequency amplifier if you would see in it, not a substitute for the more commonly used audio frequency amplifier, but rather a scheme to supplement the audio frequency amplifier and hence, a scheme whereby communication is made possible over ranges and with such insignificant antennas that have in the past been quite impossible, and this without serious operational complication and without loss in stability.

I feel of course as you do, that we should have tubes whose characteristics are more nearly suited to the requirements of the radio frequency amplification. I believe that such tubes can quite easily be designed without seriously effecting their other useful properties and that the art of amplification will be greatly improved when such tubes are available. Such tubes will, however, merely simplify the matter of the design of effective radio frequency amplifying equipment rather than to remove it from the realm of the impossible into that of the possible as you would imply.

You of course, through the publicity which you control are well able to help to bring this state of affairs about and you have my heartiest good wishes and my offer of assistance in anything which you may do in this matter.

Let me point out, however, that with no tube, however well designed, will we get what you term "an efficient all-wave amplifier," even though in the extreme case, we were to limit ourselves to the relatively inefficient resistance coupled amplifier, and that we must continue to look forward to narrow band R. F. Amplifiers as compared with the breadth of band of A. F. Amplifier. The average radio frequency amplifying transformer of this day is admittedly low in efficiency or is of extremely narrow frequency band. A high degree of efficiency and broad frequency band are essentially inconsistent in any coupled circuits where resonance, or any approach to it is involved and this same lack of consistency between frequency range and efficiency is characteristic of all electrical or accoustical apparatus and we must in all fairness to any devices which we criticise certainly bear in mind that this inconsistency is quite naturally inherent and that only by especially careful design can the best compromise between frequency range and efficiency be realized. There are several methods by which this may be done and the most effective device is one in which the best compromise is made. I am in hearty agreement with Mr. Lippincott that a high degree of workmanship and material is required in the radio frequency amplifier and that his "Chinese New Year Celebration" will be fatal to the operation of such an amplifier, but I must point out that no more careful choice of material and workmanship is required in the construction of a good radio frequency amplifier than is required in the tuning system of a good radio receiver. It is necessary perhaps that more care be taken to see that interconnections between parts are as short and as direct as possible and that good dielectric materials are in the dielectric fields that exist.

I object very seriously to Mr. Lippincott's point that enameled wire impregnated or unimpregnated in radio frequency transformers is quite fatal to their action. This is usually the fact but it need not be since an energy loss in such material can only exist when a voltage exist across that material. It is quite easily possible to build radio frequency transformers in which the voltages which exist between adjacent conductors are so small as to be utterly neglible and such transformers of the type I have in mind have extremely desirable characteristics in the way of gain and range and to which the low dielectric loss is merely incidental.

The schemes for making amplifiers interchangeable, as pointed out by Mr. Lippincott, are, of course, to be condemned whole-heartedly as are the sharply tuned amplifiers which he mentions, since such amplifiers have not only a narrow frequency band but a high degree of instability, which to my mind more than nullifies the possible advantage of their efficiency.

I disagree with the editorial statement that the Armstrong "Super-hetrodyne" is seriously at a disadvantage in that it requires a large number of tubes and I believe you will agree with me if you will review in your own mind the circuit arrangements, since you will find that with the exception of the local generating tube and the first rectifier, there is nothing more required than in the case of the R. F. Amplifier and under certain conditions, the function of generator or detector, or both can be combined in the first tube or may be accomplished with only one additional tube. I wish to correct you in this regard, since through the Armstrong super-hetrodyne scheme, many of the disadvantages of radio frequency amplification at the very high frequencies are eliminated and its actual effectiveness for increasing the signal voltage before rectification may then be taken advantage of in an extraordinary degree. I believe that this scheme of amplification will ultimately come into exceedingly general use and probably entirely replace the ordinary type of R. F. Amplification. Your criticism of the Armstrong super regenerator is quite in agreement with my own attitude toward the device, but since my experience with it is limited to a few trials I am not willing to put myself on record as saying that it is too critical for general use. I feel that with a year of development work behind us it, too, will have become a very practical scheme and that we may well look to this scheme for exceedingly high degrees of amplification with higher power output than has ever been possible in the past with relatively simple and cheap apparatus.

I would be indeed glad to have you publish this letter in the columns of your very worthy magazine and to hear from others of your readers as to their experience with and criticisms of the various amplification schemes here discussed.

Respectfully,

LAURENCE C. F. HORLE.

Buffalo, N. Y.

NEWS OF THE RADIO CLUBS

The North Shore Radio Club of Chicago issues a clever mimeographed paper known as the "Radiator Glues," of which 9BRE seems to be the chief instigator. The feature of the September number was "Thy and Ur Neighbor," wherein Brother Bill's new C. W. transmitter raises as much ire among the neighbors as did his old spark set. 9BDL is mourning the loss of a fine QRN collector because the landlord objects to his Ant Enna.

The American Radio Relay League announces another series of trans-Atlantic tests from Dec. 12th to 31st, during which time it is hoped to hear French and English amateurs on this side as well as to have American and Canadian stations heard on the other.

The Bay Counties Radio Club is holding weekly meetings on Friday evenings at Library Bldg., 52nd and Telegraph Ave., Oakland, Calif. The first meeting of each month is given over to a feed and social events, with prominent speakers addressing the other meetings on some subject of radio interest. Fred A. Anderson is president.

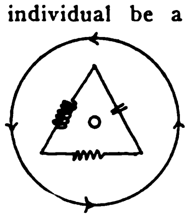
The organization meeting of the Piedmont High School Radio Club was held Sept. 14, about thirty prospective members being present. It was agreed to form Junior and Senior Sections of the club to accommodate the needs of various members, depending upon their experience. Officers elected: Arthur Merrill, president; David Atkins, vice-president. The club will meet weekly, Junior Section on Tuesdays, and Senior Section on Thursdays.

Meetings of the Sunset Radio Club at San Diego, Calif., were suspended during the summer, but will be resumed in October. Lester Picker, 6AJH, is getting a real wollup out of his new 20 watt C. W. and fone set. With 2 amps in the antenna on the initial adjustment he worked 7OZ within ten minutes after the installation. With 1½ amps in the antenna and good voice modulation, his telephone promises much. Lester has already placed his spark set in the junk pile. Lex B. Benjamin, 6XAQ, and W. Lindsay, 6ZF, visited San Diego recently. The "Round & Rounders Club" presented Mr. Benjamin with a loving cup beautifully engraved in charcoal with the emblem 5c. Lex B. made a blushing response. Elliott Pohl, the handsome young announcer at KDPT, has found a new voice lozenge which he recommends to broadcasters as producing the best imitation of a man talking, so far discovered. 6BJY leads all San Diegians in the C. W. miles per watt contest with his 10 watt transmitter. 6MZ has been in Mexican waters on his yacht, the "*Spray*," KDYB, for three months. It is rumored that on his return he will install C. W. to replace his famous sink set. Deputy Radio Inspector D. P. Trim has dismantled his set owing to change of residence, but promises the big noise again in the near future with straight C. W. The recent visit of Messrs. Cattell and Wisner to the NPL arc and spark stations have proven effective relief from mush and other interference. 6AHF having exhausted his spark, is rushing the completion of a 20 watt rectified A. C. transmitter. 6BJU has not lost any time during the summer months sending and receiving messages and promises much for the coming season's relay work. 6BJV, George Remington of Coronado, is reconstructing his station for winter traffic and will eliminate spark, according to reports. The club is planning to meet at San Ysidro at the station of 6AJH in the near future.

THE "ROUND AND ROUNDERS"

Radio has developed many sidelines. We have seen in the good old days, the three, four, and six inch spark hound entrenched in his thunder factory, the DX results being almost as audible via the air as the ether. The carborundum fiend was followed by the galena craze. At a later date came Fleming tubes, DeForest bulbs and circuits without end. Then Armstrong started brainstorms in the amateur ranks by bestowing his regenerative circuit. Rotary gaps superseded the straight ones. The law demanded an actual tune to 200 meters and not more. Antennae fearfully and wonderfully constructed and conforming to all possible variations broke up the landscape. Finally CW appeared. It is common practice among amateurs to attain a given result with receiver and transmitter and immediately become dissatisfied, with a result that the whole works is torn up and reconstructed.

In San Diego, not satisfied with the limited opportunities for argument afforded by monthly meetings of Sunset Radio Club a certain coterie of amateurs who had found themselves going "round and round" in the vain hunt for maximum transmitting and receiving efficiency, formed an informal association called the "Round & Rounders." Qualifications for admission to this circle are that an individual be a recognized amateur in radio or interested in the art. Meetings are held daily at noon at a restaurant, in a private box. Members come and go as they please, Dutch treat being the rule. Since the illusive ohm seemed to be the main source of all radio difficulties this was given a center place in the emblem adopted. Encircling the ohm is found a resistance, an inductance and capacity in series. The circle with arrow points denotes the name. Whenever a visiting amateur arrives in town one member of the Round & Rounders is sure to grab him and hale him before the festive board in an endeavor to spoil his appetite. All who have set at the "Round & Rounders" table have admitted that they have found this informal discussion-method of attacking radio one of the greatest helps they have experienced. When a member finds himself faced with a difficulty he springs it the next day. If the trouble is not cleared up that day someone is sure to dig up a remedy the day following. Some of the hottest arguments ever staged have been threshed out in this way. Some of the most firmly cemented friendships have been made possible through the "Round & Rounders."



It would seem that every city could have a "Round & Rounders" Club as there is not always time at a formal radio club meeting to dispose of individual needs of members. Since the "Round & Rounders" have flourished now for a period of over two years it is no longer an experiment. The members desire to pass a good thing along.

The San Diego Chapter has the following membership: Major John F. Dillon, Radio Inspector 6th District, San Francisco, Cal., D. B. McGown, Asst. Radio Inspector, San Francisco, Cal., Mr. Linden, Asst. Radio Inspector, San Francisco, Cal., Roy K. Freeman, Electrical Engineer, Long Beach, Cal., A. A. Hudgins, 6IZ, Coronado, Cal., John F. Gray, 6MZ, Del Mar, Cal., Coleman M. Gray, 6MZ, Del Mar, Cal., Milton Jackson, 6IZ, San Diego, Dr. A. E. Banks, 6ZB, San Diego, D. P. Trim, Deputy Radio Inspector San Diego, Lex B. Benjamin, 6XAQ, Los Angeles, B. Lindsay, 6ZF, Reedley, Cal., Lawrence Mott, 6XAD, Catalina Island, A. E. Bessey, 6ZK, Sunnyvale, Cal., I. I. Mahler,, Jr., Sunnyvale, Lt. F. S. Bennett, U. S. Navy Radio Aide, Mare Island, F. L. Wisner, Oakland, G. MacMullen, Coronado, Edward Banks, 6AAZ, San Diego, E. P. Merritt, KDPT, San Diego, F. K. Johnson, 7YJ, Corvallis, Ore., Chief Petty Officer Duane Stewart, U. S. Navy, San Diego, George Remington, 6BJV, Coronado, Lester Picker, 6AIH, San Ysidro, Al Frost, San Diego, F. Cattell, Mare Island, H. Berringer, 6ZR, Los Angeles, F. W. Van Why, 6ZG, Los Angeles, H. A. Duvall, 6EN, Los Angeles.

One attendance qualifies for a life membership. There are no dues. There is no policy, the sky is the limit. One may choose one's own diet—BUT—ARGUE ONE MUST.

No C. W. at 3BV

Sir:—I have been receiving numerous "QSL" cards for a station signing "3BV" on CW. In several instances the cards said that the station had been "Worked." There is no CW at 3BV, and if anyone can get in touch with this station, signing 3BV, and get a QRA they will be doing me a great favor if it is forwarded to me at once. I have been hearing the station myself, but have nothing but a vague location for it at present.

I would appreciate it if you would allow this letter to be published in your paper.

Yours for better radio,
PAUL G. WATSON.
214 West Barnard St.
West Chester, Pa.

NEWS OF THE AMATEUR OPERATORS

Radio call has been reissued to Clarence T. Stevens, 434 60th St., Oakland, Calif.

Will any one hearing 6BRG-C. W., please QSL to 1708 W. 23d St., Los Angeles.

The correct address of 6BDW is 232 N. Gower St., Los Angeles, Calif.

News of the Broadcasters

KSD, THE FIRST CLASS B STATION

As KSD, the class B station of the St. Louis, (Mo.) *Post Dispatch* has been heard on both the Atlantic and Pacific coasts, on the Gulf and at Alberta, Canada, a description will be of wide interest. The transmitter is a standard Western Electric 500 watt outfit installed in a brick structure on top of the Post Dispatch Building. The studio is on the second floor of the same building. The

One of the Towers of KSD on the Roof.

4-wire antenna is supported by two 80 ft. steel towers on the roof 131 ft. apart. the lead-in comes from the center giving a T-aerial.

A 5 h. p. motor-generator set housed in a sound-proof compartment supplies 1600 volts for the plate circuit and 16 volts for the filament circuit of four 250-watt tubes.

The view of the operating room shows the speech input panel at the left, the transmitter set at the rear center and the power panel at the right. On the table may be seen the receiving set, loud speaker and two stage amplifier together with microphone transmitter.

As the standard transmitter apparatus has been described several times in these columns its details as applied to this installation are omitted. The general arrangement is shown in the side view. Two 250-watt tubes are used in modulators and two as oscillators.

Among the many letter reporting distinct reception is one from WTD, G. E. Robinson, operation on the *F. H. Buck* who reported good reception on one step of audio frequency amplification while 30 miles off the California coast 50 miles north of Point Arguello.

CLASS B APPLICATIONS

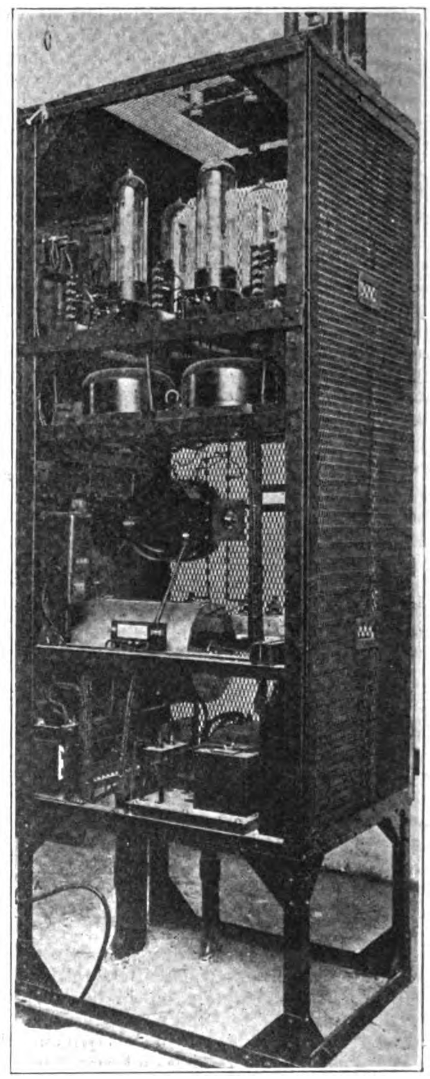
Several applications from larger broadcasting stations for the Class B License, permitting the use of the 400 meter wave, have been received by the Department of Commerce, but to date only two have been authorized to transmit on this wave. They are the St. Louis Post Dispatch and the Westinghouse Station at Chicago. The officials in charge of the licensing of radio stations do not anticipate that more than a dozen applications for the Class B license will be received, as only the most powerful stations carrying high-class entertainment regularly can hope to qualify.

Operating Room of KSD.

RADIO STATION K. F. B. K.

By Hugh R. Sprado

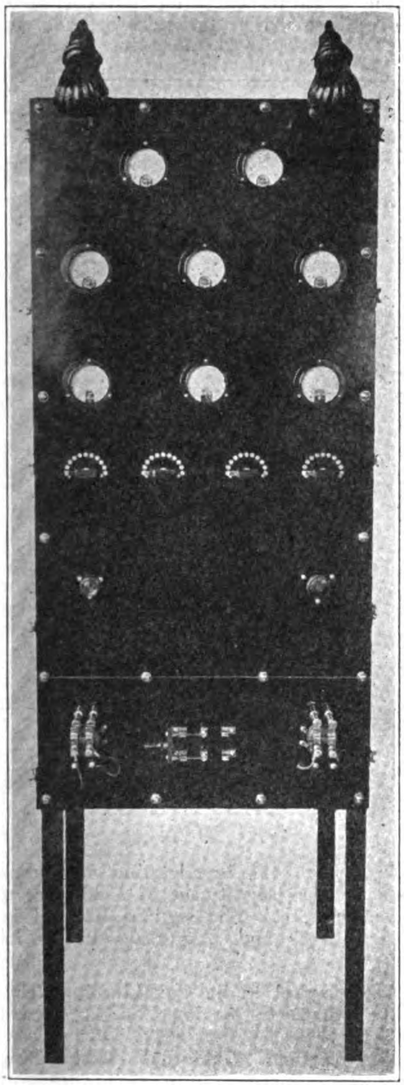
KFBK, the broadcast station of the Kimball-Upson Company and the Sacramento Union of Sacramento, Calif. started operations on September 2nd with the first four letter call letters heard in the west. Telephone calls from all parts of California reported unusual strength of signals and clearness of music and voice. For a week later letters kept pouring in from all parts of the West, some of the most interesting coming from San Diego, Calif., Alert Bay, B. C., Pueblo, Colo., Kingman, Ariz., Hanna, Alberta Canada, and Lorborn in Saskatchawan, Canada. All said that signals were wonderfully clear and distinct.



Side View of Transmitter at KSD.

KFBK is not a high powered station, its maximum output being 50 watts of radio frequency power. The great range of the transmitter is due to the unusual design, the entire transmitter being mounted in one complete unit as shown in accompanying pictures.

Three shelves in the rear of the panel contain all the parts making up the transmitter. The lower shelf contains the high and low tension line fuses, filter choke coils and filter condensers, and filament heating transformer. The second shelf holds a plate circuit reactance coil, grid biasing batteries, and modulation transformers. The upper shelf contains only radio frequency appaatus and tubes. A large oscillation transformer is mounted on the rear and directly in front of this are three 50 watt vacuum tubes. One tube is used as the oscillation generator and two tubes as modulators to control the output. A 5 watt tube is also used for amplification of the speech currents which control the two modulator tubes. Numerous condensers, radio frequency chokes and other small but important parts are also mounted on this upper shelf. An electrically operated antenna send-receive switch is mounted in one forward corner of this upper shelf.

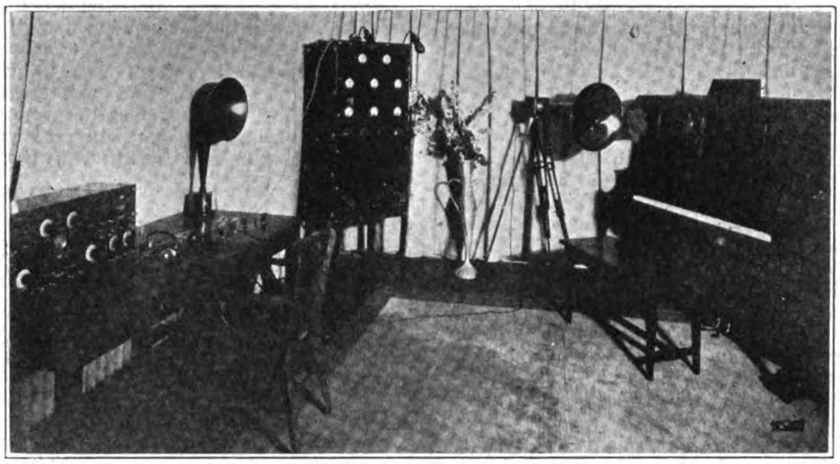


KFBK Panel Front.

The panel proper is of highly polished Formica. On it are mounted eight meters placed in the following circuits; antenna, for measuring radiation current; 1500 volt meter across high voltage generator; 500 volt meter across plate and filament of 5 watt speech amplifier; 200 milliampere meter in modulator plate circuit; another milliammeter in oscillator plate circuit; still another milliammeter in speech amplifier plate circuit; and two voltmeters for 5 watt and 50 watt filaments. With this outlay of meters, no guessing need be done as to what is happening in any circuit. Under-modulation, bad tubes, or any other defects are shown instantly by the meters.

Below the meters are mounted four variable resistances, the one on the extreme left being 500,000 ohms in ten steps of 50,000 ohms each and is shunted directly across the secondary of the modulation transformer. This resistance acts as a load for the transformer secondary, thereby eliminating distortion due to potential surges which are common when using a potential transformer with an open circuited secondary. The potential drop across any portion of this load resistance can then be utilized for controling the speech amplifier and permits of any degree of modulation.

The second resistance is made up of ten 4000 ohm units in series. and are used for



KFBK Operating Room and Studio

cutting down the potential of the high voltage generator sufficiently to be used on the plate of the small 5 watt speech amplifier tube. By this method, any voltage from 150 to 1000 is available for speech amplification.

The third resistance is used for coupling the plate circuit of the speech amplifier to the grids of the modulators and can be varied to control the voice input to the modulator tubes. The last switch controls the grid leak resistances of the oscillator tube and is variable in ten steps of 1000 ohms each. It has been found that different tubes require different grid leak resistances, and a variable resistance allows adjustment for maximum output.

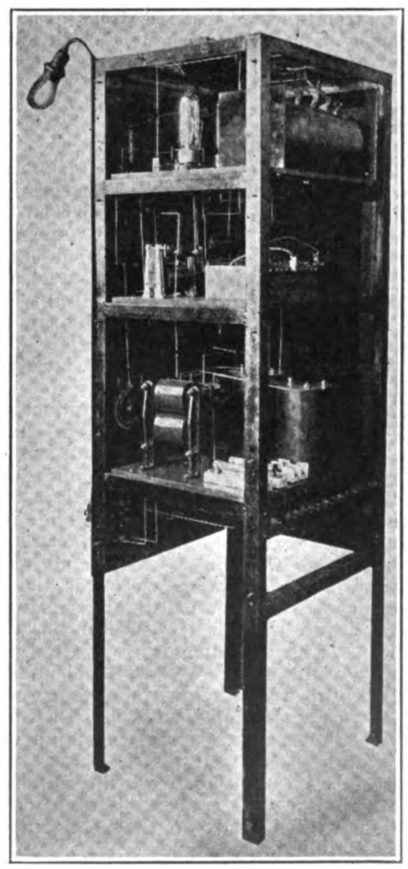
The two small knobs are filament rheostats. One rheostat is used in the filament circuit of the 5 watt speech amplifier, while the other controls the filaments of the three 50 watt tubes. The small switch in the center of the lower panel changes the ratio of primary to secondary voltage of the filament heating transformer. When thrown to the left, the transformer supplies 10 volts to the filament circuit, and when thrown to the right the transformer supplies 12 volts. This feature is of value when the 110 volt supply voltage drops too low to give full 10 volts across filaments.

Two small electrically operated contactors are seen on either side of the filament supply switch.

A Robbins and Myers ½ kw 1000-1500 volt motor generator supplies the high potential to the plates of the vacuum tube modulators and oscillator. This motor generator is installed in a room adjoining the studio and is mounted on felt pads to prevent any noise or vibration reaching the microphones.

Three microphones are provided, one hand microphone for the announcer and two special pick-up microphones for music or speeches. The pick-up microphones are of special design and are built to reproduce perfectly every sound that reaches them. Special precautions have been taken to eliminate "blasting" of musical notes of some particular frequency. The microphone proper is mounted in a small cabinet heavily lined with felt. Music or voice is picked up through a small hole in one side of the box. A horn can be attached to this box when necessary to record very weak sounds.

Probably the most unique feature of the set is the control table shown to the left of the transmitter panel. This table has mounted on it a board by which the operation of the transmitting equipment can be controlled. Push switches with red indicating lights control the antenna send-receive switch, the motor generator starting contactor, the filament supply contactor, and the plate supply contactor. This system of switches and contactors are also "interlocking," that is, they are so arranged and connected that no harm can be done to the tubes by throwing in the wrong contactor at the wrong time. The 1500 volt plate supply can not be connected to the tubes until the filaments have been lighted and until the antenna switch is in the "send" position. Should the tubes be excited while the antenna is disconnected from the oscillator tube, its plate would get white hot and finally melt. Through the above method of interlocking, this is impossible and will



Rear of Panel.

probably save many tubes during the life of the set.

The control panel also contains switches and jacks for switching any microphone on or off. A potentiometer is placed in each microphone circuit to regulate the current flow thru its particular microphone. Means have also been provided for increasing or decreasing the modulation of any particular microphone. This is an advantage where two instruments or a singer with piano accompaniment are being broadcast; the singers voice may be made louder than the piano or the piano louder than the singer or both can be made equal.

The antenna system consists of two 2 ft. cages each 85 ft. long and of six wires. They are supported by two 60 ft. poles on the roof of a 90 ft. building. The lead-in wires are approximately 80 ft. long. Directly beneath the antenna and 6 ft. from the roof is a twelve wire counterpoise. Both counterpoise and ground connection are used, by tuning the ground and counterpoise separately. The antenna current at 350 meters is 4 amperes when not modulating and rises 5 amperes at full modulation. No generator hum is noticeable when transmitting, even when listening in the studio with a detector and two stage amplifier, the filter circuits being designed for a "cut-off" frequency of 30 cycles. The absence of any foreign noises is probably one of the chief reasons for the excellent quality of modulation of this station.

No tone arm is used when transmitting phonograph music, as the full quality of the record is preserved and the needle scratch or "surface noise" is eliminated by recording the music through one pick-up microphone placed some distance from the phonograph. This complete station, designed by the writer, was built by the Radio Specialty Shop of Oakland, California. Before shipping the set to Sacramento it was given a thorough test in Oakland. A small single wire receiving antenna was used for transmitting, and with an antenna current so small that it would not flicker the radiation meter, reports were received from a point 95 miles east saying that test music was strong and clear.

NEW SALT LAKE BROADCAST STATION

KDYL, the new broadcast station of the Salt Lake (Utah) *Telegram* installed on the top of the Newhouse Hotel came on the air Aug. 28th with some exceptionally fine operatic and instrumental programs which have been enjoyed by radio fans thruout the Rocky Mountains and Pacific Coast territory. The equipment was designed and installed by Mr. Ira J. Karr, an electrical engineering student at the University of Utah.

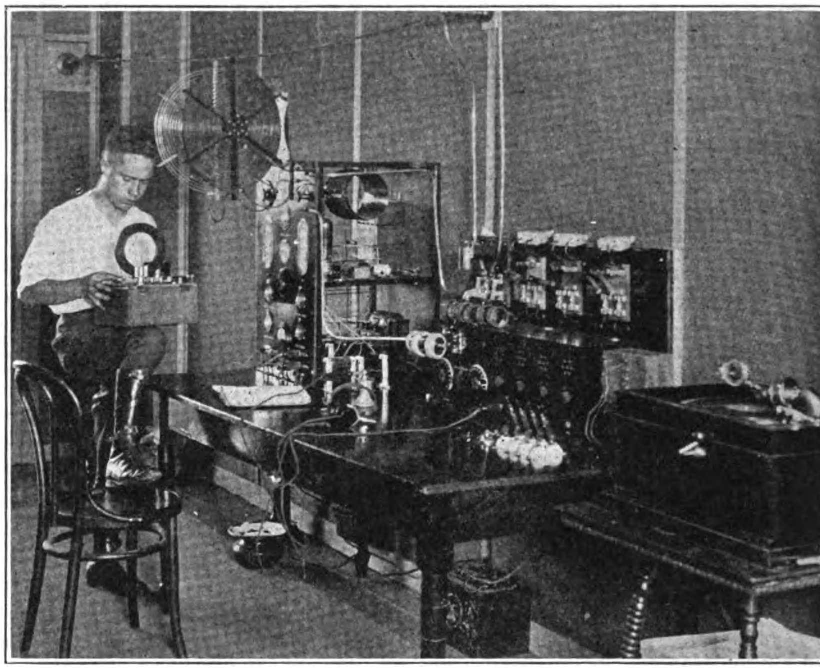
The antenna consists of 10 conductors of 7-22 copper wire arranged as a cage. The hoops are of copper band and are 18 in. in diameter. One of these hoops is placed every 15 ft. The antenna is insulated at either end by four 10 in. insulators in series. The lead in cage is taken off at the exact center and also consists of a 10 wire cage. This is brought down directly to the bushing which leads to the transmitter in the station. The antenna is supported 45 ft. above the roof by two steel masts making the total height above ground slightly over 240 feet and is 150 ft. long.

The counterpoise system is supported 12 ft. above the roof by the same two masts. It is a duplicate of the antenna with a similar cage lead-in. Ground connection is also made to the steel frame of the building.

The transmitter is designed to deliver 50 or 100 watts of reversed feed back circuit being employed. The inductances are mounted on the front of the main panel thus assuring rapid and convenient change of wavelength. All meters are mounted on this panel and every vital circuit is metered. The Heising system of modulation is employed. A cam switch is used to determine whether undamped continuous waves, interrupted continuous waves or voice be transmitted. In this way code may be used when desired. Normal antenna current will be in the neighborhood of four amperes. A wavelength of 360 meters will be used for music, news and like matter, 485 meters will be used for weather reports.

The operating room has concrete walls and is made non-reverberatory by hanging heavy cloth on all sides. All controls are mounted on a switchboard behind the operating table and convenient to the operator.

The studio adjoins the operating room and also has concrete walls hung with heavy cloth. Separate microphones are used for the collection of different kinds of music. These are all controlled from the operating room. Arrangement has been made for the accommodation of complete orchestras or bands. Piano accompaniment to vocal selections will also be clearly audible.



Interior of KYDL, Showing Ira J. Karr as Operator.

NAVY DAY IN THE AIR

Radio broadcasting will be employed in connection with the celebration of Navy Day on Friday, October 27th by Assistant Secretary of the Navy Roosevelt at the instance of the Navy League. While representatives of the Navy League and Naval organizations throughout the country will undertake to promote general interest in the Navy and its gallant traditions through meetings, concerts, banquets and with the aid of the moving picture industry, a number of the large and more powerful broadcasting stations have been invited by the Navy League to put on a radio program. In this connection all Naval stations have been ordered to assist in making Navy Day a national celebration which shall be remembered by the radio fans. Either the Navy or the League will furnish speakers, glee clubs or other forms of entertainment to the radio stations cooperating.

BROADCASTING STILL GROWING

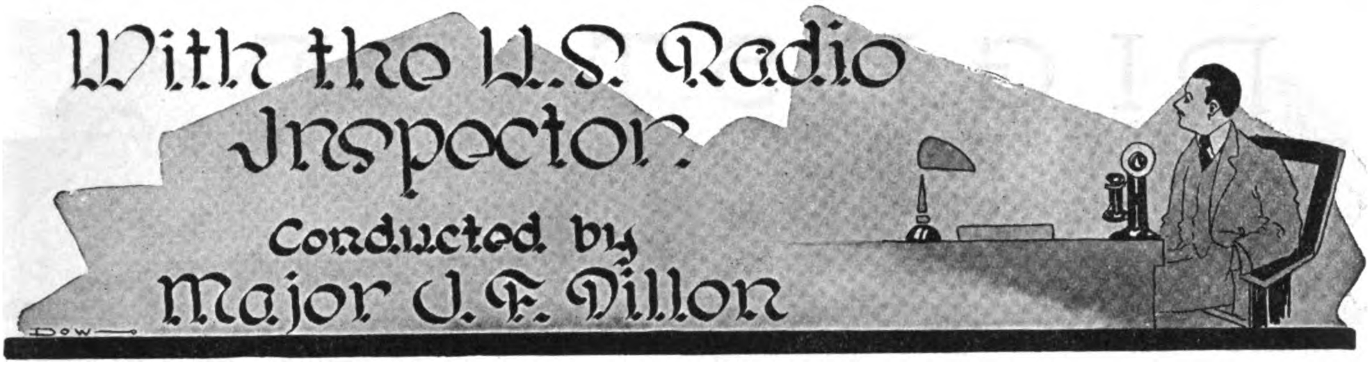
On September 21, there were 510 active broadcasting stations, according to a survey by the Radio Section of its Limited Commercial Stations, operating on 360 meters. California still leads, with 66 stations sending entertainment, news and information; Ohio is second with 34; and New York third, having 28 stations—while Wyoming brings up the rear without a single station. Every other station of the Union has one or more transmitting stations carrying entertainment in some form for the owners of receiving sets.

BROADCASTING STILL GROWING

There were 487 broadcasting stations licensed by the Department of Commerce up to August 26th. The stations licensed between July 29 and August 26 are as follows:

WIAX—Capital Radio Co., Lincoln, Neb.
KFBG—First Presbyterian Church, Tacoma, Wash.
WIAV—New York Radio Laboratories, Binghamton, N. Y.
WKAA—H. F. Paar and Republican Times, Cedar Rapids, Iowa.
WKAC—Star Publishing Co., Lincoln, Nebr.
WJAK—White Radio Laboratory, Stockdale, Ohio.
WIAY—Woodward & Lothrop, Washington, D. C.
WJAM—Central Park Amusement Co., Rockford, Ill.
WIAZ—Electric Supply Sales Co., Miami, Fla.
WJAP—Kelly-Duluth Co., Duluth, Minn.
WKAD—Charles Looff, East Providence, R. I.
WJAR—The Outlet Co., Providence, R. I.
WJAN—Peoria Star and Peoria Radio Sales Co., Peoria, Ill.
WJAX—D. M. Perham, Cedar Rapids, Iowa.
KDZT—Seattle Radio Association, Seattle, Wash.
WJAL—Victor Radio Corp., Portland, Me.
WKAF—W. S. Radio Supply Co., and Wm. Schack, Wichita Falls, Tex.
WJAQ—Capper Publications, Topeka, Kans.

Continued on page 33



May an amateur holding an operators' license, amateur first grade, operate at any amateur station other than his own?—H. J. K., Portland, Ore.

Yes, he may operate at any amateur station, provided he has the owner's consent. He may sign the call letters assigned to the station he is working, however, and not not those of his own station, as call letters are assigned for a certain station, and not for the individual operator using the apparatus.

Why can't an amateur operate a broadcasting station?—Same.

The class and grade of license required for stations of all classes is set down in the Radio Laws and Regulations. Nothing is said in them distinguishing between operators of telephone and telegraph stations. Operators of limited commercial stations must hold at least second class third grade licenses.

How much experience credit will be allowed an amateur who has operated a station for 10 years when he appears for a commercial examination?—H. G. T., Kansas City.

Only 5 per cent is allowed for amateur experience.

If an amateur, licensed for 200 meters, uses his receiving set, while oscillating, to send a short distance on waves over 200 is he working in violation?—T. U. K., Riverside.

Yes, he may only do this on 200 meters, or below.

How long may an amateur operate without being charged with intentional interference, or "hogging" of the air?—R. W., Sacramento.

This depends entirely on local conditions. A man may be operating without any interference in a remote district, and his continual working may cause no trouble, while the same operation might cause great interference in a congested zone.

If one already holds an amateur license and desires to take a commercial examination, does he lose his amateur license if he fails?

No.

When reporting change of address, do you send anything back to the Radio Inspector?

You should return your station license, and fill out new forms 762 (Amateur Applicant's Description of Apparatus), which gives all details of the new station. It is unlawful to operate at the new address until the license has actually been corrected and returned to the licensee.

Is it necessary for me to take an examination to get a sixth district call if I hold a second district amateur license?—W. F., Los Angeles.

No. Merely file an application for a station license with the Radio Inspector, Custom House, San Francisco.

Can a person holding a second class third grade commercial license operate on ship?—P. F. P., Salem, Ore.

Yes, he may operate according to law on certain ships, but there are so many men available with first class licenses that there is little chance of getting employment.

Are the call letters of a station changed if it is changed from D. W. to C. W.?—T. S., Claremont, Calif.

The changing from damped wave to continuous wave does not affect the call signals attached to the station.

BROADCASTING STILL GROWING

Continued from page 30

WAJT—Kelley-Vawter Jewelry Co., Marshall, Mo.
KFBH—Thomas Musical Co., Marshfield, Ore.
WLAJ—Waco Electrical Supply Co., Waco, Tex.
WAJU—Yankton College, Yankton, S. D.
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa.
WIAN—Chronicle & News Pub. Co., Allentown, Pa.
WIAQ—Chronicle Publishing Co., Maron, Ind.
WIAF—Gustav A. DeCortin, New Orleans, La.
KFBE—Reuben H. Horn, San Luis Obispo, Calif.
WJAD—Jackson's Radio Eng. Lab., Waco, Tex.
WIAG—Matthews Elect. Supply Co., Birmingham, Ala.
WIAD—Ocean City Yacht Club, Ocean City, N. J.
WHAW—Pierce Elect. Co., Tampa, Fla.
WIAP—J. A. Rudy & Sons, Paducah, Ky.
WIAC—School of Eng. of Milwaukee, Milwaukee, Wis.
WIAL—Standard Radio Service Co., Norwood, Ohio.
WHAV—Wilmington Elec. & Specialty Co., Wilmington, Del.
WIAE—Mrs. Robert E. Zimmerman, Venton, Iowa.
WJAB—American Radio Co., Lincoln, Nebr.
WIAS—Burlington Hawkeye-Home Elec. Co., Burlington, Iowa.
KPAV—Cooke & Chapman, Venice, Calif.
KFAW—The Radio Den, Ashford & White, Santa Ana, Calif.
KFBF—F. H. Smith, Butte, Mont.
WJAE—Texas Radio Syndicate, San Antonio, Tex.
WIAU—American Security & Savings Bank, Le Mars, Iowa.
WJAG—Huse Publishing Co., Norfolk, Nebr.
WIAT—Leon T. Noel, Tarkio, Mo.
WJAC—Rodoll Co., Joplin, Mo.
WIAW—Saginaw Radio & Elec. Co., Saginaw, Mich.
WJAJ—Y. M. C. A., Dayton, Ohio.
WKAN—Alabama Radio Mfg. Co., Montgomery, Ala.
KFBJ—Boise Radio Supply Co., Boise, Ida.
WKAP—Flint, Dutee Wilcox, Cranston, R. I.
KFBK—Kimball - Upson Co., Sacramento, Calif.
WKAQ—Radio Corp. of Porto Rico, San Juan, P. R.
KFAY—W. J. Virgin Milling Co., Central Point, Ore.
WJAZ—Chicago Radio Lab., Chicago, Ill.
WKAG—Edwin T. Bruce, M. D., Louisville, Ky.
KFBM—Cook & Foster, Astoria, Ore.
WKAJ—Fargo Plumbing & Heating Co., Fargo, N. D.
KFBL—Leese Bros., Everett, Wash.
WKAH—Planet Radio Co., West Palm Beach, Fla.
WJAX—Union Trust Co., Cleveland, Ohio.
WLAD—Arvanette Radio Supply Co., Hastings, Nebr.
KFBN—Borch Radio Corp., Oakland, Calif.
WLAF—Johnson Radio Co., Lincoln, Nebr.
WKAM—Adam Breede, Hastings Daily Tribune, Hastings, Nebr.
WKAL—Gray & Gray, Orange, Tex.
WKAR — Michigan Agri. College, East Lansing, Mich.
WKAK—Okfuskee County News, Okemah, Okla.
WMAM—Beaumont Radio Equipment Co., Beaumont, Tex.
WKAT—Frankfort Morning Times, Frankfort, Ind.
WMAH—General Supply Co., Lincoln, Nebr.
WLAB—George F. Grossman, Carrollton, Mo.
WKAV—Laconia Radio Club, Laconia, N. H.
WKAS—L. E. Lines Music Co., Springfield, Mo.
KFDB—John D. McKee, Lombard & Kearney, San Francisco, Calif.
WNAL—John D. Rockwell, Omaha, Nebr.
WKAW—Turner Cycle Co., Beloit, Wis.
WLAX—Greencastle Community Broadcasting Station (Putnam Electric Company), Greencastle, Indiana.
WLAS—Hutchinson Grain Radio Co., Hutchinson, Kansas.
WPAN—Levy Bros. Dry Goods Co., Houston, Texas.
WMAG—The Tucker Electric Co., Liberal, Kansas.
WNAD—Atkinson County Mail, Rockport, Mo.
WKAY—Brenau College, Janesville, Ga.
WKAX—Wm. A. Macfarlane, Bridgeport, Conn.
WLAC—North Carolina State College, Raleigh, N. C.
WLAH—Samuel Woodworth, Syracuse, N. Y.
WLAO—Anthracite Radio Shop, Scranton, Pa.
WLAM—Morrow Radio Co., Springfield, Ohio.
WMAB—Radio Supply Co., Oklahoma City, Okla.
KFCC—Auto Supply Co., Wallace, Idaho.
WMAJ—Drovers Telegram Co., Kansas City, Mo.
KFBQ—Savage Electric Co., Prescott, Ariz.
WLAL—Tulsa Radio Co., Tulsa, Okla.
KFCB—Nielsen Radio Supply Co., Phoenix, Ariz.
WLAG—Cutting & Washington Radio Corporation, Minneapolis, Minn.
WKAZ—Landaus Music and Jewelry Co., Wilkes-Barre, Pa.
WLAN—Putnam Hardware Co., Houlton, Mo.
KFCD—Salem Elect. Co., Salem, Oregon.

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

John H. Hammond, Jr., Pat. No. 1,418,788, June 6, 1922. System for Control of Bodies by Radiant Energy.

The fluid pressure piston 23, connected to the rudder of the vessel steered may be controlled by energization of magnet 7 by radiant waves. This magnet causes piston 13 to rotate a rotary valve, not shown, by means of which fluid under pressure may enter either through pipe 20 or 21, and exhaust either through pipe 50 or 49. This control is only for changing the course, which is maintained normally by a gyro having a shaft 25 which turns relatively to the hull 37 in case there is a deviation. This control by the gyro involves the use of valves in a disk 36. While the control is effected by radiant energy, the valve disk 36 is disconnected from the gyro by the lifting up of the stem 28 out of a depression 34 in the disk. When the radiant energy reception ceases, this rod 28 is permitted to fall and to reconnect the gyro operatively with the valves.

E. O. Scriven, Pat. No. 1,418,739, June 6, 1922. Oscillation Generator.

An oscillation Generator is described which is especially adapted to maintain the amplitude of the oscillations constant. For this purpose a feed-back circuit is utilized for a vacuum tube device G, in which the direct current circuit for the plate includes a large resistance 13, whereby the space current in the tube is maintained constant irrespective of minor variations in the tube characteristics. The oscillations are taken off in a branch circuit including a large condenser 18 and a resistance 19. Since there is little reactance in this circuit, the oscillatory current does not vary materially with the frequency, so that the same intensity of current is obtained irrespective of frequency used. An amplifier A is used to amplify the e. m. f. across resistance 19, and to pass the amplified oscillations to a receiving or transmitting circuit connected to transformer 27.

E. F. W. Alexanderson, Pat. No. 1,419,797, June 13, 1922. Amplifying System.

A multi-stage amplifier system is described, in which the tendancy for the tubes to produce oscillations is effectively overcome, as well as any tendency for low frequency currents to flow in the d. c. paths. The amplifiers 3, 4, 5 and 6 have their filaments heated from a common battery 18. The plate circuit of the tube 3 includes a high resistance 23, and furthermore the generator 7 for the plate circuit is connected to filter circuits formed by resistances 14, 13, 12, 9 and 8, and condensers 10, 11, 15, 16 and 17. In this way it is possible to maintain the space current substantially free from variations. The high resistance 30 and condenser 29 branch this plate circuit, and the drop across the resistance is impressed on the input circuit of tube 4. Here again the plate circuit is protected by filter paths, but not by so many, since only elements 3, 9, 10, 11, 12, 13, 15 and 16 are active. Since the signals are stronger by amplification, however, this lessening is not detrimental. Succeeding stages may be added, as indicated. The last stage 6 is arranged as a detector also, and in order to prevent possible oscillations, it is made responsive to a double harmonic of the radio frequency waves transmitted, as by the aid of circuits 34, 35, and 36, 37. It has been found that the double harmonic tends to be amplified as well as the fundamental, and this fact is made use of to destroy the objectionable continuity of the identical frequency currents in the amplifier circuits, which might cause oscillations.

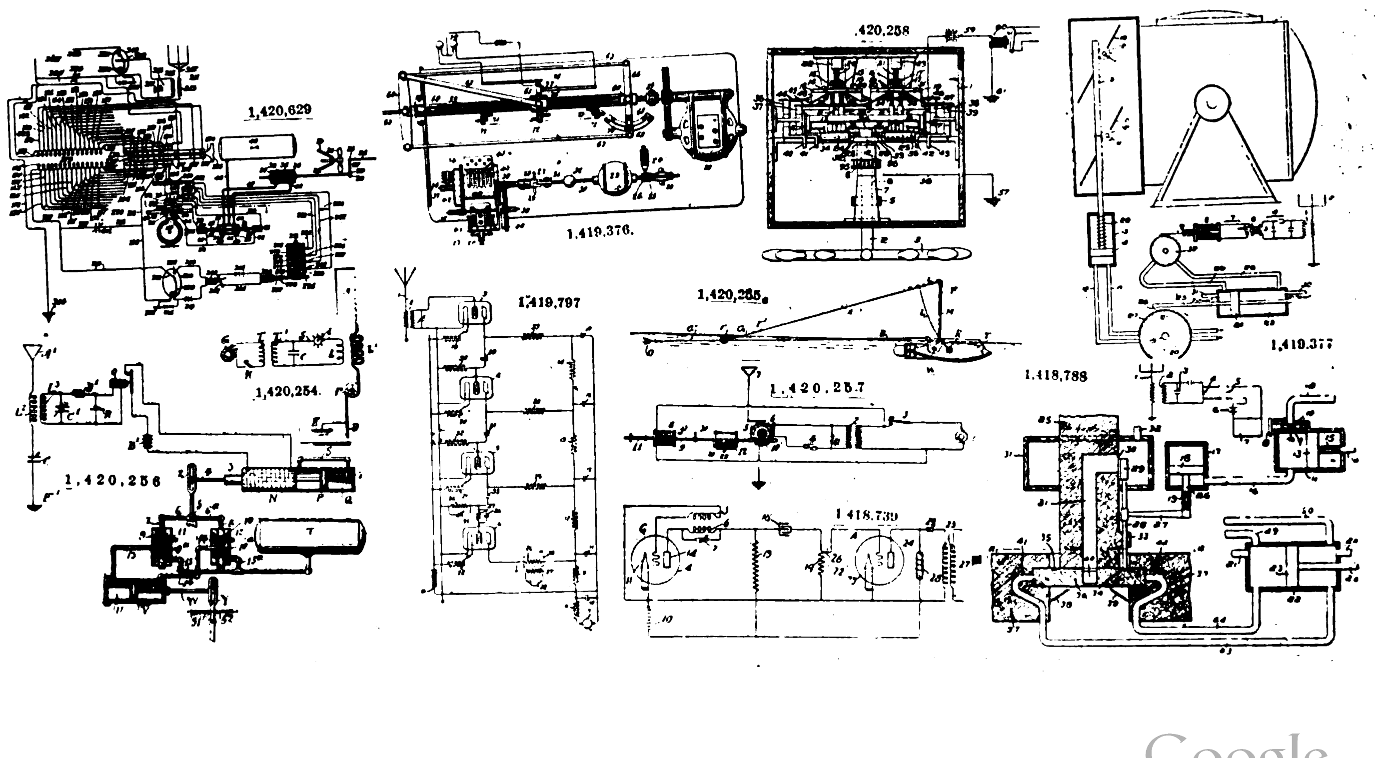
John H. Hammond, Jr., Pat. No. 1,420,258, June 20, 1922. System for Radiocontrol of Moving Bodies.

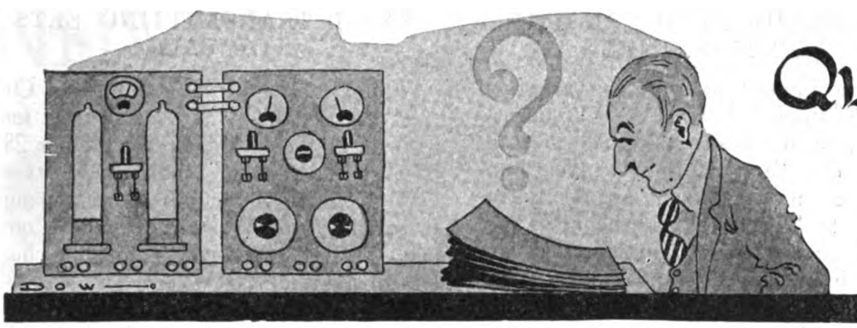
A transmitting system is described so arranged that movement of a wheel 3 in one or the other directions causes radiation of waves to effect a receiving set which is connected to operate a pneumatic cylinder. The cylinder is in turn arranged to move the steering rudder. This steering mechanism is so controlled that each impulse received causes movement of the rudder from neutral to port or starboard or vice versa; these movements take place in a regular periodic cycle in accordance with the impulses received. In order that the correct number of impulses be sent to move the rudder to port or starboard, irrespective of the phase of this cycle, the transmitting switch is provided with an arm for contacting with contact points B, C, D, and E, which are movable to an active position in accordance with the number of times the arm moves to its extreme right or left hand position to contact with fixed contact F or A.

John H. Hammond, Jr., Pat. No. 1,420,254, June 20, 1922. Electric Wave Transmission.

In this system a conducting fluid such as salt water is used for the antenna A, the water being pumped through a coil L′ coupled to a coil L which receives current impulses from a spark gap S. In order that variations in the antenna capacity due to wind, etc., have no effect on the tuned condition of the receiving antenna, the circuit therein is tuned to the group frequency of the impulses generated by the spark, and not to the radio frequency of the current.

Continued page 42





Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Please show a circuit employing three stages of radio frequency and three stages of audio frequency amplification, using a Paragon RA 10 receiver.

M. L. B., Pittsburgh, Pa.

It would be rather difficult to use the Paragon receiver for radio frequency work without altering the present wiring to a considerable amount. Fig. 1 shows a three stage radio frequency amplifier, with detector and three stage audio frequency amplifier, which, while not guaranteed to work with the particular apparatus you might select should give good results if properly handled, and if it is not used for amplifying local broadcasting or nearby signals.

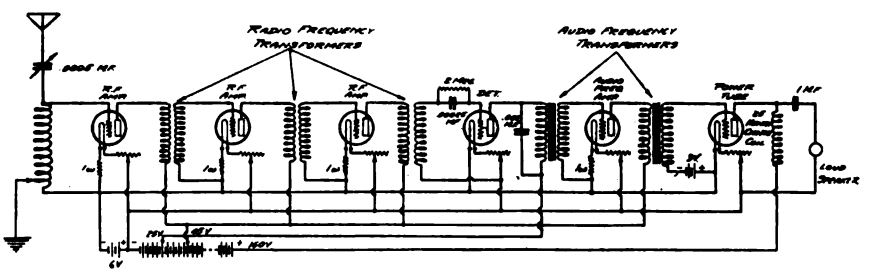


Fig. 1

Please publish the data on the construction and operation of synchronous rectifiers for obtaining high voltage dc for the plate supply of transmitting tubes. Can this instrument be used with 5 or 10 watt C. W. sets?

C. K. Provo, Utah.

An article on the design of a synchronous rectifier will be published in an early issue. This rectifier can be used for any C. W. set within the amateur power restrictions.

My receiver has Remler vario coupler and variometers, with .001 M. F. air condenser across the secondary. Can get 360 meter stations but cannot hear the 485 meter weather reports. Please tell me what the trouble is.

A. L. F., Chickasha, Okla.

With the air condenser you should be able to tune to seven or eight hundred meters. Perhaps there are no weather stations in your vicinity, and you have not yet learned to tune for the more distant ones. Try to obtain a wavemeter from some one near you, and calibrate your air condenser dial for the proper wavelengths.

What is the most efficient circuit for a 10 watt self rectifying C. W. transmitter.

W. L. G., Indianapolis, Ind.

The set described on Page 15 of June RADIO employs what is known as the reversed feed back system, and while more difficult to tune than the single coil circuits, will give good satisfaction.

Please give the correct capacity values of the condensers shown in the Armstrong regenerative circuit in Fig 1, Page 32 of September RADIO. Should the grid leak be variable? What size of wire is best for such a set?

C. M., Washington Court House, Ohio.

The primary and secondary condensers should be .001 M. F., the grid condenser .00025 M. F., and the phone condenser .002 M. F. respectively. The size of the grid leak depends entirely upon what tube is used. Provide whatever size is recommended by the manufacturer of the tube. This value is generally around 2 megohms. No. 14 or 16 B. and S. wire is about right for the wiring.

Please publish an efficient circuit for two stages of radio frequency and detector, using honeycomb coils.

C. E. F., Cleveland, Ohio.

Elsewhere in this issue you will find an article by H. E. Parsons, which describes the set you wish to know about, in greater detail than possible here.

I have a ¼-kw spark set consisting of the following material: One Thordarson transformer, two .004 sections of Murdock moulded condenser, set of pancake inductances, radiation meter, key, etc. Can any of this be used in constructing a 10 watt C. W. set?

R. O. J., Philadelphia, Pa.

Practically everything you have mentioned can be used in a 10 watt C. W. telegraph set. The circuit shown in Fig. 2 is the one best adapted for your use and is known as the reversed feed back system. Assuming that you have a ¼ K. W. Thordarson of recent design, you can remove the high voltage secondary and build up a new winding of lower voltage. This winding should have 7500 turns of No. 30 or No. 32 B. and S. S. C. C. or enameled wire wound on empire cloth or other good insulating material. A center tap should be brought out at the 3750th turn. For the filament circuit, wind a separate secondary of 75 turns of No. 14 B. and S. S. C. C. wire, with a tap at the 37th turn. Your condensers will serve very well in the plate circuits of the tubes, and the set of pancake inductances can be used according to the sketch. Of course, you will have to buy the necessary tubes, sockets and filament rheostats to complete the set.

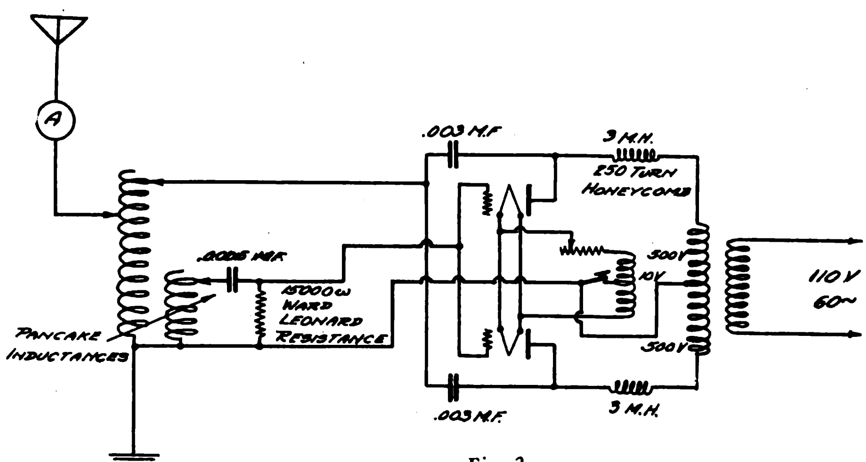


Fig. 2

Does the length of the leads in a C. W. set make any particular difference in the efficiency of the set?

J. F. B., San Francisco, Cal.

In any transmitting circuit, particularly those of such high frequencies as used in amateur transmitters, the shorter the connecting leads, the more efficient the transmitter will be. Long leads, and particularly adjacent ones, will introduce capacity and inductance into the circuit at points where least desired, and the most efficient C. W. set is the one having all the high frequency leads as short as is possible within reason.

RADIO TYPING PERFECTED

The Bureau of Standards recently explained some experiments by F. W. Dunmore which indicated that a recently perfected radio relay recorder might do away with code operators by printing the code message on a tape, so that it could be read visibly by inexperienced men, but now the naval aerial and radio experts have gone the Bureau one better; they print radio messages automatically on a typewriter.

Co-operating with the Radio Laboratory of the Bureau, experts of the Navy successfully tested the operation of the line-wire teletype by radio a few months ago, and succeeded in printing messages from a distance of nine miles. The radio circuit was established between the Bureau of Standards near Chevy Chase and the Naval Air Station at Anacostia.

More recent experiments have established the fact that teletype messages printed on a machine installed in an airplane and transmitted by radio can be recorded on a typewriter in a ground station. Future experiments will undertake the reversal of this operation; the sending machine being on the ground and the receiving apparatus installed in a plane in flight. Great interest is manifest by naval experts as the new method will permit the sending and receipt of duplicate orders of record, eliminating errors and a knowledge of code, besides saving time of rewriting.

The practical tests made assure future commercial uses in aerial news reporting, when a correspondent covering an aquatic event, marine engagement, or sea maneuvers can send his copy straight to the desk. Another value, if aerial passenger lines are extended, would be the receipt and dispatch of typewritten telegrams, stock reports, news dispatches, etc., ready for delivery.

The sending instrument of the teletype resembles in general the commercial typewriter in that a keyboard having the letters of the alphabet and other conventional symbols on it is arranged so that it may be operated by hand. Each key is connected to the radio installation in the plane and when a letter is struck on the keyboard a radio impulse is sent out from the antennæ of the plane and is received at a ground station. The similarity to the typewriter is completed in the receiving device. When the letter A is struck on the keyboard in the air, the radioactive energy released travels to the recording instrument and selectively energizes the type-letter A, causing it to be reproduced on paper carried in the receiver. The teletype has been in use for eight years in connection with land-wire operations, but its application to radio use is a recent development. The tests at the Naval Air Station are the first that have ever been conducted in aircraft.

AMATEUR RADIO IN THE PHILIPPINES

Great interest in radio has arisen in the Phillippine Islands. A broadcasting station has been established at Manila by the Electric Supply Co., hundreds of receiving sets are being installed to "listen in" on the news and band concerts from Luneta that are being broadcasted. And about thirty amateur transmitting stations are in operation. Because of the difficulty in buying sets most of the boys are assembling their own. A flourishing radio club has been formed at Manila and a school of instruction is contemplated.

APARTMENT HOUSE RADIO INSTALLATION

A choice of "listening in" to either of two programs being sent out by the big broadcasting stations will be a feature of an unique radio system being installed in a 72-family apartment house in Newark, N. J., by the Davis Electric Company. Two complete receiving sets will be installed, each with a large loop or directional aerial, pointed to a particular broadcasting station and the program received without interference from whatever may be coming in on the other loop. A special radio room in charge of a licensed operator will house the equipment. From this room will emanate two complete circuits connected to each of the 72 apartments and so arranged that the tenant may plug in his receiving set to whichever of two programs he may prefer. The apartment operator will tune in each evening to the two stations that offer the best programs or are heard the clearest, and in this way the tenants will be able to enjoy the best in the ether each night with the least of trouble. Two complete G-E receiving sets, each equipped with a detector tube, two stages of audio and two steps of radio frequency will be installed.

NAVAL TRANSMITTING SETS FOR SALE

The U. S. Navy Central Sales Office offers 396 radio transmitting sets for sale by sealed bids on September 28. These sets are of short-range type, CW-396, with vacuum tubes, manufactured by the Western Electric Company for use on Naval submarine-chasers during the war.

This apparatus is said to be reliable for radio telephone communication within a distance of ten miles, but numerous instances have been noted where the sets have been used for distances up to 300 miles at sea. In the hands of competent operators, under favorable weather conditions, they should have a reliable land range of 50 miles.

NEW ZEALAND RADIO HEARD IN BRITISH COLUMBIA

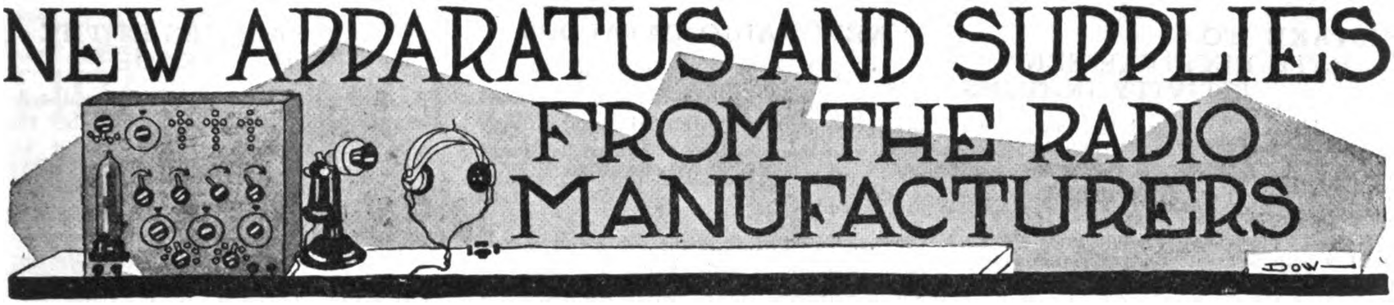
An unusual combination of atmospheric conditions is believed to have made it possible for the wireless station at Estaven, 150 miles southwest of Victoria, B. C. to work Raratonga, New Zealand, 6,500 miles away.

NEW CHINESE STATIONS

The Federal Telegraph Co. of Delaware has been formed with R. P. Schwerin as president to construct high-powered stations in China for direct radio communication with the Pacific Coast of North America. Stock in the new company is held jointly by the Federal Telegraph Company of California and by the Radio Corporation of America. Duplicate 1000 k.w. arc transmitters are to be installed at Shanghai for trans-Pacific work and smaller sets are to be installed at Canton, Harbin and Pekin. Two years will be required to finish the work, the cost being estimated at $13,000,000.

"I wanna—h—hear some m—music on that man's r-radio receiver."

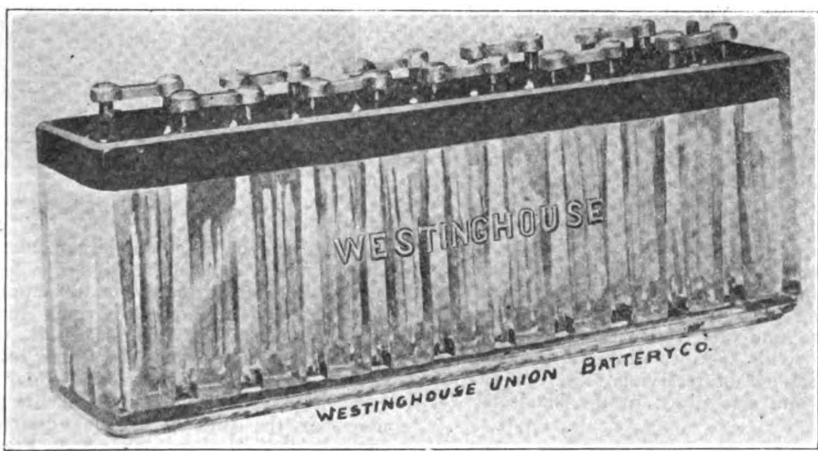
NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



NEW WESTINGHOUSE "B" BATTERY

Service and convenience are the keynotes behind the new B battery which is just being placed on the market by the Westinghouse Union Battery Company, of Swissvale, Pa. It is a marvel of compactness and built to serve indefinitely. It will function noiselessly and with steadiness and dependability.

This new battery is a departure from the separate glass jar container for each element. The 2 volt elements, under the new construction, are placed in a one-piece, eleven-compartment glass container, and are arranged so as to be clearly visible and easily accessible for recharging. The improvement of this method over the old style is apparent, as the integral glass jar arrangement makes it much easier to inspect the condition of the battery and the height of the electrolyte.



New Westinghouse "B" Battery

In addition to this battery, the company has two other types of B batteries and ten types of A batteries, ranging from 27 to 162 ampere hours' capacity, and in 4, 6 and 8 volt sizes. The accompanying picture shows the compactness of the new arrangement of elements, as well as the clear vision afforded of each cell.

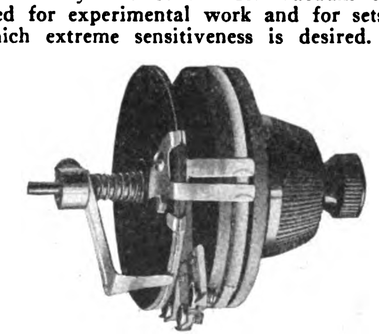
"MICON" NOISELESS MICA CONDENSER

Micon fixed mica condensers are a new departure in condenser design. The outer casing is of seamless brass or copper tubing. The interior is built up after the

best practice of alternate layers of mica and brass or copper sheets. The tubing is partially flattened, then the condenser elements are inserted and the presses complete the operation of flattening into the final form. This process produces equal pressure over the entire plate area and does away with troublesome noises. The metal case protects the plates and reduces hysteresis losses to a minimum. These condensers are also made to stand several thousand volts if desired. MICON is manufactured by Charles Freshman Co., New York City.

VERNIER POTENTIOMETER FOR EXPERIMENTAL WORK

The vernier potentiometer, recently placed on the market by the Central Radio Laboratories of Milwaukee, represents a new development in the radio field and is meeting the demand of those who have been looking for a very fine control for vacuum tubes used for experimental work and for sets on which extreme sensitiveness is desired.



Vernier Potentiometer for Experimental Work

The resistor consists of a machine winding, the turns of which are anchored firmly on a substantial, insulated core. This wound core is retained in a groove between insulating discs. The use of enameled wire makes the short-circuiting of the adjacent turns impossible. This design insures smooth, noiseless action and a uniform change of circuit resistance.

The vernier wire for the fine adjustment is 6 in. long and is carried on the outer edge of a separate disc on which two contact shoes, which ride on the main winding, are mounted. This vernier wire shunts those turns of the main potentiometer winding which lie between the two contact shoes and thus provides for very accurate adjustment of the potential.

A small thermoplax knob, located in front of the main knob, operates the vernier shoe. The relative sizes and shapes of the two operating knobs are such that they are easily manipulated.

A potentiometer of the plain type, manufactured by the same company, is of the same general design and construction as the vernier potentiometer already described, minus the vernier attachment. Both potentiometers have a resistance of 250 ohms.

RADIO "B" STORAGE BATTERIES AND THEIR RECHARGE

Several battery manufacturers are now offering miniature storage batteries to take the place of the small dry "B" battery used with vacuum tube receiving sets and especially where power amplifiers and loud speakers are used. These batteries range anywhere from 8 to 60 small cells in the lead acid type, all connected in series, and about double this number if of the Edison alkaline type. The voltage, therefore, ranges from 16 to 120 volts or better, although the charging current required is very small as compared to the current required for the 6 volt "A" battery, varying from 0.1 to 1 ampere.

The France Mfg. Co., manufacturers of the new F-F radio rectifier have added a special winding to the regular "A" battery chargers so that by simply throwing a switch from the "A" position to the "B" position any voltage "B" storage battery can be quickly charged automatically. A special lamp socket is mounted on the frame of rectifier and into this is screwed a 60 watt tungsten lamp or any other wattage bulb, depending upon the ampere charging rate desired. A 60 watt lamp will cause approximately 0.2 ampere to flow when charging a 100 volt battery.

Since rectification of the current takes place thru carbon electrodes which are infusible and cannot burn, the high voltage required for charging is handled with absolute safety and the rectifying device can be operated continuously, if desired, for thousands of hours without renewal of electrodes.

In case one should accidentally turn on the receiving set with "B" battery connected to it while it was on charge, no harm would result to the audion tubes or other parts of the set or loud speaker, for the high voltage secondary "B" winding is well insulated from the line, there being no electrical or common ground connection between the two.

This makes the operation of charging a "B" storage battery as safe as could be expected and there is no way the operator can detract from the safety features by accidentally doing the wrong thing, for there are no alterations to make in changing from an "A" to a "B" battery except to connect up one battery in place of the other and throw the voltage switch. This rectifier operates independent of the condition or state of charge in the battery. Hence, no difficulty will be experienced in bringing up a completely discharged or dead battery.

MISTAKE TO RATE RECEIVER SENSITIVITY IN OHMS

"Yes this is a very good receiver. It has a resistance of 4,000 ohms." This is a sales talk that many clerks in the radio shops give to unwary purchasers of headsets. In doing so, they not only show their ignorance concerning 'phone construction and design, but they help to create an impression that is entirely wrong. They are responsible for the notion that the sensitivity of a headset is indicated by the resistance of the receivers.

In commenting upon this, Mr. F. Dietrich, president of C. Brandes, Inc., recently said, "This policy of selling headsets on the strength of their resistance is wrong and should be discouraged by dealers. It not only hoodwinks a badly mis-informed public but it is a gross injustice to manufacturers who, for sound technical reasons, do not wish to carry the resistance of their headsets to such a high value. One might just as well measure the horsepower of an automobile by the size of its carburetor. The average 2000 ohm headset is as sensitive and in many cases more so than the receiver with a resistance of 4000 ohms. Radio receivers should be rated by their impedance. The Brandes headset is designed to have the same impedance as the average circuit in which it is used since it has been found that this gives maximum efficiency. This impedance varies, of course, with the frequency of the current. The Brandes company have taken as a standard 1000 cycles and at this frequency their headsets have an impedance of 22,000 ohms. It has been found that this is the resistance of the average crystal or tube circuit. This in itself however, does not guarantee the efficiency of a headset since there are many other requirements and features that determine the operating efficiency and sensitivity of a radio headset.

TRADE NOTES

The Capitol Phonolier Corporation of New York City calls attention to the omission of the word "all" in the advertisement of their new all wave coupler in August RADIO.

The Signal Electric Manufacturing Company of Menominee, Mich., has acquired the Hulbert patents and taken over the Hulbert Electric Manufacturing Company of Chicago, Ill. Under this arrangement production of the Hulbert battery charger will be increased and others of the Hulbert patents will be developed and put into production. Mr. C. H. Hulbert will hereafter be identified with the Signal Electric Manufacturing Company, in the capacity of research and development engineer.

H. G. Cisin, author of The Radio Telephone Handbook, has been placed in charge of the Dictograph Products Corporation's radio sales promotion, advertising and publicity. He was formerly engineering editor of *Electrical Record.*

C. W. Horn, manager of the Radio Division Service Department, Westinghouse Electric & Manufacturing Company, has been appointed as superintendent of radio operations of the Westinghouse Company. Mr. Horn succeeds L. R. Krumm, who left the service of the Westinghouse Company to become manager of the radio department of the Erner-Hopkins Electric Company, of Columbus, Ohio. In his new position, Mr. Horn will have charge of all radio operations of the Westinghouse Company, including complete charge of the company's four radio broadcasting stations, KDKA, at East Pittsburgh; WJZ, at Newark, N. J.; KYW, at Chicago, Ill.; and WBZ, at Springfield, Mass.

NEW RADIO CATALOGS

Catalog No. 10 from the Detroit Electric Co., Detroit, Mich., is a complete illustrated price list of Radio Material from a large number of manufacturers. As supplementary information the code and the "Q" signals are given.

"Paradex" Units are the subject of a bulletin from the Pacific Radio Exchange of San Francisco. They comprise a tuner, a detector, a radio frequency and an audio frequency unit.

Bulletin R, from the American Radio and Research Corporation of Medford Hillside, Mass., is devoted to Amrad Radio Frequency Amplifiers No. 3071 and No. 3045. The former is uniform in appearance and is especially designed for use with other Amrad units, while the latter may be employed with any tuner or detector units. The new Amrad radio frequency transformers, or "Radioformers," are employed with both, various sizes of which are available for different wavelengths. For 360 meter reception there are two designs, one for the first stage and another for subsequent stages.

Bulletin No. 250, from the Roller-Smith Co. of New York City, illustrates and describes their Types LGD and KGD Galvanometers, the former an instrument of high sensitivity and great accuracy, and the latter a lower priced instrument for the use of students.

Remler Radio Mfg. Co. of San Francisco are distributing their 1922-23 catalog of radio parts. These include variometers, vario-couplers, detectors and amplifier, control panels, dials, rheostats, tube sockets, potentiometers, inductance coils and mountings, coupling plugs, lever switches, knobs and binding post. In each case there is a clear picture and description of the device together with specifications and prices. Useful hook-ups of receiving sets, formulas and tables are also given in the handsome catalog.

"Radio in Your Home" is the subject of an attractive pamphlet from the Provision Equipment Co. of Cincinnati, Ohio.

LINKING THE AMERICAS BY RADIO

The Radio Corporation of America announces that it has received orders from the United Fruit Company and the Tropical Radio Telegraph Company for five radio stations, three for Central America and two for the United States, each with a sending radius of more than 2000 miles. The erection of these five stations will fill an important and essential gap in the radio communication system of the Americas.

The three Central American stations will be located on the corners of the triangle embracing Honduras, Nicaragua and Panama. The Tropical Radio Telegraph's stations will be located at Managua, the capital of Nicaragua, and at Tegucigalpa, the capital of Honduras, the city designated as the capital of the new Central American Union. These stations will connect with the United Fruit Company's station at Almirante, Panama.

The United States terminals of this communication system will be at New Orleans, La., where the present station of the Tropical Radio Telegraph Company is to be enlarged and new apparatus installed, and at a new station which the Tropical Radio Telegraph Company will erect in the vicinity of Miami, Fla.

PERSONALITIES IN THE RADIO TRADE

ELMER T. CUNNINGHAM, distributor of Cunningham vacuum tubes and manager of the Remler Mfg. Co. of San Francisco, is one of the pioneer radio manufacturers of the country. It was in 1915 that he entered the field as the Audiotron Mfg. Co. making vacuum tubes for amateur use. In the subsequent readjustment of the patent situation as regards the vacuum tube he discontinued manufacture of the tubular audiotron tube in order to become distributor of the Cunningham C-300 detector and C-301 amplifier made by the General Electric Co. for him.

As he possessed the vision to realize the future growth of the radio industry and

Elmer T. Cunningham.

the resultant demand for high-grade, reasonably price amateur equipment, he also started the Remler Mfg. Co. to supply this need. It is of interest to note that the coined name "Remler" is formed R, the initial of "radio" and his first name reversed.

The immediate success of Remler parts constructed from moulded bakelite made necessary the present spacious quarters at Second and Howard St., San Francisco, where nearly 100 mechanics are engaged in the manufacture of Remler products.

In addition to his business duties he has served as a director of the Pacific Radio Trade Association since its inception. His business sagacity and initiative have been of the greatest value in conducting the affairs of the association in its efforts to stabilize, standardize and popularize the radio industry.

TECHNICAL COURSE FOR RADIO SALESMEN

The Radio Corporation of America, which operates the Radio Institute of America, a school for commercial operators, announces a new course devoted in the amateur field. This course is intended primarily to meet the needs of the radio salesman, insofar as equipping him with the necessary technical knowledge is concerned. It has been so mapped out, however, that anyone interested in the radio art can, by completing it, obtain a sound working knowledge covering the theory of radio telephony, as well as the installation and operation of receiving sets. Day and night classes have been organized, and standard modern equipment has been installed. For further information, communicate with L. O. FASSETT, Radio Institute of America, 331 New Call Bldg., San Francisco.

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station

BY FRANK LA BARBA, 1537 SUNSET BLVD., LOS ANGELES, CALIF.

Kzn, kwv, kwg, kfaw.

BY R. C. ANDERSON, LONG BEACH, CALIF.

Kdyl, khj, kuo, klz, woai, kzn, kgg, kfaf, kqw, kgw, kfc.

BY 8AU, CANTON, OHIO.

Spark—6zx, 7fu, 7og, 7uv, 7xv, 7ya.

C. W.—6ale, 6en, 6gl, 6hd, 6ob, 6ut, 6xad, 6zac, 6zz, 7aa, 7cg, 7cw, 7dm, 7fk, 7fm, 7gm, 7go, 7gq, 7iv, 7ly, 7on, 7op, 7rf, 7tm, 7up, 7vc, 7wo, 7xd, 7zl.

BY 6ABR, 57 DOUGLASS ST., SAN FRANCISCO, CALIF.

C. W.—5za, (6aqw), (6atg), 6bir, 6fh, 6abx, (6apw), (6bjx), 6bjy, 6bqc, 6rd, 6nx, 7mf, 9sf.

Spark—6od, 6amn, 6ea, 6ol.

BY 6BKG, REDWOOD CITY, CALIF.

5za, 6xj, 6zq, 6abx, 6cp, 6atq, 6ajf, 6zaf, 6uw, 6ajh, 6ajf, 7sy, 7tq, 7lu, 7xl, (Fone) 7na, 8ft, 8zz, 9awm, 9bxa, 9xac, 9amb, 9km, 9dky, 9xay, Can. 5bq, 9bd.

BY 6BAP, 670 WALSWORTH AVE, OAKLAND, CALIF.

Spark—6kc, 6ke, 6mh, 6od, 6ol, 6va, 6aak, 6ald, 7tj, 7to, 7aea, can. 9bd.

C. W.—6bf, 6cu, 6ea, 6eb, 6en, 6ft, 6jd, 6ka, 6ku (cw and voice), 6alu, 6beg, 6bes, 6bqg, 6zf, 7mf, 7oz, 7sy, 7zb, 9zaf, kzn, kuy.

BY 6ABW, ROSEVILLE, CALIF.

C. W. 2fp, 4bv, 4kf, 4bq, 4eb, 5sm, 5anx, 5za, 5zh, 8bwa, 8zz, 8cw, 8afy, 8ach, 8wr, 8asv, 9avg, 9ays, 9wp, 9yaj, 9aou, 9di, 9bsg, 9zaf, 9aww, 9awm, (uyqsa), 9dcr, 9dsm, 9dky, 9io, 9amb, 9dpl, 9aou, 9ajh, 9hh, 9xaq, 9dn, 9hd, 9bxq, 9bcd, 9bvo, 9dte, 9ctu, 9ags.

Canadian Stations—CW 4cb, (9bd).

BY 4AX, 873 PRESTON AVE, WINNIPEG, CANADA.

C. W.—7lu, 9cp, 9nx, 9amb, 9aon, 9aor, 9awm, 9bhd, 9bjv, 9bln, 9dky, 9dqm, 9dtm, 9yaj, 9bzi, 9afw, 9bvs.

Spark—9ayw, very qsa.

Fone—wcx, wok, and Sweeney Tractor School.

Any one hearing 4ax ½-kw Spark please qsl.

BY RADIO 6BEW, OAKLAND, CALIF.

Spark—6cc, 6dd, 6gr, 6iv, 6kc, 6od, 6ol, 6qk, 6up, 6aak, 6acr, 6ahf, 6ajh, 6ajr, 6ald, 6ark, 6ars, 6asc, 6avr, 6zu, 7bh, 7bk, 7nw, 7vo, cl8. Canadian 9bd.

C. W.—6ec, 6ef, 6en, 6ff, 6fh, 6gx, 6ka, 6oh, 6abx, 6alu, 6aqw, 6bbc, 6bjq, 6boe, 6bqc, 6bqz, 6brk, 6zb, 6zg, 6zs, 6zz, 7lu, 7mf, 7nj, 9zaf.

BY 7LA, SOUTH TACOMA, WASH.

6cc, 6cp, 6fr, 6ft, 6ff, 6gr, 6tu, 6oh, 6xf, 6zf, 6aat, 6abg, 6acr, 6amz, 6aqf, 6aqu, 6awt, 6boe, 6bsa, 6zac, 7fq, 7ge, 7kj, 7lu, 7nw, 7oz, 7qd, 7tj, 9aja, 9bxt, 9zaf.

Canadian Stations 9ac, 9bd, 5ac.

Any one hearing my call please drop me a card.

BY CW-6EB, 343 SO. FREMONT AVE., LOS ANGELES, CALIF.

C. W.—5di, 5za, 5zav, 6bf, 6cp, (6fh), 6gf, 6gr, (6gx), 6gy, 6ik, 6ku, 6lo, 6lv, 6nv, 6nx, (6oh), (6rd), 6ti, 6tw, 6za, 6zb, (6zf), 6zi, (6zs), (6zx), (6abx), 6ada, 6aeh, 6aiy, (6aoi), 6aoz, 6arb, (6asj), 6atc, 6aud, (6awt), (6bcd), 6bcj, 6bfk, 6bhk, 6bjy, 6bmd, 6bmu, 6boe, 6bob, 6boo, 6bpf, 6bqf, 6bsa, 6bum, 7aea, 7iy, 7lu, 7mf, 7na, 7sc, (7th), 9ac, 9aja, 9amb, 9aon, 9dtm, 9wd, (9zaf).

BY 6BQP, 1928 CRENSHAW BLVD. LOS ANGELES, CALIF.

C. W.—5za, 6bf, 6cp, 6fh, 6gr, 6gx, (6gy), 6ik, 6vz, (6rd), 6za, 6zb, 6zf, (6zj), 6zs, 6zx, 6zz, 6zam, 6aat, (6abx), 6ada, 6aeh, 6agp, (6ahp), 6aiv, 6ajh, 6ake, 6aok, 6aom, (6arb), 6arp, 6asi, 6asv, 6atc, 6awt, (6bcd), (6bcu), (6buy), 6boe, (6bgf), 6bql, 7iy, 7lu, 7mf, 7na, 7xc, 7aae, 7aea, 9amb, 9dtm, 9zaf.

Spark—5xd, 6cc, 6gr, 6vi, 6kc, 6tu, 6aak, 6acr, 6aeg, 6ahf, 6aht, (6ajh), 6akl, 6amk, 6aqd, 6bdc, 6bvu, 7ya.

PS.—Anyone hearing my CW please QSL.

BY 6EA, 343 SO. FREMONT AVE., LOS ANGELES, CALIF.

C. W. Only—5uo, 5za, (buzzer), (6bf), 6bk, 6cp, (6fh), (6gr), (6gx), 6ik, 6lv, 6nn, 6nx, (6rd), (6ti), 6zb, 6ze, (6zf), (6zs), (6zx), (6xad), 6zaf, (6ajf), 6aot, 6aqw, 6arb, 6arc, (6asj), 6avv, (6awt), 6bcj, 6bmd, (6bqf), (6bsa), 6bjy, (7aea), 7jw, (7lu), (7mf), 7ot, 7oz, (7sc), 7xi, (voice and music), Canadian 9ac, 9aja, Canadian 9bd, (9zaf), (voice), kdpu, kdpv, kdpw, kfdk, (buzzer, voice, and music), dd5! (Voice at Denver, Colo.) my CW sigs were heard by 6zac on June 30th, also heard by 7fh, 7ge, 7lc, 7qw, 7sg, and 7bf.

BY 6IY, ARCATA, CALIF.

6ad, 6ak, 6aw, 6bf, 6bk, 6cu, 6cp, 6ea, 6eb, 6ec, 6en, 6ff, 6fh, 6ft, 6gd, 6gr, 6gx, 6gy, 6ka, 6ku, 6lv, 6ni, 6nx, 6od, 6rd, 6rp, 6sa, 6vf, 6ws, 6xj, 6za, 6zb, 6ze, 6zf, 6zg, 6zq, 6zs, 6zx, 6aat, 6abr, 6abx, 6agp, 6alu, 6anr, 6aoz, 6apw, 6aqa, 6arb, 6asj 6avv, 6awp, 6awt, 6baj, 6bbc, 6bcd, 6bcj, 6beg, 6bfp, 6bgg, 6bic, 6bir, 6bjc, 6bjq, 6bmd, 6bmj, 6boe, 6boq, 6bpw, 6bpz, 6bqc, 6bqd, 6bqf, 6bql, 6qp, 6brd, 6brg, 6brk, 6bsa, 6bum, 6xad.

7dp, 7iy, 7lr, 7lu, 7mf, 7nw, 7ot, 7oz, 7qd, 7th, 7tn, 7tt, 7xc,7aea.

9zaf, 9ac (can).

PHONE—6au, 6bdb, 6zal, 6bfd.

BY 6TI, 414 FAIRMONT AVE, OAKLAND, CALIF.

C. W.—5ih, 5is, 5ul, 5za, 5bms, 6cc, (6cu), (6ea), (6eb), (6en), (6fh), (6gf), 6jd, (6ka), (6rd), 6tw, 6zg, (6zs), 6zw, 6zz, (6aat), (6aeh), 6ajh, 6avd, (6awp), 6bcj, 7dp, 7ic, 7lr, 7lu, 7mf, 7oz, 7sn, 7zb, (7aea), (9amb), 9aog, 9awa, 9awm, 9bsg, 9dtm, 9zaf.

Spark—4le, 5ar, 5hk, 5kc, 5la, 5tc, 5tk, (6eb), (6ke), (6oh), 6qr, (6aak), (6ahp), (6ajh), 7ac, 7aw, (7bb), 7bk, 7bj, 7dp, 7ed, 7ga, 7hf, 7in, (7iw), 7ka, 7kj, 7ly, 7mf, 7mi, 7pr, 7qk, 7qt, 7qu, 7tj, (7to), 7ya, 7ze, 7zn, 7zt, 7zx, (7aea), 8acf, 9nn, 9hi, 9xu, 9aya, 9bss, 9dva, 9bd, Can. cl8.

6ti five Watt CW was heard by 9aiy in Milwaukee, Wis., a distance of 2,000 miles. All hearing my C. W. please qsl.

BY 6RR, 415 N. GOWER ST. LOS ANGELES, CALIF.

2pr, 4bf, 4bv, 5fv, 5il, 5kc, 5qi, 5qu, 5xy, (5za), 5zh, 5xak, 6ak, (6ar), 6fh, 6gr, 6gx, 6ik, 6ku, 6nx, 6oh, 6pgm, (6rd), 6uf, (6vz), 6aat, 6abx, 6ajh, 6ahf, 6aiy, 6akl, 6aof, 6aqd, 6arb, 6ars, 6atq, 6awt, 6bcd, 6bck, (6bcj), 6bcr, 6bic, 6bik, 6bir, 6bjq, (6bjy), 6bnv, 6boe, 6brd, 6bsa, 6bum, 6bwe, 6xh, 6hj, 6xt, 6zb, (6zf), 6zs, (6zx), 6zac, 7bs, 7dp, 7hs, 7jw, 7ic, 7iw, 7lu, 7mf, 7nj, 7oz, 7sc, 7tn, 7aeh, 7aft, 7afw, 7ahw, 7aiu, 7xc, 7xi, 7zb, 7zj, 7zo, 8ib, 8ue, 8wr, 8abr, 8amg, 8bvt, 8xj, 9dr, 9gk, 9ua, 9uu, 9wd, 9abv, 9agh, (ajs), 9amb, 9ams, 9aog, 9aon, 9aot, 9apw, 9aua, 9awm, 9awn, 9ays, 9ayu, 9ata, 9bed, 9bjv, 9bxa, 9dae, 9dkb, 9drk, 9dsm, 9dte, 9dvr, 9xaq, 9zac, 9zaf, Canadian 9bd, 9ac, 4bv, 5kc, 5za, 5xy, 6aaf, 6apl, 6avu, 6bfe, 6zs, 7bs, 7oz, 9amb, 9ams, 9bjv, 9ua, 9agh, 9zaf.

Anyone hearing 6rr 20 watts C. W. PSE QSL.

9BD, BARRON HOTEL, VANCOUVER, B. C.

C. W.—(Can.) (4bv), 4dq, 4gb, (5bq), (5ct), —U. S. 5di, 5qi, 5jl, 5kc, 5za, (7ac),—fone, Vancouver. (9ac), Calgary, 9be, (cfcn), 6ak, 6aat, (6asj), (6awt), (6abx), 6apw, 6alu, 6alv, 6aot, 6akt, 6atq, 6aty, 6atc, 6aol, (6arb), (6bes), (6boe), 6bum, 6bqg, 6bqz, 6bir, 6bf, 6boq, 6bfo, 6bcj, (6bcr), (6bsa), 6cu, (6cp), 6en, 6eb, (6fh), 6ft, 6jd, 6ka, 6lo, 6nx, 6rd, 6ti, 6xj, 6xad, 6za, 6zf, 6zk, 6zs, 6zg, 6zaf, (7aea), (7agf), (7afw), (7dp), 7hm, 7iu, 7iy, (7jw), 7jf, 7km, 7mf, 7na, 7nn, 7ny, 7oe, 7oj, 7qe, 7qw, (7th), 7tt, 7tn, 7ve, 7wm, 7xi, (7lu), 7xxc, 7zb, 8alt, 8axb, 8ib, 8kg, 8kr, 9amb, 9aja, 9awm, 9aou, 9axr, 9ans, 9abv, 9aap, 9arz, 9bjv, 9bcf, 9bf, 9bt, 9cp, 9dr, 9dpl, 9dsm, 9da, 9ri, 9ps, 9nx, 9uu, 9yaj, 9zaf, 9aon.

Spark—(5dx), (6ark), (6acr), 6avb, (6abw), 6aqu, (6anq), 6ala, 6aor, (6cc), (6gr), 6hp, 6qr, (6tu), (6vx), 6zq, (7agi), (7abs), (7aea), (7bk), (7bb), 7ce, 7fr, (7ge), (7sf), 7iw, 7kj, 7km, 7ne, 7nw, (7ot), 7oh, 7tj, (7vf), 7zb, (7zk), (9q3), (9nd).

BY 6BQL, 575 21st. AVE., SAN FRANCISCO

All C. W.—5za, 5zh, 6bf, 6cc, 6cu, 6ea, 6eb, 6en, 6ft, (6gx), 6ka, 6ku, 6pi, 6rr, 6sg, (6za), 6zb, 6zf, 6zg, 6zm, 6zac, 6xad, 6xaq, 6xas, 6abx, 6aeh, 6agp, 6ahp, 6ahq, 6aio, 6aiy, 6ajh, 6alu, 6aoz, 6apw, 6aqa, 6atc, 6atg, (6atq), 6avh, (6aqw), 6avd, 6bcd, 6beg, 6bes, 6boe, 6bjq, 6bjp, 6bjx, 6bjy, 6bko, 6bmd, 6bnv, 6bob, 6bod, 6bof, 6bpz, 6bqc, (6bqd), 6bqf, 6bqg, 6bqp, 6bqz, 6brf, 6brg, 6brk, 6bum, 6bvq, 6bzg, 7ap, 7dp, 7iy, 7jw, 7mf, 7nn, 7qn, 7qw, 7sc, 7th, 7tq, (7zb), 7zo, 7xc, 7aea, 7abs, 8azd, 9zn, 9amb, 9apa, 9avz, 9awm, 9ays, 9dtm, 9dug, 9xaq, 9yaj, 9zaf, Can. 9ac.

BY 6AOR, 2319 ASHBY AVE., BERKELEY, CALIF.

C. W.—5di, 5jl, 5qi, 5za, 6bf, (6cu), (6ea), 6eb, (6ft), 6gy, 6jd, 6en, 6ka, 6aeh, 6abx, 6ajh, 6alu, 6anp, (6apw), 6aqw, 6atc, 6bcy, 6bec, 6beg, 6beq, 6bir, 6bko, 6bjy, 6blu, (6bpz), 6bqf, 6bqp, 6bqz, (6brk), 6bum 6bvq, 6zg, 6xad, 6xas, 7d, 7ir, 7iy, 7lu, 7mf, 7na, 7nf, 7oe, 7ot, 7qw, 7sc, 7sg, 7tq, 7ack, 7aea, 7afw, 7agx, 7zb, 7zu, 8ib qra, 8wr, 8bcy qra vy qsa, 9cb, 9dr, 9wd, 9aja, 9aos, 9amb, 9ayu, 9awp, 9awm, 9ccj, 9dtm, 9zn gud note qsa. Above stns hrd on 1 tube auditron and Grebe hookup. Will all stns hearing 6aor-cw please qsl card.

BY 6AOI, RIVERBANK, CALIF.

Spark—Nao, (6cc), 6fh, 6cr, (6gt), 6ib, 6ic, 6km, 6od, 6qr, 6tu, 6tc, 6up, 6vx, 6wi, 6xh, (6aak), 6aad, 6abx, 6acr, 6acs, 6adg, 6agk, 6ahf, 6aic, 6ajh, 6akt, 6ala, 6ald, 6amk, 6apl, 6aqu, 6aqx, 6ark, 6auc, 6avb, 6avy, 6awx, 6bas, 6bbv, 6bnn.

(7tw), 7vf, 7zu, 7vc, 7abs, 7au, 7nn.

9bd, (can.)

C. W.—4bv, (can.), 5za, 5zav, 5zh, 5di, 6ak, 6av, 6cp, (6cb), 6cn, 6fh, 6gd, (6gx), (6km), (6ku), 6xj, 6xas, (6ait), (6gr), 6zm, 6zf, 6aat, (6abx), (6agp), 6ajh, 6apw, 6arb, 6asj, 6atq, 6awt, 6brd, 6bmd, 6bqc, 6bjq, 6bjy, 6beg, 6boe, 6bqd, 6bzg, 6bjc, 6beq, 6bqg, 6bod, 6bes, 6bcj, (6bpz), 7xc, 7afu, 7vc, (7lu), 7afw, 7tn, 7we, 7zu, 9ac, 9amb, 9dtm, 9zaf, 9dpl, 9ani, 9dte, 9apw, 9bjv, 9ays, (9nx)?

FONE—6au, (6ak), 6km, (6ku), 6nx, 6xv, 6xj, 6xd.

WSB—Atlanta, Georgia.

CFAC—Alberta, Canada.

Anyone Hearing My Five Watter PSC. QSL.

BY 6QU, 1512 OXFORD AVE., BERKELEY, CALIF.

Spark—(6ea), (6eb), (6gd), 6gi, (6gt), (6hy), 6iu, (6iv), (6kc), (6ke), (6lc), (6mh), (6od), (6ol), 6om, (6to), (6uo), (6up), (6wr), (6aak), (6acy), (6ada), (6adg), (6adl), (6aeh), 6afn, (6agf), (6ahf), (6ahp), (6ahq), 6ahv, (6aic), (6ajh), (6ajr), (6akl), (6ald), (6amn), (6apy), (6aqv), (6aqx), (6ark), (6asc), 6atf, (6avd), (6avr), (6awi), (6awx), 6bam, (6baj), 6bbc, (6bdz). 6bgh, (6zb), (6zu), 6zam, (7bb), (7bh), (7bk), (7ed), (7fi), (7fr), (7ga), (7ge), 7hd, (7hf), 7iw, 7jd, (7jw), (7kj), 7kz, (7mf), (7mp), (7na), (7nn), (7nw), (7ot), (7oh), (7oz), (7sa), (7sc), 7tj, (7to), (7tw), (7ve), (7vf), 7xh, 7ya, 7yg, 7yj, 7zg, 7zk, 7zm, 7zs, 7zt, 7zu, Canadian: (5cn), (9bd), cl8.

C. W.—6bf, (6cu), 6ea, 6eb, (6en), (6ft), (6gd), (6jd), 6ka, 6pi, 6aio, 6alu, 6apw, 6atq, 6awp, 6beg, (6bes), 6bqf, 6xad, 6zb, 6zf, 6zg, 6zs, 6zz, (6zac), (7dp), 7mf, 7na, (7sc), 9wu, 9amb, 9awm, 9zaf, voice wv6, voice Canadian: 4cb, 9bd.

BY 6EX, 1615 ARCH ST., BERKELEY, CALIF.

Spark—5hk, 5tc, (6bv), (6da), 6df, (6ea), (6eb), (6ef), (6en), 6er, (6fk), (6ft), (6gp), (6gt), 6gv, 6gi, 6hh, (6hy), (6is), 6iu, (6iv), 6jy, (6ka), (6kc), (6ke), (6ks), (6ky), (6lc), (6lu), (6mh), (6od), 6oh, 6ok, (6ol), 6om, 6pc, (6qk), 6sk, 6tf, (6to), (6tv), (6uo), (6up), 6vz, 6wh, (6wr), (6aak), (6abx), (6acy), (6ada), (6adl), 6aei, (6aeh), 6afw, 6aez, (6afn), 6afp, (6agf), (6agp), (6ahf), (6ahp), (6ahv), (6aib), (6aif), (6aio), (6aiu), 6aix, (6ajh), (6ajr), (6akl), (6ald), 6ali, 6alp, (6alu), (6amn), 6amq, (6aoe), 6apv, (6apy), (6aqx), (6ars), 6aru, 6arw, (6asc), (6atf), 6ath, 6aud, (6avd), 6avr, 6awh, (6awi), (6awx), 6baf, (6baj), (6bbc), 6bce, (6bdz), 6bem, (6bgh), 6bil, 6biu, 6bnd, 6bqc, 6zb, (6zj), (6zr), (6zu), (6zz), (6zal), 6zam, 7ba, (7bb), (7bc), (7bj), (7bh), (7bk), (7bp), (7br), 7bz, (7ce), 7ck, 7cn, 7cu, (7ed), 7fe, (7fi), 7fj, 7fr, 7gd, 7ge, (7gj), 7gq, 7hd, (7hf), 7hg, 7hn, 7hp, (7in), (7iw), 7ju, (7jw), (7kb), 7ke, (7kj), 7ks, 7ly, (7mf), (7mp), (7my), 7nl, (7nn), (7nw), 7oh, 7ot, (7oz), 7rc, (7tc), (7tj), (7to), 7vf, 7vo, 7wg, 7wm, 7xh, (7ya), 7yg, (7yj), 7yl, (7zj), 7zk, (7zm), 7zp, 7zs, (7zt), 7zu, 7zv, 7xa, 9oa, 9rm, can. (9bd), 9bi, cl8.

C. W.—(6cu), (6ea), 6eb, 6ef, (6en), (6ft), (6gd), 6gf, (6jd), 6jj, (6ka), 6ku, (6ky-voice), 6mn, 6pi, (6aag), 6acb, 6aeh, 6ahg, 6aif, 6ale, 6alu, 6avx, 6avy, 6apw, 6aqa, 6aqt, 6awp, (6bes), 6bir, 6bjc, 6bqt, (6xad), 6zb, (6zf), (6zg), 6zn, 6zr, 6zs, 6zz, (6zac), 7dp, 7hc, 7mf, (7na), 7nx, 7sc, 7sk, 7tq, 7xf—voice), 7zu, 9wd, 9wu, (9amb), 9dva, wv6—voice, Can. 9bd.

LETTERS TO THE EDITOR

Sir:—A word about your article concerning amateur spark transmitters on page 9 of October Radio. You invited readers to send in their opinion on this matter, so I am sending mine. Well, to start with, I think it's a fool idea. Next I can readily see that it is the idea of some radio manufacturer (fly-by-night), he—who thinks more of having the air to himself for advertising his business and putting a lot of cheap phonograph records on the air, which interfere with amateur relay traffic that actually want to give good, interesting programs and assist in co-operation between the amateur and novice. All broadcasting is understood to be now essential and A. R. R. L. relay traffic, which handles messages to and from all parts of the U. S. for the American people, free of charge, is more important and is essential. Another thing is the amateur spark transmitters do not transmit between the hours of 7:30 to 9:00 p. m., giving the novice sufficient time to hear his concerts. Do the concert people ever stop to think that their concerts might interfere with the amateur No; I should say not, and believe me, they surely do. This problem has developed through the constant complaints received from novices of whom 75% cannot read the code and are entirely ignorant of the importance and nature of telegraph conversations. Many attribute QRM from leaky "A & B" batteries, induction from electric and telephone lines, electric street cars and arc lights to the amateurs. Can any real dyed-in-the-wool hams stand for any such foolishness and ignorance as this? What do you think about it? Why not allow the concerts to be given between the hours of 7:30-9:00 p. m. only, and there would never be any complaints, as no spark transmitters are in operation under the Pacific plan during this period, or if this is not possible, publish in your magazine in letters about 6 ins. long that the air is reserved for concerts during 7:30-9:00 p. m., and that the amateurs do not interfere with the spark during that time, Hw? Practically all concert bugs are equipped with conductively coupled receivers, being very broad most of the fault being at the receivers end. All spark transmitters are licensed by law to use a wavelength of 200 meters with a decrement of 2. Such a transmitter should in no way interfere with concerts on the 360 meter wave (read D. B. McGowan's article about interference with concerts which appeared a month or so ago in your paper). Print it again, lay emphasis on these facts and assist in co-operation between the amateur and novice. Don't make your paper a one-sided affair and try to down the amateur; keep up your calls heard department; get an operating department and give us fellows what we want. About C. W. transmitters (impractibility)—Unless a considerable amount of power is used, it is necessary to oscillate the receiving tubes in order to pick up a C. W. man. This requires very delicate adjustments and sharp tuning such that unless work was arranged on schedule or a high-power spark wired QSP, it would be necessary to call a great many times. For instance, some of the 10 or 20 watt C. W. birds, who boast of working the east coast and have to call for a half hour before making connections Hi, think of all that QRM for a local spark man who only has to call three times de sine—3 times, as specified by law and in many instances less, gets his man, shoots his traffic and is off the air before you know it. And these C. W. birds locally, with self-rectifying circuits, rectified AC, generator hums cause more QRM than any spark man ever did. When one of these high-powered C. W. fellows around L. A., who boast of

Continued on page 42

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THE COLIN B. KENNEDY COMPANY
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SAN FRANCISCO | **U. S. A.** | **SAINT LOUIS**

Tell them that you saw it in RADIO

Continued from page 40

15 and 20 amps. radiation, start up it is difficult to work around the bay, no kidding. If these manufacturers you speak of offer C. W. apparatus at wholesale prices, it even then will be so expensive that it will be out of reach for many of us, and of those who buy it 85% will get self-rectifying sets with those awful gurgles and howls, with resultant QRM. It is necessary to have 100 watts output of C. W. before any reliable work can be done. There have been ships at sea using C. W. outfits which have sunk because no one heard their S. O. S. Whereby, if they had had a spark set everyone likely would have been saved. Right today KPH is doing traffic with 2 kw. spark ships 5000 miles out on the Pacific and in summer, too, on 600 meters. Are there any C. W. sets of similar power who can duplicate this work reliably every night? Or beat it? No; it can't be did. I believe I have stated why sparks should stay and I do not see any reason why they should be abolished. I would like to hear from others on this matter. Those who want the sparks abolished are grafters who want to hog the air and make it a business paying proposition. Did Marconi invent wireless for such a purpose? No; I should say not! It was meant for a utility—a convenience. These manufacturers disguise their advertising by the names of broadcast and programs so as to pass government regulations. One man has as much right to the air as any other, provided he conducts himself courteously, which all spark men do. Through the use of the NA & IM signatures QRM has been reduced to a minimum and the air is no longer congested. Let's hear someone else's opinion.

Faithfully yours,
73—A READER.

San Mateo, Calif.

RECENT PATENTS

Continued from page 34

John Hays Hammond, Jr., Pat. No. 1,420,629, June 27, 1922. Teledynamic Orientation System.

A rudder 25 on a moving object 19 is controlled from an air valve 41, the position of which is determined by the energization of solenoids 60 or 61, which in turn is determined by the position of an azimuth ring 80 with two semicircular segments relative to a brush controlled by the gyroscope 110. In this way the course steered is determined by properly locating this ring 80 with respect to the object 19. The positioning of this ring is made dependent upon the frequency of the energy waves received from a distant point by antenna 312, 313, etc. Thus, while the receiving system is unresponsively, a relay 200 is inactive, and a back contact 307 for solenoid 308 is made. This causes energization of magnet 296, and a shifting of a controller 271 so that motor 255 rotates both ring 80 as well as controllers 145 and 147. These controllers determine the amount of tuning inductance in the primary and secondary of transformer 179, respectively in circuit with detector 318 and with relay 200. When the rotation of controllers 145 and 147 is sufficient to tune these circuits to the received energy, magnet 308 is energized, magnet 296 is deenergized, and controller 271 reverses motor 255. As soon as the tuning is destroyed, the cycle begins again. Thus azimuth ring vibrates about a definite direction determined by the frequency of the radiated energy.

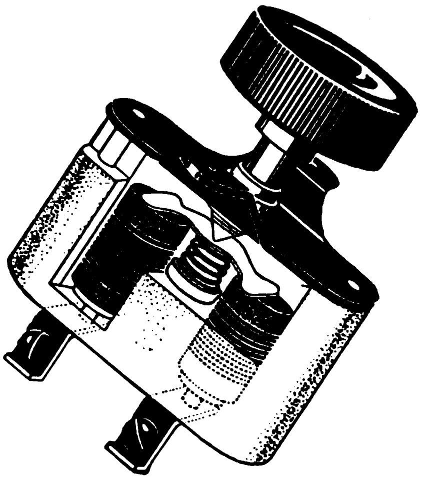
John H. Hammond, Jr., Pat. No. 1,419,376, June 13, 1922. Wireless Control Apparatus.

In this arrangement a wireless detector causes relay to operate, upon receipt of sig-

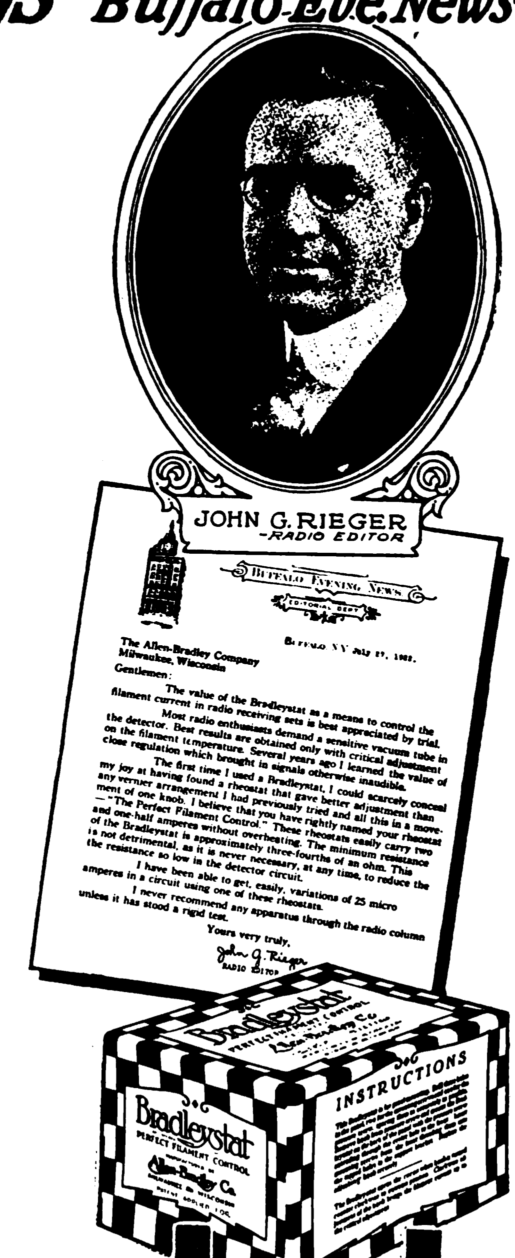
Continued on page 44

Better Adjustment than any Vernier Rheostat

Says Radio Editor Buffalo Eve. News



Retail Price
$1.85
Postage 10c extra



BUFFALO, N.Y. July 17, 1922.

The Allen-Bradley Company
Milwaukee, Wisconsin

Gentlemen:

The value of the Bradleystat as a means to control the filament current in radio receiving sets is best appreciated by trial.

Most radio enthusiasts demand a sensitive vacuum tube in the detector. Best results are obtained only with critical adjustment on the filament temperature. Several years ago I learned the value of close regulation which brought in signals otherwise inaudible.

The first time I used a Bradleystat, I could scarcely conceal my joy at having found a rheostat that gave better adjustment than any vernier arrangement I had previously tried and all this in a movement of one knob. I believe that you have rightly named your rheostat —"The Perfect Filament Control." These rheostats easily carry two and one-half amperes without overheating. The minimum resistance of the Bradleystat is approximately three-fourths of an ohm. This is not detrimental, as it is never necessary, at any time, to reduce the resistance so low in the detector circuit.

I have been able to get, easily, variations of 25 micro amperes in a circuit using one of these rheostats.

I never recommend any apparatus through the radio column unless it has stood a rigid test.

Yours very truly,
John G. Rieger
RADIO EDITOR

The Secret of Bradleystat Control

A single knob varies the pressure on the two columns of graphite discs.

The change of filament current is so gradual and smooth that no vernier rheostat can duplicate the noiseless Bradleystat. An internal switch protects the A-battery.

The Bradleystat brings louder reproduction, quicker tuning, and a greater range. The adjustment is permanent and precise.

Remember the one-year guarantee and the twenty years of experience behind the Bradleystat. Write for latest bulletin, today!

Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Ave., Milwaukee, Wis.
Member of the National Radio Chamber of Commerce

Bradleystat

REGISTERED U.S. PAT. OFF.

PERFECT FILAMENT CONTROL

Continued from page 42

nals. This in turn completes the circuit for the pilot motor 22 driving a controller 44. This controller affects a motor 58, operating a mechanism for moving a rudder 63. Various safety devices are installed, such as limit switches 68, and switches 71 for preventing the motor 58 from moving the rudder too far. Furthermore, an arrangement is also described for inserting rotating segments in the antenna circuit, whereby signals of a definite predetermined sequence can affect the detector.

John H. Hammond, Jr., Pat. No. 1,419,377, June 13, 1922. Radiodynamic Occulting System.

Shutters 10 for intercepting beams of light from a searchlight 1 are controlled by radiant energy from a distance. This is affected by the aid of receiving circuit 2, 3, 4 and magnet 8 operating a pneumatic cylinder 23. This cylinder in turn operates the valve 27 for admitting air into cylinder 15 or for permitting it to exhaust. The shutters 10 are directly operated by a rack 13 connected to piston 14 in cylinder 15.

John H. Hammond, Jr., Pat. No. 1,420,255, June 20, 1922. Antenna for Radiotransmission Systems.

In order that a sufficient length of antenna may be utilized even on small vessels, one end of an antenna A is attached to a float C, and the other end to a line F in mast M. Appropriate insulators I-I' are provided. To vary the length of the antenna A, a winch W may be connected to float C by means of a rope or cable B.

John H. Hammond, Jr., Pat. No. 1,420,256, June 20, 1922. System of Teledynamic Control.

A transmitting station is arranged to send groups of waves of a definite controllable frequency, which are received by a receiving system $A^1L^2E^1$. The relay O is energized with a frequency depending upon the group frequency, and the solenoid N takes up a position which corresponds to this group frequency. If the frequency is high, the solenoid N pulls core 3 entirely to the right, if of an intermediate value, the core 3 stays central, and if of a low value, or if no radiations are received, the core 3 moves to the left. A piston P and cylinder Q damps these movements. These movements of the core 3 are caused to operate a rudder moving mechanism Y by the aid of cylinder U and valves 9 and 10, so that the rudder is moved to any desired position depending upon the frequency of the impulses received.

John H. Hammond, Jr., Pat. No. 1,420,257, June 20, 1922. System and Apparatus for Automatic Wave Selection.

In order to prevent interference, an arrangement is provided whereby the wavelengths of transmission and of reception are synchronously varied. Thus at the transmitting station upon depression of a signaling key 3, a solenoid is energized which causes rotation of tuning coil 5. This rotation is such that contacts 6 on the periphery are changed to change the number of turns in the antenna circuit. At the receiving station a similar arrangement is provided to rotate the tuning coil as soon as a signal is received.

John H. Hammond, Jr., Pat. No. 1,418,869; June 6, 1922. Teledynamic control.

A magnet is energized in response to radiations received. The duration of the radiations determines the travel of a core and that of an attached roller. The core also carries a valve member for controlling the admission of fluid under pressure to various cylinders for causing the rudder of the body to be shifted, or for coupling a prime mover to a propeller shaft.

HOW TO BECOME A PROFESSIONAL RADIO OPERATOR

Continued from page 12

coupler should be at least large enough to tune in the 600-meter shipboard sets and the 800-meter radio-compass stations. All but the very smallest instruments on the market will do this.

When the student can afford it, an audion detector is greatly to be desired, since it will tremendously increase the effective range of the receiving set and is so much more interesting to operate than a crystal device. An audion detector will make good receiving possible on a very small aerial, and will enable the experimenter to hear the amateurs with CW transmitters. More important still, when the student has an audion he may, with small additional expense, add a long-wave honeycomb-coil circuit to his outfit and listen in on the high-power arc stations.

With an audion detector the larger arcs and alternators can be received with good audibility anywhere in the United States, and, therefore, an outfit that will bring them in is of especial value to the youth living in an isolated section of the country where there are few stations close at hand to listen to. Indeed, a receiving set that will tune in long-wave CW signals cannot but be of inestimable value to any learner, since much of the high-power transmission is carried on at a comparatively slow rate of speed and many of the larger arcs are operating almost continuously, enabling the student to have receiving practice at almost any hour of the day or night. Some of the arcs, again, are operated on very fast circuits; and therefore the advanced learner is also afforded valuable practice on the long-wave receiving set. The student who can successfully copy the Federal Telegraph Company's overland arcs and the Radio Corporation's transoceanic alternators need have no fear of the radio inspector's omnigraph.

The country boy who has no electricity to charge a filament-lighting storage battery should not despair of having an audion detector. If he can afford to buy eight Edison primary cells, his filament-current problem will be solved. The cell referred to is known as the "Edison Type Q," and is widely used for igniting farm gasoline-engines, and in motor boats. These batteries can be bought in the electrical stores or in almost any large hardware store that handles gasoline engines.

Not less than eight of these cells should be used for lighting an audion filament, since their voltage on closed circuit is about 0.6 to 0.7 volt. The voltage is considerably higher on open circuit, however, and so it is very im-

Continued on page 48

How Science has bridged with wireless the miles between city and country

TO the health and independence of farm or suburban life, Magnavox Radio adds the large city's most envied advantage—access to wholesome, inspiring entertainment.

Magnavox Radio, the Reproducer Supreme, brings out all that is finest and best in broadcasted programs—clearness, fidelity to the original; and above all, sufficient power to be enjoyed by the entire family and their guests.

When you purchase a Magnavox Radio or Magnavox Power Amplifier you possess an instrument of the very highest quality and efficiency. Without the Magnavox, no receiving set is really complete.

The Magnavox products may be had of good dealers everywhere.

THE MAGNAVOX COMPANY **Oakland, California New York Office: 370 Seventh Avenue**

Type R-3
with 14 inch horn
(illustrated above)
$45.00

Type R-2
with 18 inch horn
$85.00

Model C
Power Amplifier
2 stage
AC-2-C . . $80.00
3 stage
AC-3-C . . 110.00

MAGNAVOX RADIO
The Reproducer Supreme

Continued from page 48

portant that the experimenter employing them take care to cut in all his A-battery rheostat when first lighting his audion, or he is liable to have a burnt out filament. After the tube has been lighted for a few minutes, the voltage will begin to fall off and the filament rheostat must be readjusted every few moments until the cells become steady. I installed just such a battery outfit for a radio amateur in Alaska, wiring in a small double-pole double-throw switch to throw the current from the audion detector to the spark-coil transmitter or *vice versa,* and the arrangement proved remarkably successful.

Ordinary dry cells may also be used to light an audion filament, but they are not to be recommended for such work. Eight dry cells connected in series-parallel will give from 20 to 50 hours of intermittent service on a single detector tube.

The student operator who is so unfortunate as to live in a place where for some reason or another even a small aerial is impossible had best buy or assemble a good regenerative receiver and two-step amplifier. This is a somewhat expensive undertaking, it is true, but almost any of the better regenerative and amplifier outfits on the market will give astonishing results on a small indoor aerial or frame. The maker of one of these super-sets declares even that if the tyrant landlord prohibits wires and poles on the roof of the flat, you can "hook 'er to your bedspring, and let the rest of the world go by!"

Automatic Sending Machines

A GREAT many radio amateurs and prospective operators who are anxious to learn to receive in the shortest possible time are buying one or another of the automatic transmitting devices. The various sending machines on the amateur market are virtually alike in principle, in that they employ spring-motor-driven metal discs or records, which have raised dots and dashes on their edges; these in turn operating a vibrating contact which may control a buzzer circuit and so reproduces the signals on the metal discs.

These machines are undoubtedly of value in learning to receive, since they will furnish code drill at any time and at any speed the learner wishes it, but their most serious shortcoming is the scant variety and the inflexibility of the practice material they afford. The metal discs carry only a few words, and when the student hears them transmitted a few times, he knows them by heart. The practice then becomes valueless. The learner must constantly have new and unanticipated material to work on; he may become able easily to recognize

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constantly-repeated matter sent at a speed of even thirty words a minute when he can hardly copy ten words a minute of unfamiliar text.

There is a way, however, to get a great deal of valuable drill with one of these transmitters, and that is by putting on the dials upside down. Then, when the machine is operated, the dot and dash combinations on the discs will be sent backward, reversing not only the words, but also many of the letters—as, for an example, *B* will be changed to *V*, *F* to *L*, and so forth. The transmitter will thus reproduce groups of miscellaneous letters, virtually code, upon which the student can practice for weeks without memorizing the combinations to any great extent. It will be observed that the letters *C*, *J*, and *Z* sent backwards will form unused dot-and-dash combinations, and these must be simply disregarded. It would be a good thing perhaps if the manufacturers of automatic transmitters would furnish sets of code dials for them.

It is sometimes asserted that the sending of the automatic transmitter has a lifeless, machine-like sound, peculiarly different from hand sending. While it is true that the metal-dial type of machine lacks the personal touch of manual sending, I can not see that this is a very serious disadvantage. A typewritten letter lacks the individuality of handwriting; but it is nearly always more readable. The ultra perfect style of the dial transmitter greatly resembles good vibroplex sending, and at any rate it is easier and more pleasant to read than some of the hand-sent stuff that nightly rattles our receiver diaphragms like some one shaking a handful of pebbles in a tomato can.

The automatic transmitter is perhaps of greatest value to the beginner, not only as a means for fixing the code in mind, but especially in helping him to attain sufficient speed to read a little of what he hears on his receiving set. When he acquires a receiving speed of ten or twelve words a minute, he may lay aside the sending machine and devote his available time entirely to listening in.

In conclusion, no prospective radio operator should ever attempt to learn to receive solely by the use of a mere mechanical device. The accepted methods of handling commercial traffic; the heavy jam of interference encountered in actual work; an acquaintance with that old devil of the air, static, and skill in the manipulation of receiving apparatus—all these would be unknown to the operator who learned his receiving entirely with a sending machine. Even supposing he were to attain the speed necessary to pass the government examination for a commercial license, he would be in sorry confusion when he

Continued on page 54


REMLER
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APPARATUS THAT RADIATES QUALITY
Remler No 93 A Battery Potentiometer Price 75¢
Remler No 100 - 3" Bakelite Dial and Knob 3/16 or 1/4 Shaft Price 75¢
Remler Type 500 Bakelite Molded Variometer Price $7.50
Remler No 40 Bakelite Coil Plug Price 60¢
Remler No 42 Bakelite Panel Plug Price 60¢
Remler No 43 Bakelite Coupling Plug Price 90¢
Remler No 46 Bakelite Coupling Plug with Binding Posts Price $1.00
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WHY REMLER STANDS
Pictured on these two pages is the famous Remler line of Quality Radio Apparatus built to serve the needs of the Amateur—built from the Amateur's point of view. Look the Radio field over—you will find that Remler Apparatus is often copied in design, but never equalled in quality. It is designed right, built right, priced right, and works right. It is the Quality Apparatus—sold under a genuine guarantee.
We urge you to look the Radio market over—to test Remler alongside any make of
Remler No 810 Junior Rheostat Panel Type Price 1 1/2 amps. carrying capacity $1.00
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Remler Type 505 Panel Mounted Vario Coupler Price $12.00
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Remler Type 503 - 180° Vario Coupler
Price $5.40
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Remler No 97 Grid Condenser
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INPUT
OUTPUT
BATT.
Remler No 96 Variable Grid Leak
Price 40¢
Remler Type 333 Amplifier Panel
less transformer Price $9.00
Remler Type 331 Amplifier Panel
less transformer Price $6.00

Continued from page 50

attempted to work on the air. As has already been said, the automatic transmitter is a very helpful device for the learner, but if the student can afford only a small sum for equipment, let him by all means buy receiving apparatus.

Books to Study

LIKE piano playing and touch typewriting, telegraphic sending and receiving ability comes only by practice; it can not be learned from books. But in learning to send and receive, the prospective radio operator has traveled only a part of the way on the road to a commercial license. He has yet to learn the technical side of wireless operating; he must acquire a knowledge of electricity, especially with reference to the adaptations of electricity in the field of radio, and he must make himself familiar with every detail of the construction and use of the many different types of wireless equipment employed in commercial work. Herein we see the value of the study of books.

Not all the good books on radio can be named here, the aim being rather to mention in the order of their importance those books which are believed to be of cardinal value to any one studying to become a commercial radio operator.

It seems to be pretty well agreed that about the first book the tyro should study above all others is *"Robison's Manual of Radio Telegraphy and Telephony,"* familiarly known as the "Navy Manual," and published by the Naval Institute at Baltimore. The text-book of many wireless schools, this volume has been a guiding beacon to more than one beginner. Its greatest worth lies in its clear and plain exposition of the theoretical groundwork of radio, whereby the student is prepared for the intelligent reading of other more intensive books, and books that specialize on particular types of apparatus. The beginner should by no means neglect the first few elementary chapters; if he will thoroughly study the first half of the book, he will have a good grasp of the principles of spark radio. If the book is bought at second hand, care should be taken to see that it is a 1919 edition, or later.

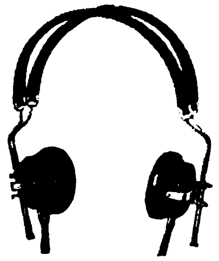
Another almost equally valuable book —on spark radio—is Bucher's *"Practical Wireless Telegraphy"* published by the Radio Corporation of America. This book is virtually a complete manual of the Radio Corporation's shipboard radio equipment, containing as it does not only much constructional information, but also specific and detailed instructions on the operation and maintenance of the apparatus. A complete circuit of a modern shipboard radio set, consisting of a quenched-spark transmit-

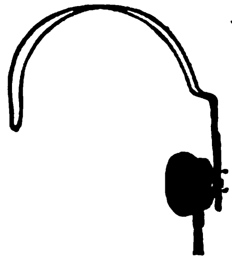
Continued on page 56

The Quality of the Parts of a Receiving Set Determines its Value

Build Your Set With Kellogg Radio Equipment and Secure Maximum Results

HEAD SETS





The value of extremely light and very small head sets in Radio receiving is most evident when using Kellogg head receivers, which, however, have proved as sensitive and thoroughly efficient as they are light in weight and small in size. The band, too, is especially adaptable and the simple receiver holders which are held in place on the lower part of the head band by the spring tension of the metal, can be instantly adjusted so as to place the receivers over the ears for the best hearing.

No. 69A Head Set 2400 ohms..............each, $12.00
No. 69C Head Set 2000 ohms..............each, 8.00
No. 74A Head Set 1000 ohms..............each, 5.00

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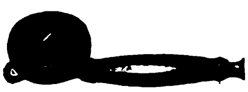
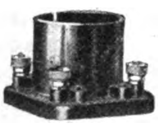


No. 2 Microphone

Standard Microphone. Super-sensitive. The result of twenty-five years experience.

Kellogg No. 21 Microphone each $7.35

TUBE SOCKETS



No. 2

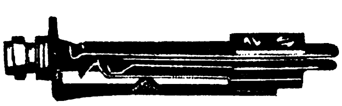
All Bakelite tube socket. Takes all standard tubes. "The Standard Socket."
No. 1 and No. 2 Tube Sockets...each, $0.75

PLUGS

The Kellogg plug fits all jacks. It is of strong construction and handsomely finished.
No. 501 Plug..........each, $1.00

SPRING JACKS

Positive contacts, constant spring tension. Durable insulated frame.



No.		Each
501—4	Conductor	$1.10
502—2	Conductor	.75
503—3	Conductor	.80
504—4	Conductor	1.10
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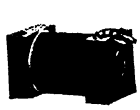
CHOKE COILS



Air Choke Coil

Iron Core Choke Coil

5 millihenrie air choke coil................each, $1.00
10 millihenrie air choke coil..............each, 1.00
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RESISTANCES

12,000 ohm non-inductive wire wound resistance....$1.75
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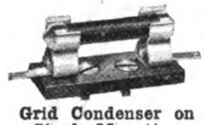
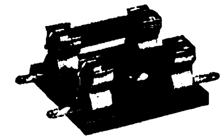
GRID AND PLATE CONDENSERS



Grid Condenser on Single Mounting No. 502



Grid Leak and Condenser on Double Mounting No. 503

Kellogg Grid Condensers and Grid Leaks are 1⅞ in. x ⅜ in. They are of the cartridge type, sealed in a moisture proof shell. Not affected by temperature changes.

No. 501 .01 M. F. No. 503 .0025 M. F. No. 505 .0005 M.F.
No. 502 .005 M. F. No. 504 .0010 M. F. No. 506 .00025 M.F.

Kellogg Grid and Plate Condensers, each, $0.75

GRID LEAKS

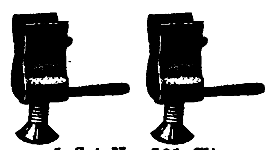
Radio Grid Leak, No.	1	Resistance 5.	Megohms	5,000,000 ohms
Radio Grid Leak, No.	2	Resistance 4.	Megohms	4,000,000 ohms
Radio Grid Leak, No.	3	Resistance 3.	Megohms	3,000,000 ohms
Radio Grid Leak, No.	4	Resistance 2.5	Megohms	2,500,000 ohms
Radio Grid Leak, No.	5	Resistance 2.	Megohms	2,000,000 ohms
Radio Grid Leak, No.	6	Resistance 1.75	Megohms	1,750,000 ohms
Radio Grid Leak, No.	7	Resistance 1.5	Megohms	1,500,000 ohms
Radio Grid Leak, No.	8	Resistance 1.25	Megohms	1,250,000 ohms
Radio Grid Leak, No.	9	Resistance 1.	Megohms	1,000,000 ohms
Radio Grid Leak, No.	10	Resistance .75	Megohms	750,000 ohms
Radio Grid Leak, No.	11	Resistance .6	Megohms	600,000 ohms
Radio Grid Leak, No.	12	Resistance .5	Megohms	500,000 ohms
Radio Grid Leak, No.	13	Resistance .4	Megohms	400,000 ohms
Radio Grid Leak, No.	14	Resistance .3	Megohms	300,000 ohms
Radio Grid Leak, No.	15	Resistance .25	Megohms	250,000 ohms
Radio Grid Leak, No.	16	Resistance .2	Megohms	200,000 ohms
Radio Grid Leak, No.	17	Resistance .15	Megohms	150,000 ohms
Radio Grid Leak, No.	18	Resistance .1	Megohms	100,000 ohms
Radio Grid Leak, No.	19	Resistance .05	Megohms	50,000 ohms

Kellogg Grid Leaks, each, $0.25

Radio Grid Leaks Nos. 5, 7, 9 and 12 are most generally used

MOUNTINGS

FOR GRID LEAKS AND CONDENSERS



1 Set No. 501 Clips

No. 501 ....per set, $0.20
No. 502, single mounting .... each, 0.45
No. 503, double mounting .... each, 0.85

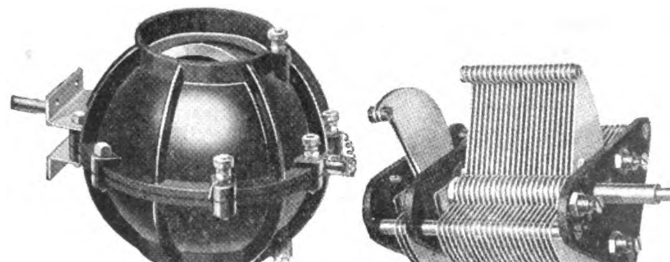
STRAIN INSULATORS

Kellogg Bakelite Insulators will stand a pull of approximately 350 lbs.

No. 4, Length 2 inches.....................each, $0.19½
No. 3, Length 3 inches.....................each, .25
No. 5, Length 4 inches.....................each, .30.6
No. 6, Length 6 inches.....................each, .41.1

Variometers, Variable Condensers

In production October 1st.



KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, Ill.

If your dealer or jobber does not handle Kellogg equipment, write us for catalog, advising us of his name. Address Department A

Continued from page 54

ter, auxiliary battery and charging-panel, and a standardized receiver, is given, and this or some similar circuit must be drawn from memory in the commercial license examinations.

For the student who aspires to become an arc operator, the *"Arc Manual,"* sold by the Pacific Radio Publishing Company, is indispensable. This up-to-date and profusely illustrated book has been prepared by the engineers of the Federal Telegraph Company, the sole manufacturers of arc radio equipment in America, and it is the only authoritative arc treatise in existence. Every student will find it well to understand arc apparatus, since a great number of the Shipping Board vessels have this type of equipment. No one can regard himself as an all-around operator when there is a system of radio being widely used about which he knows nothing, and not only this, but it is probable that questions pertaining to arc equipment will soon be included in the government license examinations.

"The Quiz Book," which is also sold by the Pacific Radio Publishing Company, will prove helpful to the prospective radio operator if used to put a sort of finishing touch on his technical study. It contains questions representative of those which the candidate for a commercial license is required to answer. Rightly used, this volume is of real service, but do not make the fatal mistake of many would-be operators who, instead of thoroughly studying good radio text-books, attempt to cram into their memory the contents entire of some question book, and then essay the government examination. Swallowing things whole causes indigestion. The radio inspector immediately recognizes and looks with disfavor upon the question-book candidate, whose answers have the cut-and-dried style of a stack of cordwood.

The applicant for a radio operator's license must be familiar with the radio laws and regulations and the international abbreviations, and these are best studied in the government pamphlet *"Radio Communication Laws of the United States,"* obtainable from the local radio inspector, or from the government printing office at Washington, D. C.

As has been said already, there are many other good books on radio besides those considered here, but the writer believes that the books named above are among the best for the student wireless operator. Beware of the radio book that is out of date—there is more than one such. Some time ago a set of electrical books were announced in advertisements cleverly designed to give the impression that the books contained a great amount of ultra modern

Continued on page 58

Announcement

We are now carrying a complete stock of Grebe Radio Apparatus at our

Western Branch

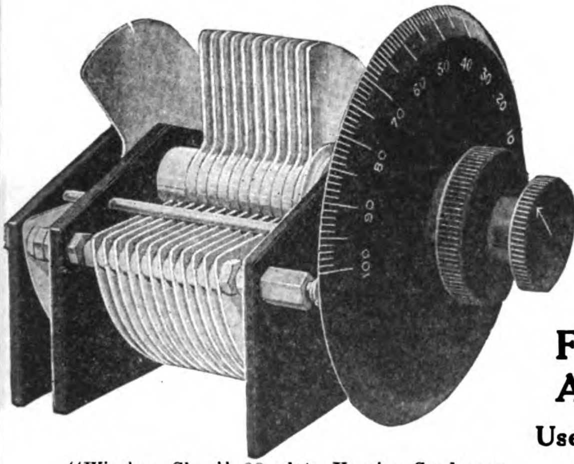
451 East 3rd Street,
Los Angeles, Cal.

A. H. GREBE & CO., Inc.
General Offices and Factory
Van Wyck Boulevard, Richmond Hill, N. Y.

Buy Direct from the Manufacturer

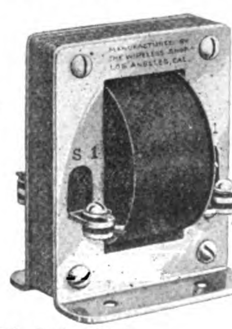
SAVE 20%

PROMPT SHIPMENT FROM STOCK
QUALITY APPARATUS—SERVICE
THE "WIRELESS SHOP" NAME
IS YOUR GUARANTEE OF SATISFACTION
All Goods Sold at Net Prices—*No Discount to the Trade*
The Vernier Condenser shown is only one of our Quality Line of Instruments
IT IS REASONABLY PRICED—The 23 plate selling for **$6.00** complete with Gorton Engraved Dial. The 31 plate is **$6.50,** and the 43 plate **$7.20.** Can you beat this in either quality or price?


"Wireless Shop" 23 plate Vernier Condenser

For Your New Audio Amplifier . . only $4.00

Use the NEW "WIRELESS SHOP" QUALITY TRANSFORMER



Endorsed by leading radio men from actual comparative tests as THE BEST YET

A few Accessories that are usually hard to get—WE HAVE 'EM!

Tinned No. 15 copper for wiring your new set—25 ft. coil	20c
"Spagetti"—yellow or black—per 3 foot length	20c
Solder Lugs for No. 4, No. 6 or No. 8 screws—per doz.	10c

For the convenience of Los Angeles Amateurs we will open up a Branch Store located at Hope & Washington Sts., about Oct. 10th, directly opposite Poly High, on Hope Street

THE WIRELESS SHOP Radio 11
1262 W. 2nd St., Los Angeles, Cal.
Be sure and send my copy of the New Wireless Shop Catalogue with New List Prices to

NAME..

Street..

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Address all communications to Factory—1262 W. 2nd Street
Postal charges and insurance should be included in your remittance.

"OUR QUALITY ALWAYS PREDOMINATES"

THE WIRELESS SHOP
A. J. EDGCOMB

1262 W. 2nd St. Los Angeles, Cal.

Continued from page 56

wireless data, a mysterious-looking receiving circuit that no one had ever seen before being reproduced in the advertisement for the gullible reader to bite on. The circuit in question was an antiquated experimental one of fifteen years ago, which has never been put to any practical use, and the contents of the books, so far as radio is concerned, were equally musty. Generally speaking, the radio amateur or student should not buy any book on wireless that has not been written or revised later than 1915.

As a last word on the subject of book study, however true it may be that the mere perusal of a few books on wireless will not enable anyone to step into a commercial radio station and immediately operate it, at the same time it is certainly a fact that the conscientious study of good books, carried on in conjunction with the operation of a small amateur set, will bring the prospective radio operator a surprising distance on toward his goal.

To be continued.

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BY 7WM 1422 SO. J. ST., TACOMA, WASH.

CW—6aw, 6bs, 6cp, 6dp, 6gx, 6jd, 6ka, 6nx, 6zf, 6zx, 6aat, 6abx, 6akt, 6ajf, 6arb, 6awt, 6bbg, 6bqc, 6bum, 7dp, 7dx, 7iy, 7lu, 7mf, 7mr, 7jw, 7qn, 7oo, 7sc, 7th, 7tn, 7xc, 7xb, 7adp, 7agh, 7agx, 9ani, 2beb.

Spark—6dd, 6km, 6ic, 6qr, 6abs, 6acr, 6amk, 6ahi, 6ark, 6akt, 6avx, 6cka, 6qsm, 7fi, 7kj, 7ge, 7im, 7ro, 7vf, 7wg, 7jf, 7nw, 7we, 7aea, 7aqu, can. 9bd, 5cn.

Q S T

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Perfection in Radio Headsets attained in "ECHO HEADSETS"

give clear distinct tones, reproduces perfectly, the most sensitive radio signals in music, speech and code.

No matter how perfect or expensive your apparatus; no matter how strong or perfect the waves; without *"Echo Headsets"* your results cannot be perfect.

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RICHMOND HILL, L. I.

MT. TAMALPAIS, Marin County, California, whose inspiring peak is plainly visible from the plant where Parkin Parts are made.

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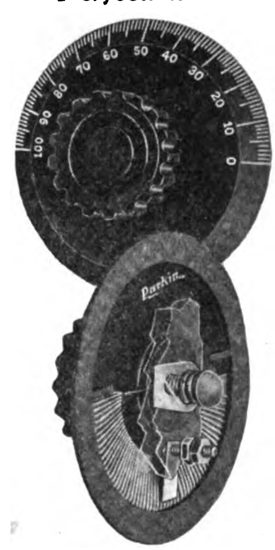
The new illustrated guide and catalog to PARKIN *Peak of Perfection* PARTS is just out. Interesting and instructive. Send us your dealer's name and we will send you a copy absolutely free.

—for constant signal strength put in a Parkin

Dial Type Rheostat

(Patd. Aug. 1, 1922)

"The Peak of Perfection"



If you want constant signal strength without the annoyance of constant adjusting, put in a *Parkin Dial Type Rheostat.* The resistance element is recessed in the back of a moulded Bakelite dial, *outside the cabinet.* It cannot overheat. The temperature remains constant. Thus you get a uniform flow of current to your tubes and a signal strength which does not vary. You know the importance of that. It also gives you more cabinet space and eliminates resistance heating from inside the cabinet. Saves you the cost of an extra part, too.

In the rear view at the lower right, note the resistance element—a flat, semi-circular core wound radially with non-corrosive resistance wire. Note how it is recessed in the Bakelite dial. Note also the stationary contacts which engage the dial at extreme positions. The resistance is 5 ohms, carrying capacity 1½ amperes. Mounting is extremely easy, only two small holes in the panel being required. Screw and nut are furnished. Order No. 100, at your dealer; price complete **$1.50**

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Quality dealers and jobbers, write us.

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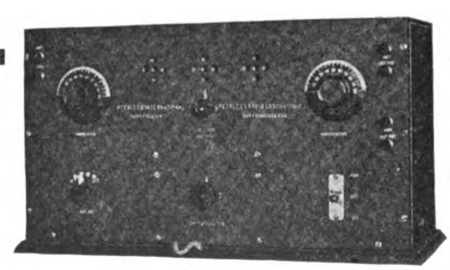
distant concerts too, with a real
PEERLESS
long distance receiver



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Install a Peerless

International Receiver and enjoy the vast variety of entertainment from *distant* stations as well as local. The PEERLESS International has two stages of radio frequency amplification, which gives *extreme scope* and *range*, and two stages of audio amplification, which gives *maximum volume.* Most easily operated quality set made. Every one tested for 500 miles, and *fully guaranteed.* Write for complete description and name of nearest PEERLESS dealer.

PEERLESS RADIO LABORATORIES, 50 Second St., San Francisco
DEALERS—Write for merchandising arrangements, mentioning your jobber's name

TRANSMITTERS, RECEIVERS AND TUNING

Continued from page 14

In the first assignment, we learned that light waves are in reality electromagnetic waves, exhibiting all the properties of radio and heat waves except that the frequency of light waves is very much greater than that of either of the other two types. Clerk Maxwell, an English physicist, advanced the ***hypothesis*** that light waves were electrical waves as far back as 1862 but it was not until 1884 that Hertz, a German scientist, was able physically to produce electrical waves and to measure their velocity and frequency, thus transforming Maxwell's unproved hypothesis into a ***proved theory***. Hertz used two metallic vanes, as shown in Fig. 11, and by charging them to a high voltage by means of a spark coil, similar to the ignition coil on a Ford machine, he obtained an oscillatory discharge from the vanes in the form of a spark across the spark gap represented by the two small metallic balls in the figure.

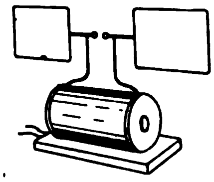


Fig. 11. Hertzian Oscillator

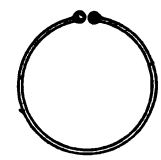


Fig. 12. Hertzian Receiver

We learned from equation (2) in this assignment, that the frequency of a condenser discharge varies inversely as the capacity C of the condenser; that is, as we ***decrease*** the ***capacity*** of a condenser, we ***increase*** the ***frequency*** of its discharge current. In the first assignment, we learned that the capacity of a condenser is increased by increasing the size of its plates, but while the plates or vanes of Fig. 11 may be fairly large, their capacity as a condenser is quite small since they are not facing each other, as are the plates of Fig. 3, but are placed some distance apart and end to end. With this small capacity, therefore, the frequency of the discharge current is very high and the wavelength of the waves produced is very short.

Hertz discovered that electrical waves were being radiated from this device because when he placed a loop of wire, in which was inserted a spark gap of very short length, as shown in Fig. 12, at some distance from his vanes, he obtained a small spark across the balls of his loop whenever a spark jumped across the gap of the device shown in Fig. 11. Fig. 11 thus represents crudely a small radio transmitter and Fig. 12 its companion receiver.

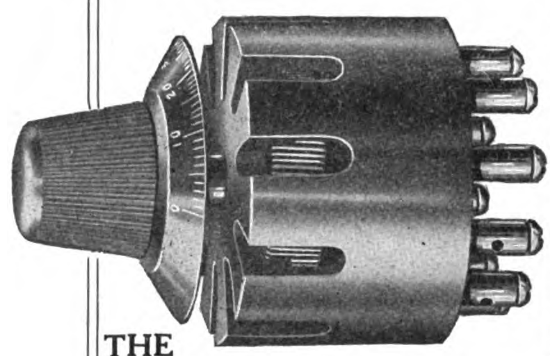
The waves produced and detected by Hertz in the manner described above were called Hertzian waves. They

Continued on page 64

New Method of Controlling Amplifying Tubes

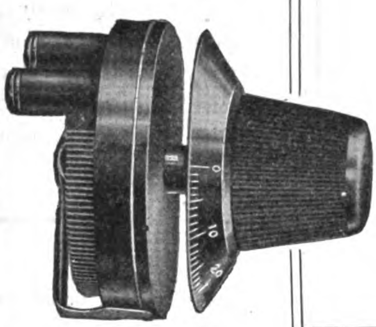
Complete control and adjustment of each amplifier tube merely by turning a simple knob. Does away with all jacks, plugs, rheostats and switches. A turn of the Amplitrol knob switches on the plate circuit and adjusts the filament circuit at the same time.

Lengthens the life of the tube from one-third to one-half as it absolutely prevents the ruinous practice of suddenly throwing a heavy current onto the delicate tube filament. With the Amplitrol, the filament current is turned on GRADUALLY. Genuine indestructible condensite, white graduations on a black dial, phosphor bronze contacts. Strictly highest grade. Each of your expensive tubes deserves one. Complete with simple wiring instructions, retail price, $4.00, from your dealer or from us direct.

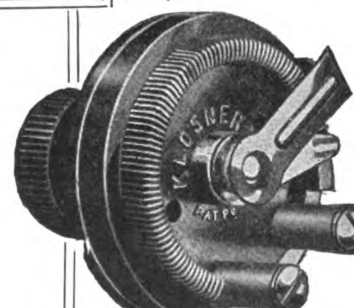


THE AMPLITROL

Detector Tubes demand a Rheostat with a VERNIER



MODEL 200



MODEL 100

It is simply impossible to get perfect reception unless you have perfect adjustment of your detector tube. No ordinary rheostat can be sensitive enough. It cannot give you the fine adjustment necessary for best results. This is why every detector tube should be controlled with a VERNIER rheostat.

The Klosner Vernier Rheostat Model 200 has a micrometer adjustment that permits getting EXACTLY on the very spot for perfect tuning.

The Klosner is the original Vernier Rheostat. No other operates both the coarse and fine adjustments with the ONE knob. No other can be so handy.

Also—the Klosner is wire-wound like all true electrical instruments—everything is where you can see it and repair it if ever necessary.

And it has a graduated DIAL to show at all times just where it is set. No guessing.

Genuine Condensite, phosphor bronze contacts, white graduations on black dial. Very high grade. Buy from your dealer. If from us, direct, $1.80.

Klosner VERNIER Rheostat, Model 100, is the original VERNIER Model. It was first and still is best except only Model 200. Thousands and thousands are in use. Same high quality as Model 200, but equipped with a pointer instead of a dial. Greatly improved, but still priced at $1.50. All dealers, or direct from us.

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2024 Boston Road, New York City

KLOSNER

Continued from page 60

mark the first step toward the modern development of radio transmission and reception. Because of his very crude apparatus, however, Hertz was not able to propagate his waves, or detect them, over distances greater than a few feet.

In 1896, the Italian, Guglielmo Marconi, at that time a young student of electricity, made the first *great* step toward modern radio by substituting for the metallic vanes used by Hertz an elevated vertical wire to replace one vane and a connection to the earth to take the place of the other. By this means, he was able to produce a radiating condenser of far greater capacity than that of the Hertzian vanes. He was able not only to increase the wavelength of the waves—to reduce the frequency—but also, through the increased electrostatic capacity of his radiator, to charge his transmitter with far greater power. This increase in power increased the transmitting range. By employing an aerial for receiving, in place of the loop used by Hertz, Marconi was able to detect the waves up to distances of a few miles.

There is a decided difference between the Hertzian waves and those obtained by Marconi. With the Hertzian oscillator, as the device shown in Fig. 11 is termed, the waves travel out from the vanes very much like sound or light waves; that is, unguided by any element and spreading out freely into space. With the Marconi waves, we may consider the two transmitting spark balls as inserted in the lead-in between aerial and ground. Since one end of the oscillator is grounded, as shown in Fig. 9, the waves are grounded at the lower end and hence move out from the antenna *along the surface of the earth.* Marconi waves are represented in Fig. 13 as leaving one side of an aerial. In reality these mounting waves completely surround the antenna in circular rows, similar to the amphitheater seats mentioned in the first assignment; they travel, as we say, "with their feet on the ground," and are thus guided by the surface of the earth not only around the curvature of the earth, but over mountains and down into valleys. Hertzian waves would shoot off on a tangent into free space, if not influenced by certain limiting factors such as the reflecting and conducting properties of the upper atmosphere.

The radio waves shown in Fig. 13 are simply electrostatic strains in the hypothetic ether, but since they are moving along the surface of the earth, they are accompanied by a movement of electrons, or an electrical current, in the earth itself. These electrons in the earth and the electrostatic strains in the space above the earth generate mag-

Continued on page 68

Crosley Radio Receiving Apparatus

LINES OF FORCE to an electrician mean the invisible magnetic field set up about a magnet or coil of wire carrying an electric current. Were it not for these LINES OF FORCE, wireless communication would be impossible.

LINES OF FORCE to a manufacturer are the invisible field of Favorable Opinion set up about his product which insures steadily increasing sales. It is only when a manufacturer places on the market, articles of real merit at a legitimate cost, that his LINES OF FORCE become established.

The LINES OF FORCE created about CROSLEY Radio Instruments have made them the most attractive buy in the Radio field today. Study carefully the descriptions and prices on this and the opposite page and you will see why CROSLEY instruments carry with them the invisible LINES OF FORCE that overcome and break down sales resistance.

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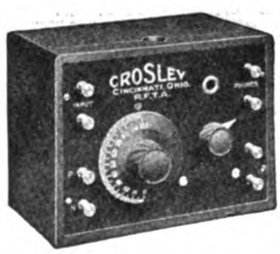

CROSLEY RADIO FREQUENCY TUNED AMPLIFIER. This is a unit that we have especially designed to be added to any audion detector set. This will enable you, at a very low cost, to add one stage of Tuned Radio Frequency Amplification without purchasing an entire new equipment. The R. F. T. A. not only amplifies the signals before they reach the detector, enabling it to work more efficiently, but also makes sharper tuning possible and eliminates interference to a wonderful degree. Will add at least six times the volume and range. Price, without tubes, batteries or phones........$15.00

HARKO SENIOR MODEL V. A combination Tuner and Audion Detector. Equivalent to a combination of the CROSLEY CRYSTAL RECEIVER MODEL I and CROSLEY DETECTOR UNIT. Will receive broadcasting stations up to one hundred miles. Under favorable conditions, a user in Denver has heard Schenectady with his Model. Price, without tubes, batteries or phones.............$20.00

TAP SWITCH
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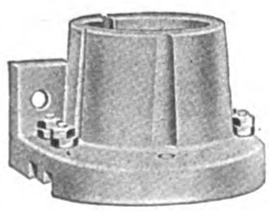
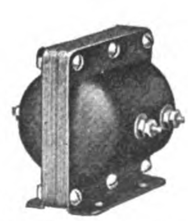
PARTS $1.50



V-T SOCKET
$.50



SHELTRAN TRANSFORMER $4.00

VARIO-COUPLER
$3.00

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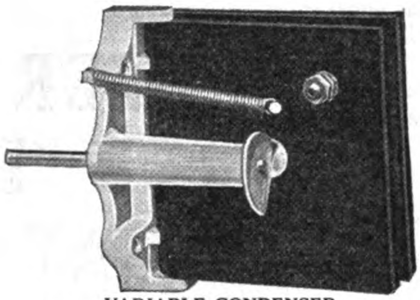
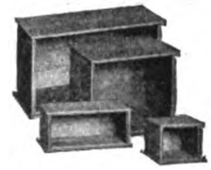


VARIABLE CONDENSER
MODEL "A" $1.25
MODEL "B" 1.75
MODEL "C" 2.25

RADIO FREQUENCY
AMPLIFYING TUNER
$4.00



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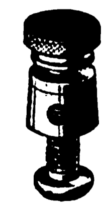

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THE CROSLEY MANUFACTURING COMPANY makes a complete line of Radio Parts that are as good as money can buy and at about one-half the price you will pay anywhere else.

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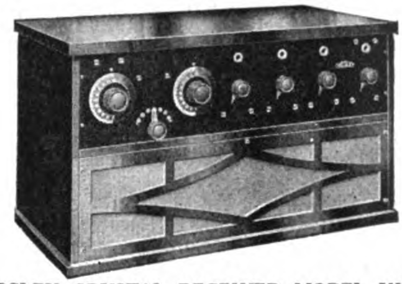
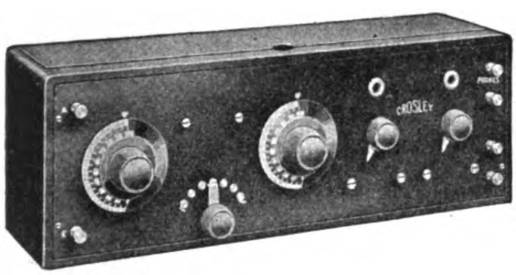
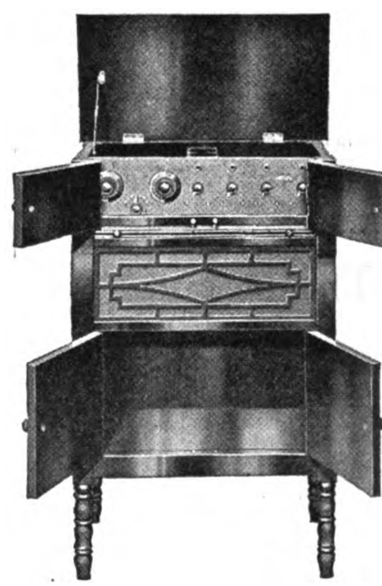


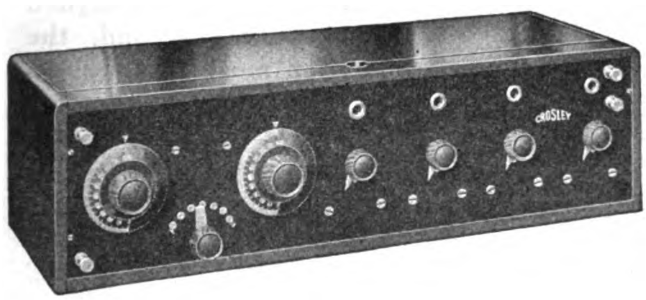
CROSLEY CRYSTAL RECEIVER MODEL XV. A beautiful mahogany finished cabinet with amplifying compartment. The Receiver is the same as CROSLEY RECEIVER MODEL X shown on this page and is the acme of efficient and beautiful construction. See below for description of RECEIVER MODEL X. Price, without phones, batteries or tubes..$70.00



CROSLEY RECEIVER MODEL VI. This set consists of one stage of Tuned Radio Frequency Amplification and Audion Detector. It is normally for use with head phones but is especially recommended to be used with any type of loud speaker. Additional amplification is unnecessary if head phones and horn are used in receiving local stations. Price, without phones, batteries or tubes..$30.00



CROSLEY RECEIVER MODEL XX. Same as the CROSLEY RECEIVER MODEL XV shown above but with compartment for batteries and a board under the amplifying chamber that slips out forming a desk for the operator. Music received on these instruments will be heard through a large room and often through the entire house. Beautiful Mahogany finished cabinet. Without phones, batteries or tubes, Price......................$100.00



CROSLEY RECEIVER MODEL X. Is the same as MODEL VI with two stages of Audio Frequency Amplification added. In placing this receiver on the market, we are offering you a unit whose range, volume and selectivity is remarkable. Nothing can compare with it at twice the price. Developed in the CROSLEY laboratories, this unit is absolutely the last word in long range Radio Receiving Apparatus. Used with head phones and loud speaker, it will bring in distant stations all over the house. Price without phones, batteries or tubes $55.00

Jobbers and Dealers

If you offer CROSLEY Apparatus to your trade, you will be working with the LINES OF FORCE instead of against them. The demand for CROSLEY instruments is increasing by leaps and bounds. Write for our attractive discount sheet.

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CROSLEY MANUFACTURING COMPANY

DEP'T. R3 **CINCINNATI, OHIO**

Continued from page 64

netic fields around them, as we learned in the first assignment. Hence radio wave propagation really consists of three factors—(1) electrostatic strains or *lines of force* in the space *above* the earth, represented by the waves of Fig. 13; (2) electrical currents *in* the the earth, represented by the arrows of Fig. 13; (3) and electromagnetic fields both in and above the earth.

Since part of the energy of the radio wave flows through the earth, anything which will reduce the resistance of the earth or of the connection to the ground

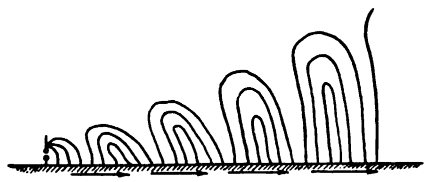

Fig. 13. Representation of Radio Wave Propagation

at the transmitter or receiver will increase the range over which radio waves may be sent and received. Sea water is such a perfect conductor of electricity, due to the presence of salt which makes an ionized solution (see first assignment) that radio waves can be sent from two to five times as far over the ocean as over land, particularly if the latter is dry and rocky with consequent high resistance.

Aboard ship, the "ground" connection is obtained by fastening a wire to any of the steel bulkheads or decks. These form part of the complete metallic hull which is in perfect contact with the ocean water, a perfect conductor. Since resistance of the "ground" aboard ships, therefore, is usually very low, ship sets are generally very efficient in this respect. With wooden ships, it is necessary to fasten a metallic plate outboard on the hull, to which the necessary ground wire is connected.

Occasionally, where the soil is dry or the land rocky, it is necessary, in order to obtain the equivalent of the lower plate of our antenna "condenser," to string a large network of wire under the antenna, often insulated from the earth which is a poor conductor.

Such a "ground" connection is called a *counterpoise.*

In aircraft, where it is obviously impossible to secure a connection to the earth when in flight, a counterpoise effect is obtained by "grounding" the radio apparatus to the metallic engine, wire stays or struts, etc. The same practice is followed in installing radio equipment in automobiles. The aircraft antenna usually consists of a wire trailed below and behind the machine while in flight, although on large airplanes and dirigibles, it is possible to install a two or three wire miniature

Continued on page 70

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aerial along the planes or within or on top of the gas bag itself.

We have seen that a circuit containing an alternating current of proper frequency produces an electrical wave of the same frequency. Radio reception is based on the reverse of this action. When a radio wave strikes the "condenser" of a receiving antenna, its "plates" become charged and an alternating current flows in the receiving antenna circuit, consisting of the antenna, lead-in and instruments, and ground. The frequency is equal to that of the voltage charge which builds up on the antenna and "ground plates." This frequency is that of the radio waves.

A high antenna is desirable for receiving purposes in order that as much as possible of the radio wave may be intercepted. A good ground is of paramount importance in view of the earth currents, natural and artificial, which comprise part of the wave transmission.

FOURTH ASSIGNMENT
Tuning

In the last assignment, we learned that since the discharge current of a condenser is oscillatory, it may be used as the generating current for the production of radio waves, and that it is customary to erect a huge condenser at the transmitting set in the form of an elevated aerial or antenna which serves as the radiator of these waves.

We also learned than an antenna may radiate two different types of waves—damped and undamped. The damped waves are those which are emitted from an antenna which has first been charged and has then been allowed to discharge until all of the original charge has been dissipated in the resistance of the antenna circuit and in the radiation of waves. The undamped waves are those which are radiated from an antenna which receives a fresh impulse or charge after each complete swing or cycle of antenna current, just as a clock pendulum receives a fresh impetus from the clock works after each complete swing. When the antenna receives a fresh charge after each cycle of antenna current, as is the case with transmitting sets which employ the Poulsen arc, the vacuum tube, or the Alexanderson generator as the charging source, the nature of the antenna current is very similar to that of the charging current. The difference in the radiated waves in the cases of radiotelegraphic and radiotelephonic transmission is due to the different types of transmitting apparatus which are used to charge the antenna.

With the radio telephone, in whose reception we are particularly interested, the transmitting apparatus is such that

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the charging current very faithfully reproduces the vibrations of the human voice, as does the current of the ordinary wire telephone. The wave which travels out from the radiophone station is *modulated*, as we say, in accordance with the characteristic vibrations of the particular voice which is actuating it. So much for the transmitting set. We shall examine the different kinds of apparatus used for charging the antenna and for the consequent radiation of waves in later assignments. We are particularly concerned at present in providing means for their reception at some distant point.

You are probably familiar with the phenomenon of *resonance* in sound. By this we mean the "sympathetic" vibration of a body due to the vibration of another body of the same pitch. When a piano is being played, you have, no doubt, heard a vase or some similar object "hum" or vibrate when a certain key is struck. This is because the natural frequency of vibration or "pitch" of the vase is exactly the same as that of one of the strings of the piano. We say the vase is in *tune* or in resonance with that particular piano string.

In the study of sound in physics, it is a common experiment to take two tuning forks of the same pitch, to set one into vibration by striking one of its prongs on a table, then to stop it, after which it will be found that the other tuning fork is still vibrating. If the two tuning forks are not of the same pitch, however, the second fork will not respond to the sound waves emitted by the first.

This is exactly analogous to the reception of radio waves. Unless the receiving antenna circuit has the same frequency as the transmitting antenna, it will not respond to the transmitted waves, and no sound will be heard.

In the last assignment, we learned from equation (2) that the frequency of the antenna current depends upon the capacity and inductance of the antenna circuit. Obviously, unless the receiving antenna is an exact counterpart of the transmitting antenna, i. e., is of the same height and length with an equal number of wires and with all other conditions equal, it will not have the same values of capacity and inductance as the transmitting antenna. Also, in erecting a receiving antenna, it would be very difficult, if the capacity should turn out to be one-half of that of the transmitting aerial, to compensate for it with exactly twice the inductance value. We must supply some convenient means, therefore, at the receiving station so that we may make the natural frequency or wavelength of the receiving antenna equal to the frequency or wavelength of the waves from the

Continued on page 74

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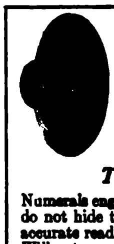

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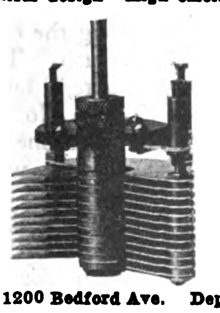

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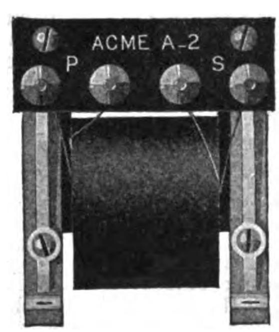

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ACME

for amplification

Continued from page 72

transmitter which we desire to receive. Obviously, if the natural wavelength of the receiver is greater than that of the transmitter, we must be able to reduce it by the necessary amount, and if its wavelength is too low, we must be able to increase it to that of the transmitter.

Since frequency, as we have seen, depends upon the capacity and inductance of the circuit, we must supply either or both in such manner that we may vary them so as to make the receiver in resonance with the frequency of any particular wave which we desire to receive.

A variable condenser is one whose capacity may be varied by sliding or rotating one set of plates insulated by air from a set of stationary plates so that the active area of the opposing plates is increased or decreased. If we insert one of these condensers in series

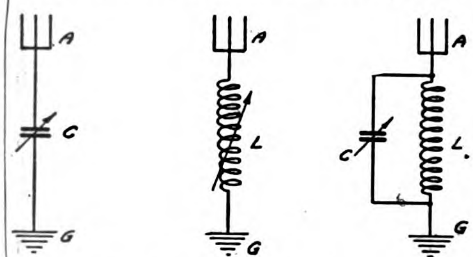

Fig. 14. Capacitative Reduction *Fig. 15. Inductive Increase* *Fig. 16. Shunted Circuit*

with the receiving antenna as shown in Fig. 14, the wavelength of the receiving antenna may be reduced to almost one-half its natural wavelength. Its natural frequency of vibration will, therefore, be almost doubled.

On the other hand, if we insert variable inductance in series with the antenna and ground, as shown in Fig. 15, we may increase the natural wavelength of the antenna an indefinite amount, solely dependent upon the size and number of turns of wire in the inductance.

The variable inductance shown in Fig. 15 may take the form of a single slide tuning coil. This consists of a cardboard or fiber tube, from 2 to 4 ins. in diameter. On the tube is wound one layer of insulated wire, arranged with the insulation removed for a distance of about ½ in. on each turn and along the entire length of the coil, so that a slider may be run along the coil, making contact with each turn. The wire is usually "magnet wire," ranging in size from No. 22 to No. 28 B. & S. gauge, insulated with one or two layers of cotton or silk, or with enamel lacquer.

If the inductance is not variable, i. e. if it consists of a coil of wire of approximately the correct amount for increasing the wavelength of the antenna

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circuit, we may *shunt* a variable condenser across the inductance as shown in Fig. 16. In this case the condenser will increase the wavelength above that of the antenna circuit with the coil included in it.

Thus, let us suppose that the natural wavelength of the antenna is 280 meters, and it is desired to receive from a broadcasting radiophone station whose transmitting antenna wavelength is 360 meters. We may add a fixed coil to the antenna as in Fig. 16, which may increase the wavelength of the antenna to 325 meters, and by means of a variable condenser whose maximum capacity is

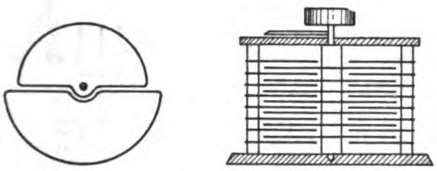

Fig. 17. Plan and Cross Section of Variable Condenser

0.001 microfarads (the customary abbreviation is 0.001 m. f.) we can increase the wavelength to exactly 360 meters without rotating all of the movable plates of the condenser within the fixed ones. Under the conditions noted above, we should probably be able to tune the antenna circuit to something more than 400 meters by using all of the capacity available in the condenser.

Fig. 17 shows the plan and cross-section views of a typical variable condenser, using air as the dielectric. Such a condenser may be enclosed in a glass case and castor oil used as the dielectric, in which case it will have a very much greater capacity.

In most receiving circuits, it is necessary to have some inductance in the circuit in order to transfer energy by inductive means to another circuit. (We shall go into this phase a little later in this assignment.) If the addition of this necessary inductance increases the wavelength of the antenna circuit above that of the wave which we desire to receive, a variable condenser may be inserted in series with the inductance as shown in Fig. 18. This will permit the wavelength to be reduced to the natural wavelength of the antenna, i. e., its wavelength before either the inductance or capacity were inserted, or even below this value.

Some times, in order to receive both long and short waves, it is desirable to connect the variable condenser both in series with the inductance for short waves and in shunt, or parallel, with the inductance for long waves. This is most easily effected by means of a series-parallel switch which is commonly supplied on many receivers. This switch consists of two switch blades

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Continued from page 75

operated simultaneously by a single knob, as shown in Figs. 19 and 20. If you will carefully trace the wiring of Fig. 19, you will see that when the switch is in the position shown the condenser is in parallel with the inductance as in Fig. 16, while in Fig. 20 it is in series with the inductance as in Fig. 18.

In the last assignment, we learned that the frequency of the discharge current of the transmitting condenser or antenna circuit "is that which automatically, we might say, gives equal values of inductive and capacitive reactance, so that in a freely oscillating circuit, the combined inductive and capacitive reactance is zero and the impedance of the circuit is equal to its resistance." Since we are tuning the receiving antenna circuit so that it will have the same frequency as the transmitting circuit, obviously we must be varying either the inductance or the condenser so that the inductive and capacitive reactances of the *receiving* antenna circuit will also be equal and hence neutralize each other for that particular frequency. Thus, we are eliminating all reactance from the impedance of the receiving antenna at the particular frequency which we are receiving, so that the only impedance offered the current set up in the receiving antenna by the radio wave is that of the resistance of the circuit.

While in Fig. 14 it would appear that we have only a condenser in the circuit and hence there is no inductance for it to offset, the fact is that every antenna has a certain amount of inductance by virtue of its shape, just as every wire has a certain value of inductance although this value is increased if the wire is wound in the form of one or more turns. And similarly, in Fig. 15, the inductance shown offsets the natural capacity of the antenna. (See Fig. 10.)

In the first assignment we learned that an alternating current circuit is said to be in *resonance* when the inductive reactance is exactly balanced by the capacitive reactance and in this assignment we have learned that the receiving antenna is in *resonance* with the transmitting antenna when the inductive and capacitive reactances of the receiving antenna are balanced or equal for the particular frequency which the transmitting antenna is radiating. You can see, then, that the two definitions of resonance as we have learned them are really identical.

After all, radio circuits are simply alternating current circuits of higher frequency than we commonly meet in practice, so that the more you know or may learn about alternating current, the easier it will be for you to understand the operation of radio circuits.

With tuning forks, full advantage of the principle of resonance can be obtained only when the vibrations of the first fork are feebly damped, i. e., when they do not die out too suddenly. The vibrations picked up by the second fork will not reach any great strength or amplitude if the prongs of the first fork

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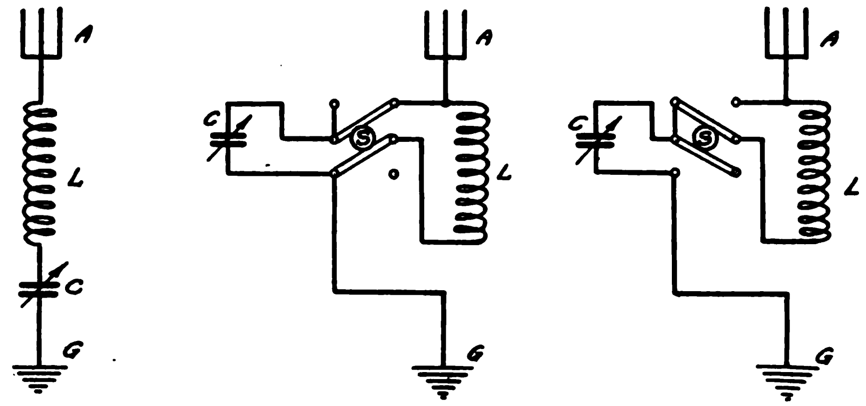


Fig. 18. Condenser in Series with Inductance *Fig. 19. Condenser in Parallel with Inductance* *Fig. 20. Condenser in Series with Inductance*

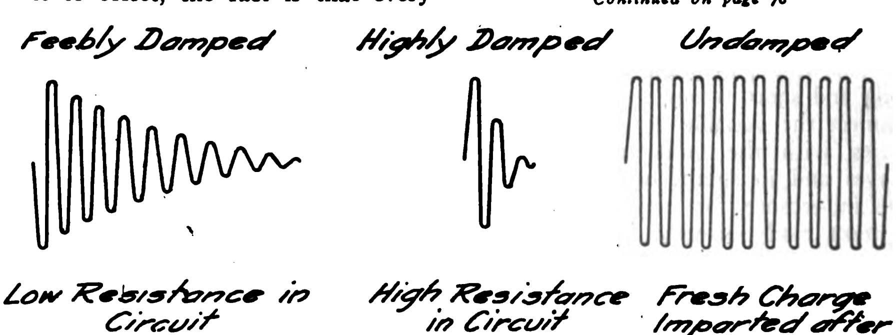
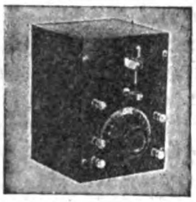


Fig. 23



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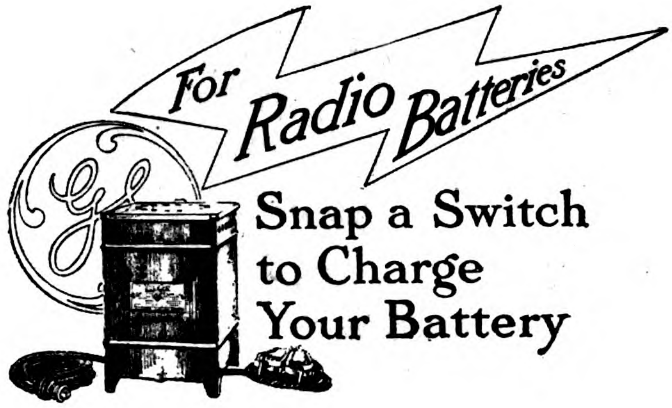

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Continued from page 76

vibrate only a few times. The vibrations of the second fork are built up only by the cumulative action of a series of waves striking it, each wave being of almost equal strength to that of the one which preceded it. If we should seize the prongs of the first fork after one or two vibrations have taken place so as to check or damp its vibrations, there would not be enough waves radiated to produce much effect on the second fork. Similarly, if we should hold the prongs of the second fork, even though those of the first fork were left free to vibrate, it would be impossible for the second fork to assume much vibration from the waves radiated by the first.

The same phenomena may be observed in radio circuits. We learned from the last assignment that if the resistance of a circuit is too great, its effect is equivalent to the damping effect of the hand upon the prongs. The circuit will not oscillate, or if at all—only feebly, i. e., for a few swings or cycles.

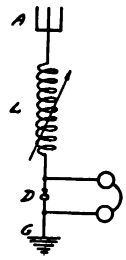

Fig. 21. Detector in Antenna Circuit

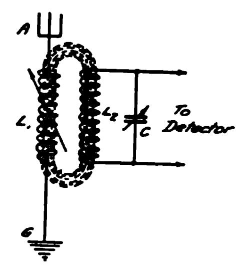

Fig. 22. Coupled Circuit

The detector is the device in the receiving set, which, after the received current is made as large as possible through the proper tuning, transforms the current into a form suitable for actuating the telephone receivers by means of which the sounds are actually heard. It is a characteristic feature of detectors that they all possess high resistance.

In the first receiving circuits which were invented by Marconi, the detector was inserted directly in the antenna circuit and the telephone receivers were connected directly across it, as shown in Fig. 21. The high resistance of the detector, however, not only greatly reduced the value of the current flowing in the antenna circuit, which resulted in the production of only very weak sounds in the telephone receivers, but the damping effect of this resistance prevented the antenna from oscillating except for a few cycles. The principle of resonance, therefore, could not be fully taken advantage of, and instead of responding to waves of only one frequency, for a particular value of inductance used, as an efficient receiver should, it responded almost equally well to waves of any frequency.

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It became necessary, therefore, to remove the detector from the antenna circuit in order to reduce the antenna resistance and to couple it to the antenna circuit by means of another inductance, so that the antenna would have inserted in it only an inductance —and a condenser, if necessary.

Fig. 22 represents the arrangement by which the detector circuit may be coupled to the antenna through the medium of a two-coil combination, such a combination being variously termed a *receiving transformer, loose coupler,* or *vario-coupler,* according to the form in which these two coils are made and the manner in which they are operated.

We learned in the first assignment that an alternating current in one coil will induce an alternating potential across the terminals of another coil placed near enough to it so that the rising and falling magnetic field produced in the first coil, from the alternating current flowing in it, will intersect or pass through the second coil. This field is shown in dotted lines in Fig. 22. It is this principle of electromagnetic induction, which we studied in the first assignment, that makes it possible for us to transfer energy from the antenna circuit of the receiver to the detector circuit coupled to it, even though there is no actual electrical connection between the two circuits.

The frequency of the alternating potential induced across the second or *secondary* coil—the coil in the antenna circuit is called the *primary* coil, for obvious reasons—is exactly that of the current flowing in the antenna circuit. To secure a maximum flow of current in the detector circuit, therefore, we must supply the variable condenser shown in Fig. 22 in order that its reactance may neutralize the reactance of the secondary coil by means of proper tuning.

Thus, with a receiving transformer, and most receivers employ one in some form, we must not only tune the antenna or primary circuit to resonance with the incoming wave but we must also tune the secondary circuit to resonance with the primary. That is to say, we must tune each circuit so that its frequency will be equal to that of the radio wave which we desire to receive, or what is the same thing, we must balance the inductive and capacitive reactances of each circuit so that they will be neutralized at the frequency of the received radio wave.

The practical methods by which this is accomplished will be discussed in the next two assignments.

SCRATCHI JOINS THE CLUSTER

Continued from page 18

still doing some adjusting with results that should not be mentioned. Much of time he get sound which resemble Chinese jazz-hound playing "Puppy on the Keyhole" with variation, and some more of time resemble saxafony solo by Broody Heesoft, mingled up with shriekings of the dying victims. He explanate to me very copiously how the radio freakwent griddle bias must be held down negatively or by force if necessary so as to give the inrushing positive electrons fine opportunity to snick across to hot plate serkit, and he quite gently turn each knob after the other, but nothing come in from outside. As every ham say sometime, "Not even static."

When my Cousin trot out for new something or another, like he do so every 40 or 37 minutes, I take turn at adjusting dials and filaments and other niknaks which overcrowd every squared inch of table top, and once or thrice I think I hear some music, but are not sure as power tube, which are really vicious animal, make most hair-curling moanings and groanings. I endeavor to cease these and vary the tickling and etcs. but only change are for worse. If grand old General Sherman could hear such wearied squealings and squawkings and screamings and howlings that struggled fourth from this much spoke-about combination, he would modulate formal opinion about war.

I try to dissuade my Cousin to donate entire fitout to some sweetish charity, but he say that lots of other radio experts like himself tell him they have most astonished success, although when he ask to visit them and hear this wonderful loud-noiser, their battery are always in ran down condition.

My Cousin are spending more than I can afford, Mr. Editor, and are ruining his indigestion and my distemper. He have even sniggest to take aparts my Sphinx receiver, which are as good and a half as his Stupor Generator, and if he continue along these lines there are going to be social function held at our place by the Hon. Coroner, and the guest of honor will not be

Yours superstitiously,
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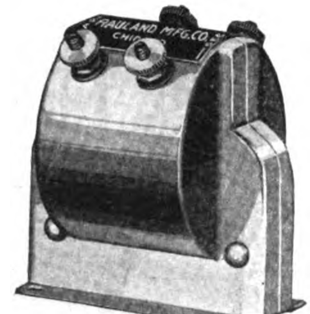

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THE ORIGINAL O. W.

Continued from page 20

ruffled by her—"let her have her admirers—and rave on! She looks well—knows how to dress—and is a public credit to the firm! What outsiders don't know won't hurt 'em!" So he gave her a large bank account of her own—and let it go at that.

"I had an accident today, Pater"—repeated Jr.

"Heard you the first time—but you don't show any ill effects"—grunted the powerfully built, elder man.

"No—but the girl is in the hospital!"

"Huh?"—the other put his newspaper down hastily—what's that again? 'Girl'—'hospital'?"

He listened carefully while the details were given.

"Don't see as it's your fault! Damn-fool women—cross the streets at wrong places—of course get run over! Pay the hospital bill, but that's all!" He said it with an air of finality that his business associates knew was useless to attempt—even—to modify.

"But it isn't 'all'—at all!"

"For the Lord's sake, boy; what do you want to do—marry her because she's got a few black and blue spots? Never knew you to be a sentimental fool—such as I was a few years ago!"—he added, with bitter gruffness.

Arthur felt his cheeks getting hot—"Don't be silly, Pater!" he said quickly, to cover his embarrassment at his father's shrewd gaze—"But she is very proud—and friendless. And she has that which you have always said that a man wasn't worth a damn without: the courage of her own convictions! She has an A-1 commercial radio operator's license and came from San Francisco—looking for a berth on some ship—poor youngster. Her father died, leaving the family in rather bad way, financially, I suspect. Why not give her a billet on one of the boats—the South American run is very easy—scarcely anything to do."

"What?"—exploded the other—so that other diners wondered why Old Man Carroll was "up in the air"—"Give a *woman* the job as radio operator on one of my boats? And be the laughing stock of shipping circles? NOT! I've made one fool of myself—where women are concerned—that's a great sufficiency!"

"But—don't you think——?"

"'But' me no 'buts'—and 'don't you thinks'—Arthur! Pay the hospital bills—slip her anything you like—tied up in a bunch of flowers—if you feel you must do something! NIX, however, for the female operator stuff! Not as long as I am boss of the Carroll Line—and that will be a good few years—yet! What—I *ask* you—would a woman do in a crises—something serious? Blow

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up! Nothing doing! I'm off for a game of bridge—see you later." Carroll Sr. signed the check and stalked from the dining room, waiters scuttling from his path as chickens scurry at the shadow of a hawk.

Long did Arthur sit at the table, sipping his coffee, and smoking. Then he, too, arose and went to the telephone booths. Giving the operator a number—he waited.

"All ready in No. 3, Mr. Carroll, please."

When the young man came out there was a smile of satisfaction on his lips. Taking his hat from the attendant he went in the street and along the line of parked cars—to his own. A touch of the starting switch and he was soon passing along the upper reaches of Fifth Avenue—and he continued along it to a certain street—where he turned sharp west — proceeding until he came to a quiet block, but faintly lighted, that smelled of various cookings—and much humanity. But it was near deserted now. Moving slowly along the house fronts, he came to the number that he was in search of. A figure was standing at the sidewalk edge.

"I could have come downtown, sir!" expostulated Wilfred Brown, in charge of the *personnel* of the Carroll Line ships.

"No trouble, Brown—I needed the air, anyway! Some of it won't do you any harm. Hop in, and I'll tell you what it is that I want, as we go."

Wonderingly, the other obeyed.

Arthur did not speak until Williamsbridge was behind, and the car rolled noiselessly along the Hudson. Then he began to talk, the other listening intently.

"It'll mean my position, if your father ever finds out!"

"I'll be responsible, and see to it that you don't lose—either way. What do you say?"

"Oh—I'll—I'll do it, right enough, Mr. Arthur. But you know your father, and if he . . . "

"But he won't—not until I am ready to prove certain things to him! After that—we should worry!"

And no other word was spoken—until the dim side street was again reached.

"Good night, Brown — and many thanks!"

"That's all right, sir — good night. Thanks for the ride!"

"AND how are we, this lovely morning?" queried Arthur, cheerily, having been again piloted through the hospital corridors, carrying a bouquet of roses, that cast their delicate fragrance above the faint traces of disinfectants.

"This is kind of you, Mr. Carroll! Oh—nurse says that I shall be out sooner

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than she thought! I am much better!"

Her masses of hair fell in wavy rolls about her face — that held a normal freshness and color. She pressed it in the blooms—breathing deeply of them.

"Well"—he sat down—"I have news for you! Consider yourself engaged as Chief—and only! — operator on our *Blythedale*—sailing in three weeks for South American ports!"

For an instant she stared at him—then her eyes filled. "I couldn't!"—she whispered—hiding her face in the roses. "You have done this out of pity. When I went, straightforwardly, and asked—at your Company—for a chance, I was—refused. Now that I was so unfortunate as to get in the way of the car of one of the firm, however—your father, or you—think it only a fair thing to do! Neither of you really want to give a woman operator a try! I—I can't do it!"

"But you said that all you wanted was a chance! Here it is! 'Pity' has nothing to do with it! In fact, the pater has long been wishing that there were women operators, for the passenger runs!" (Thus did he lie, brazenly —and as a gentleman!) "Men are obstreperous—at times—they get loaded, down South—and we've had all kinds of trouble! So—you see—this is very fortunate—for us!"

And so—little by little—he gently, carefully, led her along, until the tide of her opposition turned, and she began to show enthusiasm.

"What about a uniform? I must wear the regular thing—that your officers wear—the only difference being a —skirt!" she laughed.

"Oh—er—yes!" Hadn't thought of that! Tell you what I'll do; I'll get the cap insignia—the braid of the sleeves is regulation—everywhere—as is the 'lightning' on the collar tabs. Very simple—you see!"

"Shall I meet your father? I want to thank him for my—'chance'!"

"Meet the pater? Oh—of course! He'll be delighted! Told me to be sure and arrange it! Wants to know his first—ah—'OW'—was it not?

And they both laughed.

But, within himself, Arthur was far from laughing! If she persisted in her request to meet Carroll, Sr.—and were she to suspect that he were preventing this, Arthur foresaw more—trouble! However—that bridge was some distance off—at any rate!

TIME: Night.

Place: Claremont Restaurant, Riverside Drive.

Scene: A cosy dinner table, set for two—on the piazza, overlooking the Hudson.

Conditions: A brilliantly moon-

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lighted night, with a soft, cool breeze blowing down the river—fresh with woodsy odor.

Dramatis Personae: Dorothy Montgomery and Arthur Carroll, Jr.

The meal had been finished. A discreetly-hovering waiter had been tipped—and had disappeared.

"Let's walk. I feel cramped under a roof—a night like this!"

He lingered over the putting her scarf about her. Along the well kept paths they strolled—slowly—her hand resting lightly on his arm.

"Tomorrow at this time you will long have cleared the Lightship—and be headed south," he said softly.

"Yes—'on the old trail, the out trail, the long trail—the trail that is always new'."

"And you will sometimes think of—remember—" he stammered. Turning swiftly, he took her in his arms, holding her to him. She did not struggle—rather, looked up in his face. Thus they swayed—for an instant and their lips met.

"Now you will not leave me!" announced he.

"Ah—but I shall! I came East—looking for a position as an 'OW.' It has come my way and I am going to make good at it, my dearest boy! It will prove to owners that a woman is perfectly able to handle the work, and so be an opening for less—fortunate—" she said it shyly—"ones than I! When I return, and it is but a matter of two months, then—if you *still* . . ."

But he put an effective stop to further words. And he knew her well enough—not to argue.

"Too bad that pater had to go to Montreal last week. He did so want to see you before you 'took over' radio charge of the ship!" (Thus did he right nobly keep up the steady stream of honorable subterfuges—that he had been so hard pushed for—at times—by her that he had taken to entering all the places that Carroll, Sr. was supposed to have gone, and all the "important matters" that claimed his every attention—lest he get them, and his dates—mixed! For Dorothy Montgomery was by no means a fool!)

"Do you think that he will be pleased at having an—'OW' as a daughter-in-law?"

"Pleased isn't the word for it, sweetheart! He always likes people who DO things!" (But his mind was sore troubled at the wondering what effect the paternal storm would have on her, should it break before the stage was properly set!)

"YOU will take good care of her, Skipper?"

"Indeed, yes!" answered Captain

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Sheffield, of the *Blythedale*—and "Admiral" of the Line, in view of his seniority of service. One who preferred the comparative ease and quiet of the South American run — what 'tho the salary was less—to the more arduous duties of the pretentious passenger ships of the Line.

The two were alone in his quarters, the girl stowing her things in the operator's cabin.

"Look here, Sheffield, I haven't—er—told you all about this matter!" blurted Carroll, Jr.—suddenly.

"Don't have to, my lad! I've worked for your father many years. I've known you, boy and man, from your birth, and I've never known you to do a crooked thing! I am kind o' partial to—love affairs"—and he laughed at the other's start of surprise—"having been in love with the same woman for twenty-nine years—or it would have been, had she been left to me until next Christmas Day. I saw through your little 'deal'—from the beginning—and I was with you—then! Having seen Miss Montgomery, I am more with you than ever—*put her there!*"

The men's hands clasped, and there was great relief in the eyes of the younger.

"Well, son—it will be daylight in an hour, and I must be getting out in the stream. So say your—'goodbye's'!"

The *Blythedale* backed slowly out over the oily, black waters of the Brooklyn Docks. A fussy little tug pushed the big freighter's nose 'round, and her looming bulk got slowly under way—outward bound.

Arthur Carroll stood on the end of the wharf and watched as long as he could see her—then he went back, up the empty, cavernous shed—that smelled of spices, and that echoed strangely to his footfalls, and where a few stevedores were getting their coats and hurrying home.

"UNUSUAL to have so heavy a wind here—at this time of the year," said Skipper Sheffield one night at dinner.

The *Blythedale* was making good—tho' very high-and-lofty tumbling

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weather, of a sudden blow that had come up at sundown, when the vessel was some 800 miles off Porto Rico—according to the noon "shot."

"What was the latest weather report that you had—Miss 'Sparks'?"—and the skipper chuckled, for the girl had made a great favorite of herself on the big freighter—from firemen and oilers—upward through the ship's personnel.

"At 5 o'clock I picked up NAU, but his weather QST gave no indications of anything unusual. I hung a copy of it on the hook in the chartroom."

"I do not believe that it will amount to much, as the glass isn't seriously affected—but it certainly is blowing a gale now!"

To eat was a difficult matter, what tho' the table was a swinging one, and the racks were on—beside. Dinner was finished amid much laughter—the chief engineer having had especially bad luck with his soup!

From the lee side of the house the sight was a splendidly wild one, as the monster seas—high—maned with foam, white as snow in the moonlight, tore on at furious speed, the spindrift hissing and spattering viciously against the ship's upperwork and stack. Steadied by the skipper's arm, she went with him to his comfortable quarters. Indeed, she had gone there for a chat—after each evening's meal, finding in Sheffield a vast storehouse of information, incident and story, that—to her—was all as from another world. She liked Sheffield—much. A man, she had decided, of no great mental processes. One who avoided the deeper puzzles of life, and one who had reached—at rather long years—the stage when it was easier to take things as they came, rather than to investigate other, and possibly better, ways of attaining unto a desired end. But a splendid navigator, and one who believed—implicitly—in that adage of the sea: "Obey orders, if you break owners." Hence: an ideal seaman.

He braced her on the settee with cushions, while he took his swivel chair, that was bolted to the deck.

Suddenly there came, above the screaming drone of the wind through the rigging, four sharp blasts of the whistle.

"My God—*fire!*" he shouted, plunging through the door.

For an instant she sat very still. Then—quite calmly—she opened a locket that hung at her throat. Looking tenderly at the face therein, she whispered—"Arthur, laddie, I don't know if your 'OW' is going to see you again, but she—she is going to—make good!"

The wild fury of the storm tore at her as she stepped out and started for the radio shack—a bit farther along the bridge deck. Not a soul was in sight—

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even the officer of the watch having left the bridge. But—through the after windows of the chartroom she could see in the pilot house—and the figure of the quartermaster at the wheel was outlined by the reflected rays of the binnacle light. Although she was conscious of no fear — the sight of him, stolid in his duty, strengthened her.

Switching on the lights, she sat down at the operating table, bracing herself as well as she could against the plunging rolls. It was but an instant's work to test the power. All was in order.

Then she waited — many thoughts running riot through her mind, to the moaning distress, and the whining shrieks of the wind, the *hiissssss* of spray and the *whhoooooom*—when an unusually large sea struck the bows. She reached for the transmitting key and sent a few practice dots and dashes.

The door flew open. Sheffield came in.

"We—we—must hope for the best, Miss Montgomery," he said, controlling his voice with visible effort. "But fire is raging all through No. 4 hold. We can do nothing in this wind and sea—except to turn steam in. I am going to try and get the ship 'round with the wind. Do not be alarmed if she gives one or two very bad rolls. Listen-in and see what ships, if any, you can hear. Ask them their positions, but say nothing of the fire—yet. Then please stand by for further instructions."

He was gone again.

She donned the head harness and began to tune for signals on 600 meters. For a time—nothing. Then she picked one up—very far distant, by its weakness. Straining hard, she managed to ascertain that it was an American vessel—by its call letters—transmitting messages to NAU. As soon as he had cleared them, she threw the send switch and called the ship. Then she listened.

Silence.

Only the hurtling of the gale stole—muffled—'neath the 'phone receivers. She called the ship again, and listened.

No answer.

She tried once more to raise him.

But ether space was dead of sound. Even QRN was a negligible quantity.

For the first time, the full realization of her situation flooded her senses, and there came a tightening at her throat. She put the phones down and balanced her way to one of the ports. Even as she stood there watching the gigantic hurtling of vast waters, she felt the *Blythedale* begin a roll that she instinctively knew would be worse than any of the others.

Down — down — down — (was she never to start up again?)—until swirling foam washed level with the edge of the deck—and there the ship hung, as

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though hesitating which way to go. She held her breath. Then—very slowly—the *Blythedale* rolled back—and down the other side. Three of these rolls did she take, until her course was with the racing, hammering seas—and her motion was easier.

The girl went back to the apparata—but not a signal could she hear.

And she idly fell to wondering if God—were looking down?

She was unaware of the skipper's entrance, until he touched her.

"Hear anything?" His face was very white—with a long streak of black across it—that made it ghastly.

"Not now. There was a vessel a few minutes ago working NAU—but he has stopped, and evidently cannot hear me, as I have tried three times to raise him."

Sheffield lurched on the transom—"Can you raise NAU?"

"No. We were out of touch with him at 8 this morning. I told you—don't you remember?" she asked gently—as to a child—for the big seafarer was a tragic picture—his years, that he carried well under normal conditions—seeming to have blossomed in all their strength, causing his face to be seared and lined—and very old.

"No—no," he muttered, "I—I don't remember—I don't remember."

She went over to him, put her cool young hands on his forehead —

"Is—is the danger very near?" And she was surprised at the steadiness of her voice.

He looked up at her—and the horror in his eyes struck her as a blow.

"The—the after hold is full of explosives—for Buenos Ayres—and if the bulkhead goes—we—we will be another ship that—'vanished.' Even if it does stand—the heat may set it all off!"—and his head dropped in his hands.

One of hers went from his bowed head—to the locket—on its little chain—and her lips quivered.

"Laddie—boy-mine!" she whispered. And a silent prayer went up through the mists of flying spray, the clouds of spume—out of the infernal clamor of the night—up through the storm wrack

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—past the gardens of the stars—up, on the wings of faith in her God—fortified by the purity of her woman's love for her choice of this earth.

"Men have quit, sir!" gasped the first officer, lurching in.

His hands were bleeding, his clothes in scorched tatters. One ear was nearly torn from his head and hung by bits of skin.

The skipper looked up — "what's that?"

"Laid down, sir! Chief's broke his leg. God knows where the second is —and the men say it's no use! Flesh and blood can't stand that hell down there! I believe—that if they'd hang on a bit longer we might hold it back from—from the powders, sir, and with daylight this blow and sea 'ld go down—so's we could work better. But they've lost heart, sir!"

Slowly Captain Sheffield rose to his full height.

"Quit—have they? By God, old as I am *I'll* show them that a sailor's duty, above his life, is to protect to the last ditch—to—to—" he stammered, put his hands to his head—"to protect to — the — the — last ditch — his —his owner's — property — to — to — protect — Aaaaahhhh!" He crumpled to the lurching floor.

The first officer knelt over him—put a bleeding hand beneath the jacket.

"He's well out of it, Miss!" he said

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slowly. Coughing, he rose. "We'll all be with him—soon—I'm thinkin'—unless you raised a ship? It's our last hope—to put courage in the men!" There was a vast, terrible hunger in the caricature of a human face that stared at her—waiting.

She stared back—and decided.

"Ship? Why, certainly! Just before you came in I had been giving him our position. He ought to be here by daylight—he's only about 100 miles to the east—or a little less. I'll call him again!" She said it coolly—easily—and went to the key, he lurching behind her—watching. She began to send—and this is what she sent:

"From souls in peril on the sea—To the Creator of all things—Thou Who hast said that not a bird shall fall but that Thou knowest of it—receive this message, and help us in our extremity."

She threw the switch to receive—and listened, while the first officer watched her face with awful tensity.

To her ears the night spaces were void of sound. But she nodded several times—then jumped up—

"He says OK — coming as fast as possible!"

"Thank God!"—and the seaman seized her by the arm. "Come on!—you must! Come tell the men! They'll believe you and keep up the fight! It's our last chance!"

Down over the slippery decks — soaked by the whipped-off crests of seas —the two came at last to the engine room alley. And here, in the sickly sheen of one electric light, she saw—lying everywhere—almost naked bodies —streaked with blood—covered with soot—some with scorched, hairless heads —others with jagged cuts and fearful blisters. A few were praying. One was cursing—horribly. Another whimpered as a punished child whimpers. And there was an acrid reek of burning over everything. The men saw her —but they did not move.

"It's all right, boys! Our SOS has been heard! Help will be alongside by daylight! Glass is risin'—and the wind's fallin'—ain't that right, Miss? Tell them—for God's sake!" he whispered.

"Yes—help will be here by daylight —coming as fast as possible!" she called —her clear, young voice echoing above the turmoil.

"Let's go, boys! All hands! We'll hold her back—till daylight—all right! LET'S GO!"

As one man they were on their feet, shouting hoarsely with broken, cracked voices.

"Can you get back—alone—and keep in touch with that vessel?" the first officer croaked. She nodded. He disappeared after the others—somewhere

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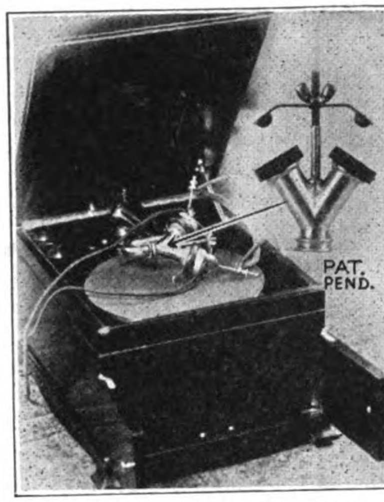

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Phones—kdyl, kfac, kfc, kfi, klz, ksdk, kuv, kvq, kwh, kyj, kzn, 7yj.

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in the smoke haze and murk and noisome gloom.

She fought her way back to the radio shack.

Just as he had fallen, Skipper Sheffield lay. She looked at the fine old face, over which there had come an expression of utter—peace. She bent—crossed the hands—

"I've done my best for your ship—and for us all. You know, *now,* what the answer will be to my message—and if it reached—Him!"

She put the head harness on—tuned—but there was no sound. Then she took the little locket from its fragile chain—opened it—

"Boy-mine—your 'OW' has done all that she could. If this is—good bye—we will—meet in—in Happier Places—boy-mine—I love you so!"

And then nature had its way. She fainted—and her tired little head fell across the white hands—on the operating table—while in the inferno below heartened men slaved and fought and scorched and blistered — hurling blasphemous blessings on her.

And—very gradually—the wind began to drop—and the seas to run in lesser mountains.

"WHO is this—'D. Montgomery'? Sounds like a new name to me! But it's of no consequence—anyway! Nothing is too good for 'D. Montgomery'!"

Thus spoke Carroll, Sr.—as he strode up and down his huge private office—to Carroll, Jr., and to Brown, the personnel manager.

"By Heaven!" the big man exploded, "to think of the magnificent nerve of it! Throw a bluff that his SOS had been heard — when he hadn't heard a damned thing! And couldn't raise a ship—anywhere! With the *Blythedale* burning under his feet—and the after-hold full of explosive—knowing this, to calmly bluff the crew into taking heart — and working the ship to port—with the poor old skipper gone—is the finest thing *I* ever heard of. How about it?"—glaring at Arthur and Brown—as though daring them to contradict him.

The two looked at one another from the corners of their eyes—and agreed.

"Well—well!" continued the senior member of Carroll & Carroll—looking impatiently at the clock. "Montgomery is due here—now! I've got this watch, properly inscribed—a comfortable check—and a guaranteed position with us as long as he cares to stay! I want 'D. Montgomery' in Carroll & Carroll!"

The other two turned their heads away.

A light tap at the door.

Continued on page 100

Static Defeated and Loop Aerials Practical for All

Cotoco

TRADE MARK REG. U. S. PAT. OFF.

Buy by the name Cotoco and you buy Radio supplies that are scientifically and mechanically right. Buy by the name Cotoco and you buy abreast of the latest developments in Radio.

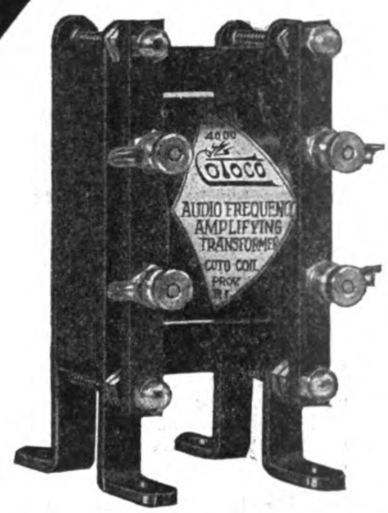
One of the nation's greatest weeklies, in an editorial article, speaks of the "growing popularity of radio frequency." The reason for this nation-wide popularity is that Radio Frequency sets alone have weathered the summer whirlpool of static. Cotoco Radio Frequency Transformer is of tapped type. Gives great selectivity and little amplification of static. The obvious advantages of Loop Aerials are fully enjoyed by those who use this method.

The name Cotoco is to be found on the best amateur and professional Radio Frequency Sets throughout the land.

Buy Always by the Name

COTOCO

Write for Free Connection Diagrams

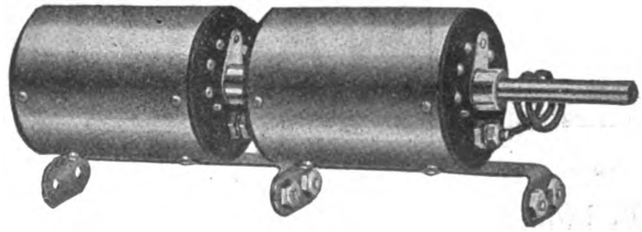


Cotoco Amplifying Transformer for Audio Frequency

Static and Distortion Yield to These Scientifically Designed Transformers

Above is our Audio Frequency Amplifying Transformer. Distortion is practically unknown to its users. Variation of audibility is at a minimum over a wide band of frequencies.

Below is the wonder working tapped type transformer for Radio Frequency that has had so much to do with the growing popularity of Radio Frequency as opposed to the regenerative principle. Many of the most efficient radio sets made this fall and winter will be built around these compact and efficient units mounted for two stages (as illustrated) or three stages of Amplification.



Cotoco Amplifying Transformer for Radio Frequency

Connection Diagrams Are Wrapped

with every Cotoco Amplifying Transformer for Radio Frequency for both two and three stages of Amplification.

If your Dealer cannot supply you, send us his name.

Coto-Coil Co.

87 WILLARD AVENUE
PROVIDENCE, R. I.

Continued from page 98

"The radio—operator of the *Blythedale* is outside, Mr. Carroll."

"Show him in, man! Good God—don't keep him waiting—show him in!"

The clerk disappeared.

Silence in the great, map-lined office. And then she entered it—gracefully—quietly—and stopped, just across the threshold, a lovely picture.

"You sent for me—Mr. Carroll?"

Carroll, Sr., gasped — once — came forward—one pace—"But—but who are—you?"

"I am Dorothy Montgomery, lately radio operator on your vessel—the *Blythedale*."

Moments passed.

Then the look of bewilderment on the big man's face changed slowly to one of understanding. He turned to his son.

"You—young—scamp! You scallywag! To play a trick like this on your trusting old father! And you, Brown!" —he roared at the personnel manager—"you had a finger in this—this put-up job! I ought to fire you—but I won't!"

He walked to the girl—put his big hands on her slight shoulders.

"I said—before you came in—that I wanted 'D. Montgomery' to be with Carroll & Carroll as long as he desired to stay! And I stick to it—tho' the gender is changed to feminine! So—you are the girl that my reckless lad tried to kill—with his go-devil car—eh? Come to me—child! You have eyes and hair like his mother's——" he coughed. "Beat it—you lucky dog! And you, too, Brown!—vanish!"

Arthur and the personnel manager disappeared—while the great shipmaster gathered the slight figure in his arms.

"The original 'OW' of Carroll & Carroll!" he whispered tenderly. "But—tell me—child—the chief officer says that he heard you—saw you—send a message! What was it—a broadcast of your own — in the hope of being heard?"

She looked up at him. "Yes, it was a broadcast—of my own—to God—and He heard it."

A shaft of golden sunlight shot from beneath a cloud—glowing softly on their figures.

RADIO FOR CONSTRUCTION JOB

Continued from page 10

The construction entrance camp is at an altitude of over 9000 feet. Due to the location of the stations and the topography of the country and the fact that little was known regarding radio communication in a mountainous territory, it was necessary to do considerable experimenting before satisfactory results were obtained. Portable radio telephone sets which had given satisfactory service in the vicinity of Los Angeles were first taken into this territory. Tests showed that to communicate a certain distance it was necessary to use about twenty-five times more power than was needed near Los Angeles.

The three 500-watt transmitters were built on special order in about twelve days. One oscillion tube is used in each set. They were designed originally for continuous wave telegraph, but have been equipped for telephone or buzzer modulated telegraph. All three methods of communication work well.

To furnish power for the boring of tunnels for the hydraulic development a thirty kilovolt volt transmission line has been built between Cascada and the two outpost mountain camps. The radio sets give a rapid and reliable means of communication during transmission line trouble and handle switching and operating line orders. The transmitter at Cascada obtains its filament current from the 110-volt supply and plate current from a 1500-volt generator belt driven by a 2-h. p. induction motor. The radio power plant at Huntington Lake portal camp and the construction entrance camp consist of a 220-volt, three-phase motor, coupled to a 32-volt direct current generator and belted to a 1500-volt direct current generator from the coupling. Under normal operation the 32-volt direct current generator furnishes power for the filament and the 1500-volt direct current supplies the plate. During a failure of the 30-volt transmission line, the 32-volt direct current generator operates as a motor from the storage batteries of the mine locomotives used in the tunnel work.

The antenna at Cascada is of the inverted L type, 140 feet high at the free end, 90 feet at the station end, and 120 feet between spreaders. Five No. 8 copper wires spaced 4 feet apart are used. At Florence Lake portal camp a T aerial is installed, being 140 feet high and 175 feet between spreaders. The same wire and dimensions are used. At the construction entrance a T aerial 90 feet high and 150 feet between spreaders. The radiation from each of these antenna is about 2.4 amperes at 540

Continued on page 102

Continued from page 101

meters, which is the normal operating wavelength.

Involved in the work of developing the full electric potentiality of the streams of the High Sierras and conserving their flow for irrigating lands in the San Joaquin Valley are many more daring engineering problems, which will necessitate the drilling of other tunnels, the erection of enormous storage dams in the mountain ranges and far beyond lines of transportation and the constant employment of thousands of men for several years to come. Radio is probably being put and continuing to be put to one of its most practical uses in becoming the medium for transmitting the instructions for the work of this great project.

UNUSUAL DX WORK

Continued from page 21

formerly 6KY, will be associate operator at 6XAD through December and January. During January a series of tests will be conducted between 6XAD and the new station of the Amalgamated Wireless, Ltd. at Sydney Australia.

It is to be hoped that the CW and ICW men will "make good" during the coming radio season, and it gives me much pleasure to state that if 6XAD can be of any use, for DX tests—and so forth—I shall be only too happy to render such assistance as I may.

Additional stations heard and worked by 6xad since the above was written are as follows:

(9bjv), (9zaf), 9yas, 9bds, 9ays, (9bhd), (9awm), 9ajm, 9dr, 9drd, 9ajs, 9tps, 9kp, (9xaq), 9ww, 9api, (9hjv) 9yaj, 9bds, 9ajm, 9bqw, 9djo, (9djo), (8bke), 8bb, (8cko), (8bux), 8cak, 8se, 8zy, (8zy), 7qd, 7zu, 7gn, (6xas), (6xj), (6byj), (6mda), (6beg,) (6gr), 5qs, (5za), 5nv, 5qs, (4bf), 4jy, 3bit, 3bhm, (3bhm) Robert C. Valentine, Marshalltown, Pa., 2apd, 2aws, (2awf).

CANADA TAXES AMATEURS

In Canada it is necessary to pay a tax of $1 for all experimental amateur radio sets. Over 400 licenses have been granted by the Ottawa government thus far. Applicants for licenses are required to get in touch with the Dominion Naval Service. Prosecutions will follow unless applications are filed within ten days of the sets being installed.

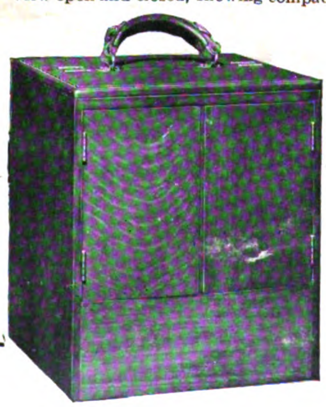
RADIO BUSES

The radio-equipped stages which travel on the California highways, are the inspiration of equipping sight-seeing buses on Broadway, New York, in a similar manner. The Greeley Sightseeing Car Co. plan to equip all their buses with radio receiving sets in 1923.

Type AP-3 two-stage Audio Frequency Amplifier
(Companion piece for Type AP-4)

Type AP-4 Short Wave Receiver

Oard PHANTOM Receptor
(Also called the A-P Special)
View open and closed, showing compactness



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THE QUALITY LINE for performance

A-P sets make good. The years of radio experience behind the name A-P guarantee excellence of manufacture. That is why dealers recommend A-P apparatus *for performance.* There is an A-P set to fit every purpose and pocketbook. Ask your dealer to show you the A-P *quality line,* or write us for *Catalog R-4,* mentioning your dealer's name and the kind of set you are particularly interested in.

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646-50 Mission Street, San Francisco

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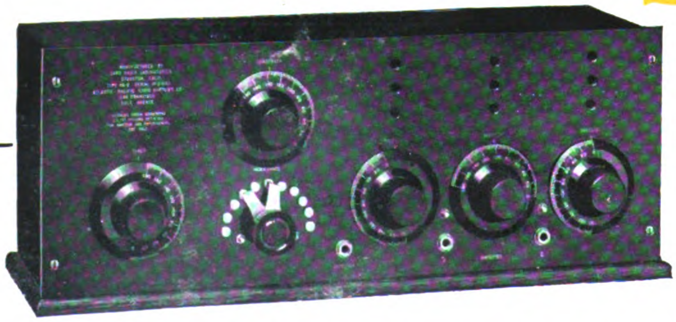

Type AR-2 Receiver Detector and two-stage Amplifier

Type DR-5 Receiver Detector


DECEMBER 1922
25 CENTS
RADIO
Santa Claus adopts Radio
—he has at last found a set so simple and easy to operate it can be used every place he calls, a marvelously efficient radio receiver which requires neither aerial nor ground connection—
The Oard Phantom Receptor
ATLANTIC-PACIFIC RADIO SUPPLIES CO.
646 Mission St. San Francisco

RADIO

Established 1917 as Pacific Radio News

Volume IV *for* DECEMBER, 1922 *Number 12*

CONTENTS *for* DECEMBER, 1922

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Forecast of Contributions for January Issue

To start the New Year there will be published the first of a series of practical articles in narrative form by S. P. Wright. These articles will give the information that every amateur should know but presented with a fictional background that will entertain the novices as well as jog the memories of the amateurs. The first in the series—"Wildcat Builds a Tuner," a story on the use of a wave trap—and then by an account of an exciting radio game for club meetings. In the quaint style of "And It Came to Pass," Mr. Wright will also have some appropriate remarks about New Year Resolutions.

D. B. McGown, assistant radio inspector for the Sixth District, has written another one of his constructional articles, this being a description of a receiving set especially adapted for use with 32 volt current from a farm lighting set, although the directions are given for using current of other voltages. This article should prove helpful to anyone about to build a new receiving set.

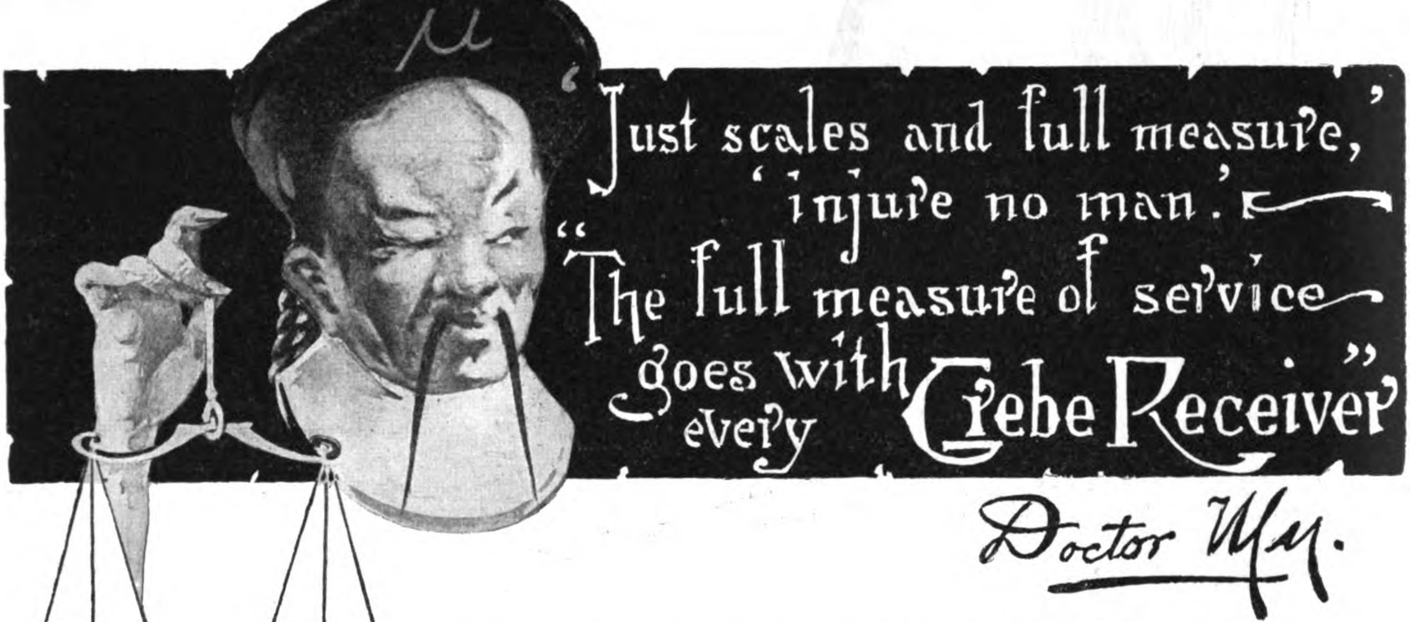
Some good stuff for the transmitting amateur will be found in Charles K. Fulghum's suggestions on the "Construction and Use of A Filament Heating Transformer for C. W. Transmission," and in Jesse Marsten's notes on "Vacuum Tubes in Parallel," which includes a comparison of master oscillators and self-exciting oscillators and gives suggestions for securing greater power output.

A fiction writer new to readers of RADIO is Albert Lippinpool, who has a good story on "The Radium Bulb," with special illustration by C. J. Dow. Speaking of Dow, we suggest that you look at his list of Calls Heard as published in this issue—'Twill make you green with envy.

Volney G. Mathison, in his fifth article on "The Practical Radio Operator," tells about getting the first ship and gives some experienced suggestions about the operator's conduct aboard ship.

Ellery W. Stone will present the seventh and eighth assignments of the University of California Extension Division Correspondence Course on Elementary Radio. His subjects are "Detection" and "Telephone Receivers."

G. M. Best, in addition to his answers to queries, will write of his experience in eliminating inductive interference from high tension power conductors, a phenomenon that had previously been ascribed to static.



ANYONE who knows radio will tell you how well the Grebe CR-5 performs on the daily concerts, lectures, etc., in the air.

Two simple tuning adjustments are used. Tiresome adjustments, unpleasant interruptions are unnecessary with the Grebe CR-5. Its range, 150—3000 metres.

Ten years experience in satisfying a critical radio public has taught us how to build it for your year-round enjoyment.

If your Dealer does not sell Grebe Radio Apparatus, send us his name and receive interesting circular.

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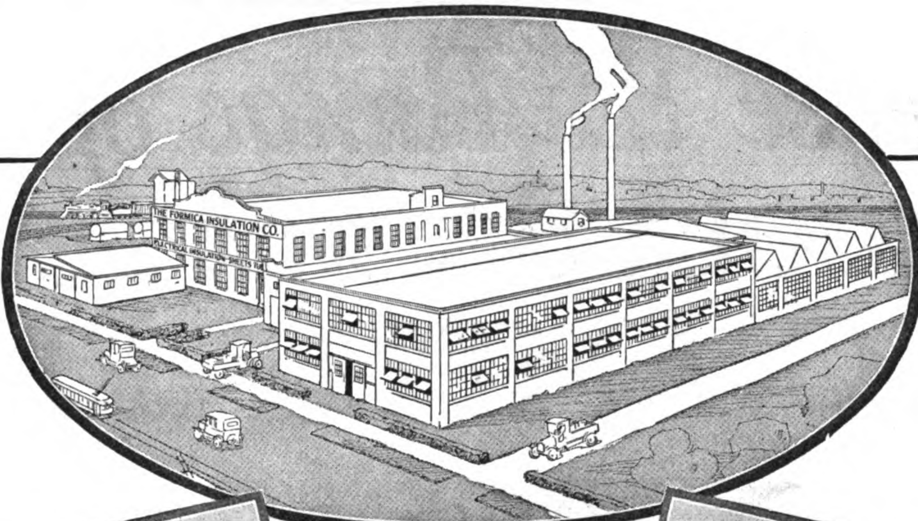
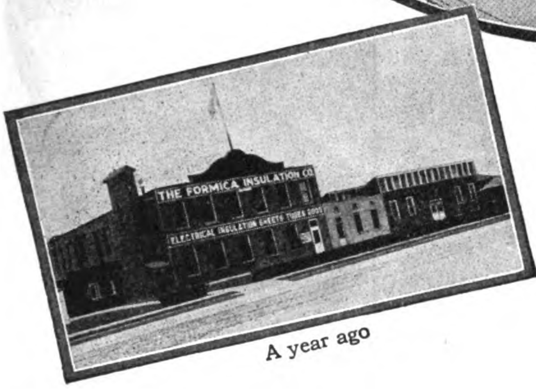
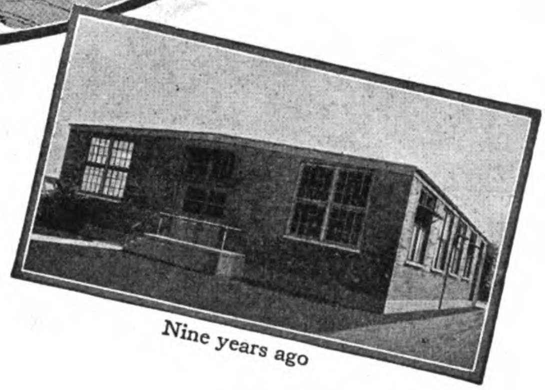


The Formica plant today



A year ago



Nine years ago

~Appreciation and Progress~

NINE years ago the Formica Insulation Company began business in the small building shown at the right.

Two years ago the demand for the product from every branch of the electrical industry, forced a move to the building shown at the left where capacity was greatly increased.

Now, recently constructed additions to that plant have brought into existence the plant shown at the top—a plant with more than twice the capacity of the company—a year ago—and the largest in the industry.

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FORMICA
A Laminated Phenolic Condensation Product
SHEETS TUBES RODS

December, 1922 RADIO Vol. 4, No. 12

Radiotorial Comment

A CHEERY CHRISTMAS TO YOU, GOOD FRIEND! RADIO extends to you the hand of radio fellowship at this Festive Season and cordially hopes that your radiations will grow none the less.

In the year that is now rapidly passing a-down the aisles of the Present, and turning the corner into the dim arch-ways of the Past, RADIO has tried to be of interest to you all! In its pages the editors have sought to place before you material that would be of interest to the ambitious beginner in radio, as well as to those that have progressed far along the way.

We have endeavored to avoid useless, and sometimes acrimonious, discussions as to various methods of transmission, feeling that it is every law-abiding operator's inalienable right to develop along *his own* lines, and after his own methods! This wee, sma' world in which we move would be a deadly dull place if we ALL thought alike, and acted alike!

There is ONE thing, however, that most amateurs have in common—and that is the very human trait of wanting to *help t'other* fellow! There seems to be, very strongly developed, in the great class of amateur operators a spirit of friendly co-operation that speaks WELL for the youth of these great United States of ours! At times the Green Eyed monster rears its ugly head—but not for long! *"Live and help live"* must always be the motto in the fair-minded operator's inner Consciousness!

Any fool can *destructively* criticize!

And no one gets any for'arder!

The thing to do is to *constructively* help!

And then everyone is—happy!

The chief factor of the great power of our blessed Nation, among the nations of the world, is our *cohesiveness!* In unity—of anything—there is STRENGTH! In warring "factions," is dangerous weakness!

Because 99% of the amateur radio operators of this land obey the laws, and pull together, their great body has earned —and won—recognition, as well as respect, at Washington. The result has been that laws of much benefit to the amateur have been passed, and his ways smoothed as far as logically possible!

The radio army is recruiting rapidly. Already the awkward squads—the tyros—outnumber the old guard a hundred to one. Their requirements oft seem unreasonable—an unreasonableness based on ignorance. If they knew better they would be more reasonable. To show them the right—to teach them—is at once the duty and the privilege of the old guard.

To try to down the flood of public opinion with opposition is suicide. But by gently leading it into the channels of understanding its power may be utilized for the benefit of all. Congress must be urged to pass the new laws that are needed to improve conditions on the air.

In the persons of the Secretary of Commerce, and the Commissioner of Navigation, radio effort is indubitably blessed! We extend to these two gentlemen our warmest Yule-tide Greetings, at the same time venturing to express our KEEN appreciation for all that they have done toward assisting the amateur! We have but to look at the endless difficulties, the drastic laws, etc., that hamper amateurs of other nations, to realize how extraordinarily fortunate we Americans are.

The thing, then, to do is to abide by our Radio Laws, thus proving that we are appreciative, and that we intend, to the best of our abilities, to show our worth.

And when the Christmas bells ring in their gladsome tidings we may be proud of our association with this wonderful agency which, more than any other, is destined to bring about world understanding and unity. So send it and receive it—*"Peace on Earth, Good Will Toward Men"*—by radio.

MAJOR LAWRENCE MOTT

TO the editor, the most interesting departments of RADIO are the "Letters to the Editor" and "Calls Heard" because they indicate what our readers are thinking and doing. 'Tis with regret that hundreds of complimentary letters cannot be published because they would crowd out material of greater interest to the reader. We are deeply appreciative of these bouquets and take this opportunity to thank the senders. Especial attention is called to some of the remarkable long distance records that are modestly listed among the "Calls Heard." In case of failure of other methods of communication or in other national emergency the nation has at its service hundreds of amateur operators ready and able to transmit messages across the continent and even across the sea. The maintenance of this reserve is the fundamental reason why every possible consideration should be shown the radio amateur.

Exit "KUSD"

That fact may be more dramatic than fiction is demonstrated by this graphic portrayal of the important part played by radio in the rescue of the passengers and crew of the ill-fated "City of Honolulu." Well-deserved tribute is paid to the former amateur operators who manned the vessel's radio cabin.

"CQ! C.Q! CQ! - de KUSD - fire aboard ship please stand by for position!"

This dramatic message, flashed across the Pacific ocean at 5:56 o'clock on the morning of October 12th, brought to a listening radio world, the first intimation that the palatial steamer *City of Honolulu* was afire 700 miles off the California coast with 262 persons, passengers and crew, aboard.

The vessel had cleared from Honolulu on October 7. It carried a standard Navy type Radio Corporation of America 2 k. w. spark set, in charge of Chief Operator Walter P. Bell of Oakland, Second Operator H. D. Hancock of Venice, and Third Operator N. C. Kumler of Yakima, Wash., —all former amateurs. The radio staff worked in three shifts of four hours on and eight hours off duty.

Kumler was on duty when the fire broke out, but he knew nothing of it. He had the "dog-watch," from midnight until 4 a.m., and there had been plenty to keep him awake. A two-hour message from Pearl Harbor was one thing. Static was another. Off to the Westward "WML" the *Lurline* had been handling re-transmission stuff to "KHK"—Wahaiwa, Hawaiian Islands—when Kumler decided to clean up. He had one for the *Manoa*—"WMQ."—and reached for his key.

"WMQ de KUSD!" he called, signing the call for the *City of Honolulu*.

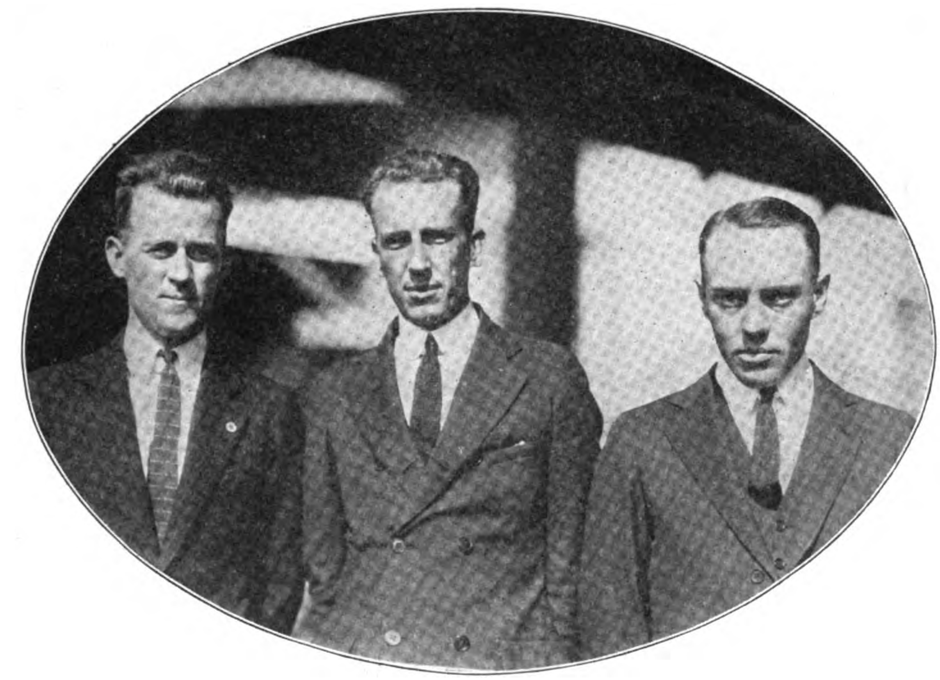
"Go ahead," sang out the *Manoa*, two hundred miles away.

Kumler reached for his key . . .

Into the radio room came the sudden ring of the bridge telephone. Kumler paused and glanced at his clock. It was 5:40 a.m., just before dawn. Instantly he knew that something had happened. Telling the Manoa to wait a minute, he answered the telephone.

Captain H. R. Lester, the vessel's commander, spoke to him from the bridge. "Wake the other operators and report to the bridge!" he commanded.

Kumler knew then that something serious had occurred. He immediately wakened Chief Operator Bell, who slept in an adjoining cabin, informed him of the captain's orders and rushed to the bridge. There he was told the ship was on fire and to ask all vessels to stand by until position computations were made.



W. P. Bell *H. D. Hancock* *N. C. Kumler*

When this was reported back to Chief Operator Bell, the latter sent out the "CQ" call, noted above, which shocked a whole West coast into instant attention, and turned half a score of half-awake operators into competent, alert machines.

East and West sped the "CQ" call. It was caught at Pearl Harbor. It was picked up by three vessels—the *Enterprise*, the *City of Los Angeles*, and the U. S. Army Transport *Thomas* many miles away. It drummed into the ears of the night operator at KPH, the Radio Corporation station at Marshall, Calif., and throwing on his full power he flashed back an answer.

"Any report?" he asked.

"Not yet," said Bell, sighing with relief. For, even in the annals of quick radio, that was somewhat of a record—a matter of three seconds response to a call from mid-ocean.

Two minutes after the "CQ" call went forth, Chief Operator Bell again broke the silence of the air with the vessel's position—"Latitude 31-07 North, Longitude 131.40 West."

Three acknowledgments came back from that position announcement—the *Enterprise*, the *City of Los Angeles* and the *Thomas*. In the meantime KPH took official charge of the air, broadcasting a "QRT" to all vessels to "stop sending." NPG, Goat Island, similarly ordered all naval vessels into silence and a tomb-like quietness dropped over 6,000 miles of busy night air.

Aboard ship, the battle against the flames had begun. The wireless operators stayed at their posts, oblivious to that portion of passing events. Bell took charge of the key work, the other two maintaining a messenger service between the radio room and bridge to facilitate orders from the ship's commander.

As all the world knows, the battle of the crew and the ship's officers against the encroaching flames was a losing one. Smoke was everywhere, swirling down upon the decks and the radio room in great billowing clouds. Passengers were running to and fro gathering up personal belongings. The crew were preparing the lifeboats for the inevitable. Through it all, three radio operators, with impassive faces, played the game with Death—and won.

The *City of Honolulu* tilted over on her beam ends as the fight went on. She wallowed with a list of thirty-five degrees to starboard. Bell braced his foot against the table. His pencil and message blanks went skidding downward. Articles fell out of the racks. The chairs slid the floor and banked against the wall. The switchboard was tilted at a crazy angle. But the outside radio world knew nothing of this until afterward. At the time Bell's sending was smooth, steady—as cool as his nerves.

Continued on page 72

Radio Tuning Devices

By Ellery W. Stone

This, the fifth and sixth assignments of the correspondence course in Elementary Radio being conducted by the University of California Extension Division, discusses the theory and practice of single and double slide tuners, variable condensers, loose couplers, variometers, vario-couplers and honeycomb coils. Previous assignments, question sheets and supplementary data may be secured from the Extension Division, 301 *California Hall, Berkeley, Calif.*

SINGLE AND DOUBLE SLIDE TUNERS

In the last assignment, we studied the theoretical side of tuning the receiving antenna to the frequency of the incoming radio wave. In this assignment, we shall consider the design and construction of some of the instruments which are used in actual practice to effect these results. Fig. 21 illustrated the earliest type of tuned receiver, one in which the detector was inserted directly in the antenna circuit. Such a circuit did not prove satisfactory in practice, however, because of the ensuing high damping of the receiving antenna circuit caused by the introduction of the high resistance of the crystal detector. Actually, in the pioneer circuits, a high resistance device called the *coherer* was used in place of the crystal detector, which was not developed until later. However, for our purposes, and in order that you may not have to spend time studying the operation of a device which is now of merely historic interest, we shall consider the use of the crystal detector only.

It became necessary, therefore, as we learned in the last assignment, to remove the detector from the antenna circuit and to couple it inductively to this circuit instead. In this connection, we have already studied the action of the two coil receiving transformer, but there is another type which was first used and which, because of its simplicity, is again finding favor in the reception of radiophone broadcasting. This is called the single coil or *auto-transformer.*

Fig. 24 shows the two coil receiving transformer, whose action we have already investigated, consisting of a primary coil and a secondary coil. The dotted lines threading the two coils represent the magnetic field or *flux,* as it is called, generated by the alternating current in the primary coil. This magnetic field threads the secondary coil and induces, by the principle of electromagnetic induction, an alternating potential of the same frequency across the terminals of the secondary coil. In Fig. 24, the primary coil is shown as consisting of three turns of wire while the secondary consists of four turns.

Fig. 25 illustrates another type of receiving transformer called the auto-transformer, the transformer action being limited to, or is self-contained in, one coil, although the single coil really contains both a primary and secondary. This coil is seen to consist of four turns of wire. Taps are taken off three of the turns so as to form the primary while the entire coil is used as the secondary. In so far as the number of turns in both primary and secondary is concerned, therefore, this arrangement is exactly similar to that shown in Fig. 24—the alternating current which flows through the three turns that comprise the primary inducing an alternating potential across the four turns of the secondary.

It will be seen, however, that while there is no actual electrical connection between the primary and the secondary of the receiving transformer shown in Fig. 24, there *is* electrical contact between the primary and the secondary of the auto-transformer of Fig. 25. For this reason, the primary and secondary of an auto-transformer are said to be *conductively* coupled to each other, although the induction of potential across the terminals of the secondary in both cases is by *inductive* means.

In Fig. 22, we showed how the detector could be removed from the antenna circuit so as to reduce the latter's resistance. The circuit shown in Fig. 26 also accomplishes the same purpose by the use of a single slide tuner or auto-transformer in place of the inductive receiving transformer. The small fixed condenser, *C,* called a *stopping condenser,* shown shunted across the telephone receivers is not for tuning purposes. Its function and that of the detector will be more thoroughly discussed in a later assignment. For the present, we shall confine ourselves to the construction and operation of the tuning coil.

This coil consists of a single layer of copper wire, insulated with a covering of cotton, silk, or enamel lacquer. This layer is wound on a tube of insulating material, such as cardboard. The tube, irrespective of the material of which it is made, is called the *core.*

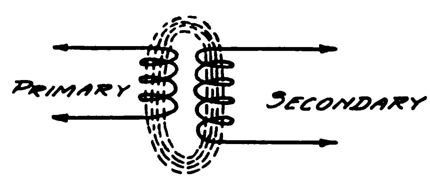


FIG 24

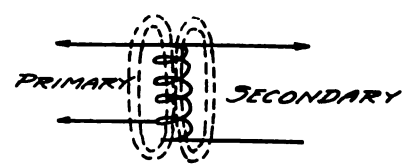


FIG 25

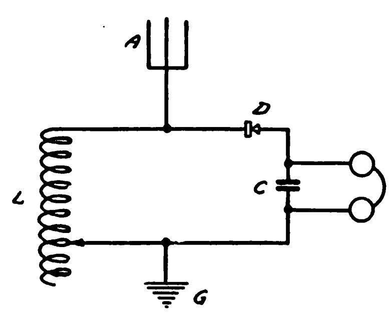


FIG 26

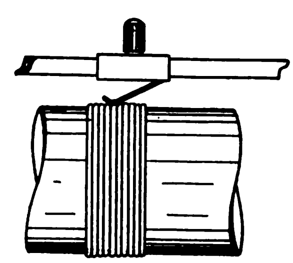


FIG 27

Fig. 24. Two Coil Receiving Transformer.
Fig. 26. Receiving Circuit with Single Slide Tuner.

Fig. 25. Auto-transformer.
Fig. 27. Detail of Slider Construction.

The inductance of this coil may be varied so as to increase or decrease the wavelength of the receiving antenna by adding to or reducing the number of turns. This is because the inductance of a coil, as we have seen, depends upon the size and number of turns of which it is composed. So far as the electrical characteristics in this circuit are concerned, the coil may be considered as consisting only of the number of turns actually in the circuit between the lead from the antenna and the arrow, representing the slider which is connected to the ground.

Since the slider must make contact with each turn of the coil, it is necessary to remove a small portion of the insulation from each turn over the entire length of the coil. This is most easily accomplished when enameled wire is used, since the enamel may be removed by sandpaper. After the enamel has been removed by this means, a soft cloth should be rubbed over the exposed surface of the wire in order to remove any fine bits of copper which may be lodged between adjacent turns and which would thus short-circuit them. Such a short-circuited turn would really constitute a single turn, short-circuited secondary and due to its low resistance, a large induced current would flow in it. Such a flow of current would thus extract a wasteful amount of energy from the antenna circuit.

The proper size of the wire ranges from No. 22 to No. 28, B.&S. gauge, No. 24 being probably the most satisfactory. If the wire used is too small not only will its resistance be too high for most efficient results, but the small diameter of the wire will facilitate the deleterious short-circuiting of adjacent turns by the slider.

The slider usually consists of a small piece of spring brass or copper soldered to a short piece of square brass tubing, about three-fourths to an inch in length. A moulded knob of insulating material is fastened to the opposite side of the brass tubing, and the whole slides along a square brass rod slightly smaller than the inside dimensions of the tubing. The detail of the slider construction is shown in Fig. 27.

Tuning coils are usually made from 6 to 10 in. in length and from 2 to 4 in. in diameter. Occasionally, they are wound with bare copper wire and thread, the thread serving to insulate adjacent turns from each other. Such practice obviates the necessity of scraping the insulation off the wire in order that the slider may make contact with it.

In Fig. 26, the antenna circuit is tuned by means of the slider. This circuit consists of the antenna, that portion of the inductance, *L*, which is included between the antenna and the slider, and the ground. The secondary or detector circuit consists of the same amount of inductance, the detector, and the parallel combination of stopping condenser and telephone receivers.

The secondary circuit is called an *untuned secondary*, since no means is provided for tuning it to the incoming wave. The wavelength of the antenna circuit will always be greater than that of the secondary because of the additional inherent capacity and inductance of the elevated antenna itself. Only that portion of the inductance, *L*, which is included in the antenna circuit as a means of varying its wavelength is common to both circuits.

In the third assignment, we learned that the current in a radio circuit "will not oscillate if the resistance of the circuit, *R*, in Fig. 8, is greater than a certain value, just as the pendulum will not oscillate if it is immersed in a very heavy liquid." In Fig. 26, unless a very large amount of the inductance, *L*, is in use (for receiving very long wavelengths the resistance of the detector, *D*, is too high to permit the detector circuit to oscillate. This means that the secondary or detector circuit is really a non-oscillatory circuit. The result is that it has no frequency of its own, since it cannot vibrate, so it responds equally well to waves or electrical currents of any frequency. In tuning the receiver shown in Fig. 26, therefore, it is only necessary to run the slider up and down on the tuning coil until the signals, voice, or music are heard the loudest.

If we shunt the inductance with a variable condenser, as shown in Fig. 28, we shall have provided means for tuning the secondary circuit, since the secondary circuit now consists of the active portion of the inductance, *L*, and the variable condenser. The detector is thus removed from both the primary and the secondary circuits, and we have two oscillating circuits, both of which must be tuned to resonance with the incoming wave and with each other. This circuit is similar to Fig. 22 of the last assignment except that the primary and secondary circuits are directly or conductively coupled to each other. (See definition of *auto-transformer* in the first part of this assignment.)

The circuit shown in Fig. 28 may be still further improved by the use of a double slide tuning coil, connected as shown in Fig. 29.

It has been found that the more turns of the inductance, *L*, which are used in, or are common to, both primary and secondary circuits, the broader is the tuning. This is because of the fact that as we increase the number of turns common to both circuits, we either increase the number of turns of the secondary threaded by the magnetic field of the primary or else we increase the number of turns of the primary generating the magnetic field which intersects the secondary. Since the potential induced across the secondary depends upon the strength of the magnetic field within it and the number of turns comprising it, we are extracting energy from the primary at a more rapid rate with an increased number of turns common to both circuits—or with *close coupling*, as we say —than when the circuits are loosely coupled, i.e., with only a few turns, if any, common to both primary and secondary.

The energy which is extracted from the primary circuit by the secondary, as far as its effect on the primary is concerned, may be likened to energy wasted in resistance in the primary or antenna circuit. In other words, it tends to in-

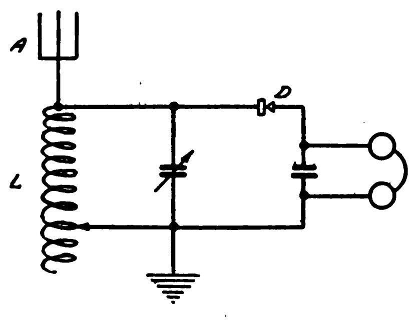


FIG 28

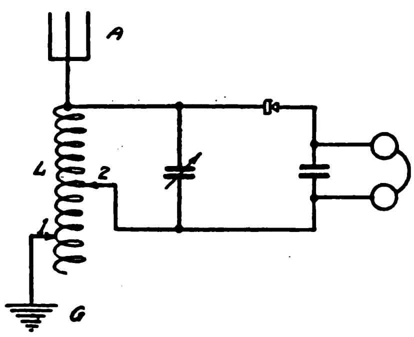


FIG 29

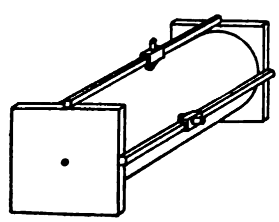


FIG 30

Fig. 28. Inductance Shunted by Variable Condenser. *Fig. 29. Circuit with Double Slide Tuning Coil.*
Fig. 30. Typical Two-Slide Tuner.

Continued on page 78

The Professional Radio Operator

By Volney G. Mathison

(Continued)

In following the long road leading to the operator's first ship the ambitious reader will here find a guide as to wireless schools, correspondence courses, and license examinations. While "there is no royal road to knowledge," a few sign posts help greatly. These the author points out from the abundance of his personal experience.

THE WIRELESS SCHOOL

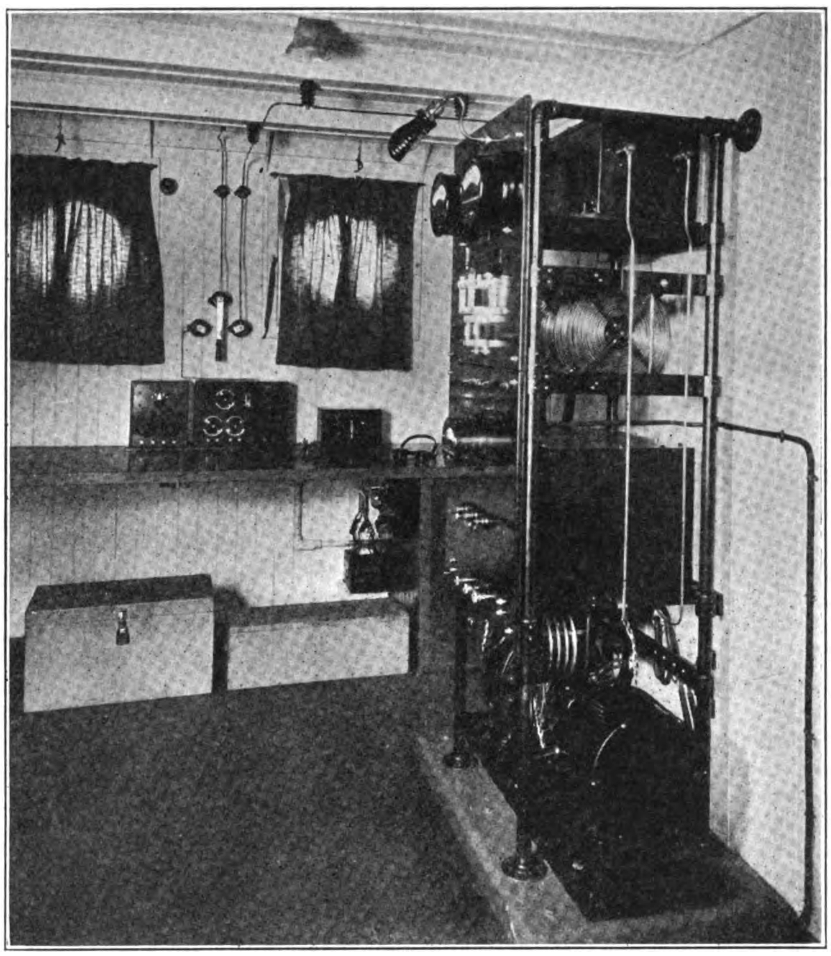
WHILE the operation of an amateur wireless outfit and diligent home study has in not a few cases sufficed in the obtaining of a commercial radio operator's license, the student should, if at all possible, plan to attend a good wireless school for a short time before essaying the government examination. If by book study he has imbibed the theory of radio and has gained a fairly comprehensive understanding of the general construction of radio equipment, in the wireless school he has an opportunity actually to operate the various types of apparatus about which he has read; he is enabled to acquire a familiarity with the instruments which only a practical demonstration of them can bring. In the school, too, he may have any desired amount of fast receiving drill that will prepare him to face with confidence the dreaded session at the test table of the government radio inspector.

In choosing a wireless school, the student should try to make sure that he selects a real school and not some sort of a semi-amateur establishment. Of the many so-called wireless schools scattered throughout the country not all are first class in the matter of instructors and equipment — especially the latter. There should be at least one complete installation of modern quenched-spark transmitting equipment; and the better schools have several. Aside from code practice, the student is wasting his time in a place where instead of finding the latest types of standard-make commercial equipment, he is introduced to a haphazard conglomeration of amateur apparatus such as he already has plenty of in his own wood-shed, or to some sort of antiquated straight-gap outfit of the type that Herr Hertz used in his experiments with oscillatory discharges of electric currents forty-two years ago.

The sort of instructors employed in a wireless school is also an important thing to determine as far as possible before enrolling. I once visited a widely advertised wireless school which I found to be in charge of a land-wire operator who could not send two lines of practice matter in the Continental code without slipping in half-a-dozen Morse letters; and who knew less about the technical side of radio than some of his students. I was informed by the manager of the school that a "radio expert" came to the place three times a week to give technical instruction. If the radio expert was in keeping with the school and its equipment, he must have been some young operator with a second-class license—or perhaps none at all.

If the student wishes to learn to operate arc equipment, he should not fail to select a school that has a modern shipboard arc installation and commercial types of undamped receiving apparatus. No practical handling of an arc set, nor indeed of any other set, can be taught entirely on paper.

As to the length of time it will be necessary for the student to attend the wireless school, this depends chiefly upon the amount of preliminary training he has been able to give himself at home. Some learners with a remarkable aptitude for Continental code attain a speed of twenty words a minute in five or six months, while others again never do get that high, but seem to stick irremovably around ten to sixteen words a minute no matter how long they practice. The layman, that is to say, one who has knowledge neither of telegraphic code nor of radio equipment, should plan to attend a good wireless school from six to twelve months to qualify for a first grade commercial operator's license.



2 K.W. Set on Tanker "Frank G. Drum"

The well-experienced amateur, on the other hand, who has operated and experimented with his own outfit at home for two or three years, and who has studied with fair diligence in the meantime, may need to go to school only six or eight weeks—just long enough to familiarize himself with commercial radio equipment and to get a brief intensive brushing up on code receiving and general radio knowledge.

A typical radio amateur with a shack full of wireless junk, I went to school twelve days before going up for the government examination. While I got away with a license, it was by a margin so narrow that I almost shudder yet at the memory of it. I really had intended to go to school longer—but that is a story. It is to be remembered, too, that the commercial operator examinations are a great deal more difficult now than they used to be.

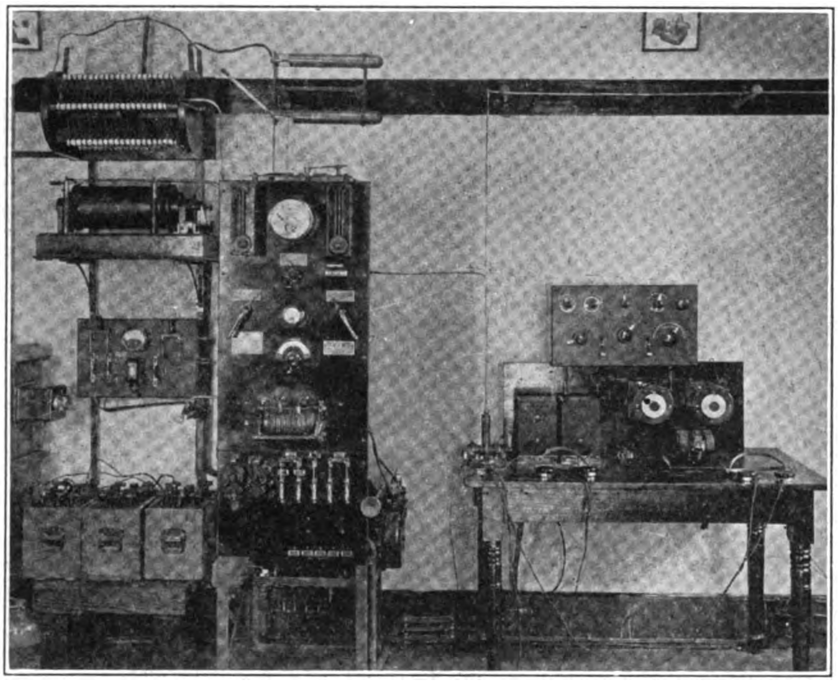
WIRELESS CORRESPONDENCE SCHOOLS

Several correspondence school courses in wireless operating have been extensively advertised during the last few years. When these courses first came out, a number of gross misstatements were made in connection with them,

It may be said truthfully, however, that the correspondence school wireless courses at present on the market are well prepared and strictly up to date; and they are undoubtedly of value if studied in conjunction with the operation of an amateur radio set.

GETTING THE LICENSE

Passing from the stage of preparatory experimentation with the amateur set or training at the wireless school practice-table, we come now to a brief discussion of what is to many timid young minds—though not justifiably so—the supremely dreaded ordeal in the



Radio School Apparatus

such as the assertion that anyone could become a radio operator in six weeks by studying a correspondence course by mail; and that upon obtaining a commercial radio operator's license, the correspondence school graduate could immediately secure a position at a salary of two hundred dollars a month or more—mostly more.

No training on earth will make a radio operator out of a raw beginner in six weeks—though a few students have managed to obtain first class licenses in six months. They were still far from being operators, however. As has already been stated, the highest salary that ever was paid to any prevailing extent for straight wireless operating on shipboard was $125 a month (this was for only a short time), and, although the maintenance furnished the radio operator aboard ship is worth a good deal, still it is not cold cash. Most of the lurid correspondence school advertising has been pretty well toned down lately, for which we are all grateful; but it did harm enough before it was discontinued.

process of becoming a radio operator: the governmental license examinations.

In the limited space available here, only the examination for the first class commercial license can be discussed, for this is the license that the prospective operator is interested in. During the war when any sort of radio operators were at a premium, a few youths with second grade licenses got away to sea; but under present conditions, with quite a number of first-rate operators idling ashore, the beginner with a "pink ticket" had as well aspire to be elected president of China.

As is pretty generally understood, the examination for the first class commercial license, as indeed for all operators' licenses except the second grade amateur, is in two parts: first, the code tests, sending and receiving; and second, a review of the candidate's technical radio knowledge.

The technical examination comprises seven subdivisions, to each of which are allotted varying point values, arranged to total in all 100, as follows:

1. A diagram (wiring hookup) of a complete modern commercial transmitting and receiving equipment, including emergency battery connections and charging panel	10
2. Knowledge of motors and generators, both direct and alternating	10
3. Knowledge of commercial transmitting apparatus (Theoretical principles, construction, practical operation, and maintenance)	20
4. Knowledge of receiving apparatus. Includes questions about the audion detector	20
5. Knowledge of storage battery construction and maintenance	10
6. Knowledge of the United States radio laws and regulations, international abbreviations, and naval regulations	10
7. Previous radio operating experience	20
Total	100

About five points are usually allowed under "operating experience" for two or three years of amateur experience, or for wireless school training. The highest grade that the applicant can make, therefore, is 85; and since 75 is the minimum passing mark for the first class license, it will be seen that the candidate must have his technical knowledge pretty well in hand to get by successfully.

It is important to answer all the test questions precisely. In the course of an examination for an extra first class license, I found this among the questions on transmitting apparatus: "What does a condenser consist of?—or something to that effect. In answer, I wrote out quite a lengthy treatise, describing in detail every kind of condenser used in radio work that I had ever heard of,—Leyden jar, oil, mica dielectric, compressed air, open rack, paraffine paper, and, for good measure, three types of receiving variables. The answer complete filled five typewritten pages.

When the radio inspector checked my examination papers, however, he nicked half a point from a possible total of two points allowable for a satisfactory answer to the question about condensers. Wondering at this, I ventured to ask the inspector what flaw he had found in my 1500-word essay on condensers; to which he replied: "You didn't answer the question in the right way; you should have said simply that a condenser consists of two conducting surfaces separated by an insulating medium of sufficient dielectric strength to withstand such potentials as may be applied to it." Although I said nothing, I thought a few things, as may be imagined. I emerged from the examination with a grade of 98, however; and so I am sure that in the long run the radio inspector gave me a good deal.

In the radio inspectors' offices, the entire examination is written; there are no oral questions. It has, however, been a practice in the past in some of the navy yards where license examinations

Continued on page 60

The Code and Its Difficulties

By Carlos S. Mundt

The romance of radio lies not in the radiophone concert but in the "dah dit" of the code messages whose staccato notes so bewilder the novice. To learn the code requires patience to the nth degree, but, once mastered, a new world is opened up to the listener-in. These suggestions from a practical teacher should prove most helpful to the beginner.

BOTH wire and radio telegraphy may be defined as means of transmitting intelligence by means of a prearranged code, each letter and number of which is made up of a combination of the two radio code elements, the dot and the dash. The dot is caused by depressing the signalling key for an instant, while the dash is made by holding the key down somewhat longer, usually for three times the length of a dot.

The code in practically universal use in radio work is the "Continental" or "International Morse" as distinguished from that used in wire telegraphy, the Morse. Although slightly slower, the Continental has for its basis all distinct combinations of dot and dash inclusive of four elements in the case of letters, and of five elements in the case of numbers and certain conventional signs, the space being reserved as a separation element. Here is the Continental Code arranged according to *classified* formations:

GROUP I (*Dots only*)	GROUP II (*Dashes only*)
- E	— T
- - I	— — M
- - - S	— — — O
- - - - H	— — — — *
- - - - - 5	— — — — — 0

GROUP III

EQUALS REVERSED

Dot Beginning	*Dash Beginning*
- — A	— - N
- — — W	— — - G
- — — — J	— — — — - *
- — — — — 1	— — — — - 9
- - — U	— - - D
- - - — V	— - - - B
- - - - — 4	— - - - - 6
- — - R	— - — K
- — — - P	— - - — X

GROUP IV

Mixed Fours

- - — - F	- — - - L
— - — — Y	— — - — Q
— — - - Z	- - — — *
— - — - C	- — - — ,

GROUP V

Mixed Fives

- - — — — 2	— — — - - 8
- - - — — 3	— — - - - 7

*Utilized in foreign language.

A careful count will show thirty-six separate combinations utilized for the twenty-six alphabetical letters plus the ten numerals.

Recognition of these code combinations must, in the case of both wire and radio telegraphy, be an oral rather than a visual process. The method of visual instruction has been given much prominence by educators during recent years. But, while admirably suited to certain educational instruction, it must of necessity fail here because of the inherent dependence upon *sound* in telegraphy for the conveyance of intelligence. Hence we are forced to accept the oral method of instruction and to point out the principles involved, as well as to suggest any aids or short cuts which may lighten the task.

Various persons are susceptible to varying degrees of oral instruction. This is just as true in teaching a child to associate the sound of a word with the word as it is in teaching code. But

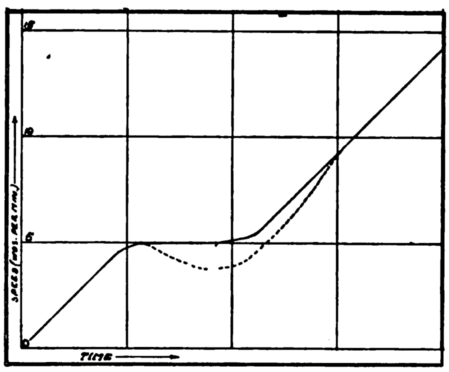


Fig. 1. Curve of Learning

we may tabulate statistical data on learning progress and attempt to draw conclusions from the graph resulting. Figure 1 is a fairly average portrayal of the analysis. We find the vertical axis scaled to represent the speed in words per minute, while the horizontal represents progressive time. A casual inspection of the curve will convince the reader of three outstanding facts, viz.: (1) In the earlier stages of code learning there is fairly even and rapid progress; (2) After reaching a speed of from four to six words per minute (depending upon the individual) there is a retardation of progress, or even a retrogression (dotted); (3) After some time the early progress is resumed. Now, if we are able to put special effort and increased care on the difficult stage (that noted under (2), we may in a large measure make this stage at least shorter in duration.

The trouble noted in (2) is in all probability due to the time element entering into the motor response at that stage. The ear detects the sound, transfers the impulse to the brain, where it is analyzed by association. However, by the time such a speed has been reached as now considered (four to six words per minute) the motor response is increasingly difficult, due to the character elements coming *faster* and *too fast for individual recognition.* Here for the first time the brain must *associate* "dah-dit with 'N' instead of saying "one dash and one dot makes N." *All* character combinations must be recognized each as a *sound group* belonging to a letter. "Sound swing" is difficult to define, but roughly it is the distinguishing sound sequence which makes "dah-dit" sound apart from "dit-dah."

We will now give suggestions for code work which are based upon the experiences of many and which are intended to lighten the task by avoiding unnecessary difficulties.

(1) Do not attempt the whole set of thirty-six characters at once. Rome was not built in a day, so they tell us. Neither was a whole code learned perfectly in a wholesale fashion. A good plan is to begin on the dot letters (group I) and the dash letters (group II). First try the groups separately to distinguish them among themselves. Then mix them, perhaps making simple words, such as the following:

HOT IS HIS MOS ITS SET SO TOM HIT MISS 5 TIES MET TIS. HE SHOT

(2) There is some disagreement as to what is the next step. Perhaps the safest thing would be to introduce additional characters only as fast as warranted. The easier ones of Group III ought be brought in before any others. Group V can be well left until the last.

(3) Similar sound combinations, such as S, H and 5, often give continued trouble. Steady practise, first on them alone and later mixed with others, will help.

(4) Indeterminate dot letters, especially from the "equals reversed" often give trouble, the 4, V, 6, B, 7 and 3 being the worst offenders. Again, special practise with emphasis on the "sound swing" will help.

(5) Certain of the "equals reversed," such as W and G, give difficulty in a few cases. Treat as above.

(6) Mixed forms cause a great deal of trouble. Q, Y, F and L are examples. Treat as above.

(7) In addition, remember that receiving slightly *faster* than you are able means faster progress. Remember to practise sending to yourself, as this helps fix the characters in mind. Never work

Continued on page 64

A Four Bulb Radiophone Transmitter

By Francis J. Andrews

GOOD results have been secured by the writer with four 5 watt tubes in a circuit adapted from one used by the U. S. Army during the war. When properly tuned it will transmit voice and music 100 miles or more.

The most important thing is the antenna system. No matter how efficient the transmitter may be, it is absolutely useless unless a proper antenna is used. For use with this transmitter, a "T" type antenna at least 40 feet high is recommended. The flat top should be 100 feet long with 2 feet spacing between wires. Seven strand phosphor bronze is recommended. Several water-pipes should be grounded together by means of a No. 4 stranded insulated wire. Also for the best results, a counter-poise should be erected directly under the antenna, a few feet from the ground. The counter-poise should be slightly larger than the antenna and thoroughly insulated from the ground and antenna. The lead-in from the counter-poise should be connected to the ground side of the set.

For lightning protection, the usual means of grounding an antenna should be employed, and a vacuum tube arrester and a single pole, double throw, 600 volt, 100 ampere switch should be used.

LIST OF MATERIAL FOR THE CONSTRUCTION OF THIS SET

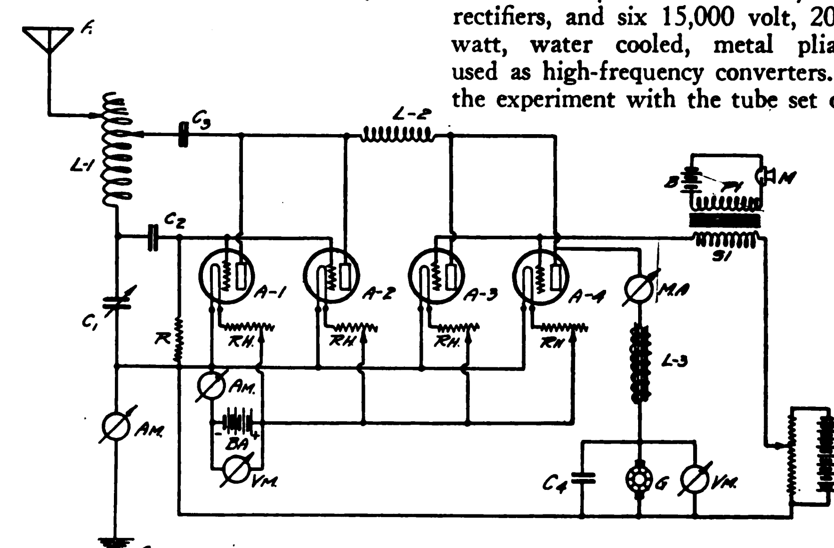
- 1 oscillation transformer, approximately 25 turns.
- 1 antenna ammeter, thermo-couple type, 0 to 3 amperes.
- 1 voltmeter, 0 to 500 volts, d.c.
- 1 voltmeter, 0 to 15 volts, d.c.
- 1 ammeter, 0 to 12 amperes, d.c.
- 1 milliammeter, 0 to 300 milliamperes, d.c.
- 1 variable condenser, .002 mf.
- 2 C. W. transmitting condensers, .002 mf.
- 1 C. W. transmitting condenser, .1 mf.
- 1 grid leak, 10,000 ohms.
- 1 plate circuit reactor or choke, 300 milliamperes.
- 1 honeycomb coil, L 50.
- 1 microphone, ½ ampere capacity.
- 4 dry cells.
- 1 potentiometer, A battery type, 300 ohms.
- 1 B battery, 22½ volts.
- 1 motor generator, 500 V d.c., 50 watts.
- 4 rheostats, 4 amperes capacity.
- 4 vacuum tube receptacles.
- 4 five-watt vacuum tubes.
- 1 12-volt storage battery.

Either a panel of bakelite or well seasoned wood, 18 in. by 30 in., may be used. The instruments should be connected up according to the diagram. The arrangement of the instruments on the panel is left to the taste of the builder. Remember that in laying them out on the panel, care should be taken to see that the instruments are so located as to make only a minimum amount of connecting wires necessary. No. 12 soft drawn copper wire and spaghetti insulation is preferably used and all connections must be soldered.

How to Tune the Transmitter.

1. Light the oscillator tubes until the ammeter registers 4½ amperes, and the small voltmeter shows 7½ volts.
2. Start the motor generator and wait until it builds up to 500 volts.
3. Fix the tap leading from the plates to the oscillation transformer at some point on the oscillation transformer. Then vary the antenna tap, and vary the plate tap until the antenna ammeter and milliammeter read maximum current. The variable condenser should also be varied to obtain maximum antenna current.
4. Light the filaments of the modulator tubes, until the ammeter shows 9¼ amperes and the small voltmeter remains fixed at 7½ volts.
5. Retune the plate and antenna circuits for maximum current.
6. Speak into the microphone and at the same time vary the potentiometer and note when the greatest deflection of the milliammeter and antenna ammeter takes place. Then leave the potentiometer on this adjustment.

Note: It would be well to have another operator listen-in while you are tuning up the set and inform you as to the quality of the transmitted speech.



Hook-Up for Four-Tube Radiophone Transmitter

URUGUAY PASSES FAVORABLE RADIO LEGISLATION

Recent modification of the rigid laws governing the installation of wireless telephone and telegraph stations have made possible the installation of radio broadcasting, according to Vice Consul Edwin B. Montgomery of Montevideo. Applications are now pending which, if granted, should mean the opening of a splendid market for radio telephone receiving apparatus in Uruguay.

V. T.s FOR TRANS-ATLANTIC TELEGRAPHY

An experimental, high-powered tube set at Radio Central, Rocky Point, L. I., is handling commercial trans-Atlantic traffic with Great Britain and Germany, on a wavelength of 19,000 meters. The set is, for the time being, composed of three 50 kilowatt, 15,000 volt, water cooled, metal kenetrons, used as rectifiers, and six 15,000 volt, 20 kilowatt, water cooled, metal pliatrons, used as high-frequency converters. For the experiment with the tube set one of the new mile and a half long antennae suspended from six towers, 426 feet high, of the Rocky Point Station, was used, and the tube set succeeded in developing and sustaining in the antennae a current strength of 350 amperes.

So successful was the set in the initial experiment that the operators controlling the automatic sending keys at 64 Broad Street in New York City did not know that they were controlling a tube transmitter rather than an alternator until after the test was completed.

The Radio Corporation also announces a service which enables the public to send messages to London and Germany at a rate slightly higher than postage. The rate announced is six cents per word with no minimum requirement. It will be possible hereafter for individuals and business houses to send messages of as few words as three or four at the fixed rate of six cents for each word, as for instance, "All well" would cost only twelve cents plus charges for address, and signature, if any. A message may be filed any day in the week up to Saturday with the designation "Radioletter" or its abbreviation "RL" and it will be transmitted in time to reach London or Germany the following Monday morning. While registered code addresses are acceptable, the text of the message is restricted to plain language only. The new service is called the "Radioletter Service."

Simplified Theory of the Federal Arc Transmitter

By V. Ford Greaves, Engineer Federal Telegraph Company

SOUND, light and radio telegraph signals are carried by means of waves which, for purposes of general illustration may be represented by simple diagrams. Waves are divided into two classes, called "damped" and "undamped."

Damped waves are those which, once started, either quickly or gradually decrease in size or amplitude until they die out entirely. When the head of a drum is struck all that is heard is a thump. The sound waves quickly fade away and are therefore called highly damped. On the other hand, when a tuning fork or piano-string is struck, a musical tone is heard which gradually dies out. Such waves are said to be slightly damped. Another analogy is that of the child in the swing. If the swing is pulled back once and then permitted to "die out," the oscillations will gradually decrease until the swing comes to rest. Such oscillations would be classified as slightly damped.

Undamped waves are those which are maintained in size or amplitude and are sometimes called continuous. Light waves are continuous or undamped. When the string of a violin is uniformly rubbed with a bow, a clear musical tone is heard, which does not fade away as in the case of the piano-string. Instruments similar to the violin, and wind instruments, produce undamped waves. Now coming back to the child in the swing, we all know that if a second person stands behind the swing and gives it a push each time it comes back, the swing will continue to oscillate at its maximum amplitude. In this case these continuous oscillations would be classified as sustained or undamped. In music, as in radio telegraphy, sustained or undamped waves are recognized as being superior to damped waves, for one reason among others, that they have better carrying qualities.

Spark transmitters produce damped waves, while the Federal arc is a generator of continuous or undamped oscillations. In addition to this advantage, the arc transmitter is much more simple in construction and operation. These differences in the characteristics of waves and electrical circuits are clearly shown in the accompanying diagram.

The spark transmitter consists of the following main units:

S A source of low voltage alternating current.

T A transformer for increasing the voltage.

C A condenser for producing damped oscillations.

SG A spark-gap for the condenser to discharge across.

OT An oscillation transformer so that the oscillations in L_1 can be transferred to the antenna through L_2.

A The antenna.

G The ground connection.

The Federal arc transmitter consists of the following main units:

S A source of direct current of low voltage.

CC Choke coils or inductances.

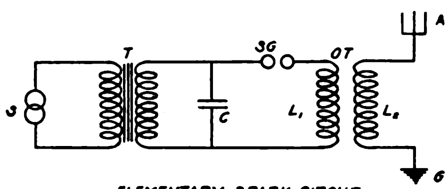
R Resistance.

ARC The arc.

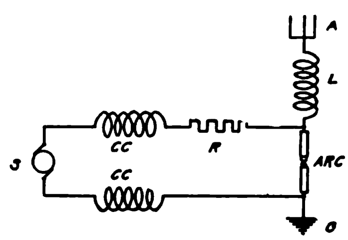
L An inductance for changing the wave-length.

A The antenna.

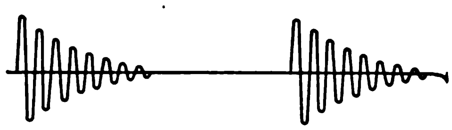
G The ground connection.



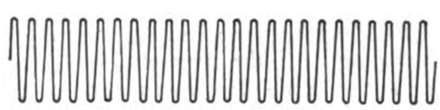
ELEMENTARY SPARK CIRCUIT



ELEMENTARY ARC CIRCUIT



DAMPED SPARK WAVES



UNDAMPED FEDERAL ARC WAVES

Characteristic Waves and Electrical Circuits

The typical spark transmitter starts with low voltage alternating current. The voltage is then increased by means of a low-frequency transformer. The high voltage charges the condenser, which in discharging across the spark-gap through the inductance L_1, produces a high frequency alternating current, the oscillations of which, however, are damped. Then, by means of the oscillation transformer, an alternating current of high frequency is set up in the antenna circuit, a part of which is radiated in the form of damped waves.

The Federal arc transmitter starts with a low voltage direct current and produces a high voltage alternating current directly in the antenna circuit, a part of which is radiated in the form of undamped or continuous waves.

Considering again the analogy of the swing, the difference between spark and arc transmitters can be illustrated by two methods of swinging the child, one inefficient and round-about, and the other efficient and business-like. In the first case, which we will compare to the spark transmitter, the person gives the swing a push and then sits down until the swing comes almost to a stop. He then jumps up and gives the swing another push, and so on. In the second case, representing the arc transmitter, the person stands firmly behind the swing and gives it a push each and every time it comes back.

Alternating current is used as a primary source of power in spark transmitters for the reason that it is more satisfactory from an engineering point of view, than direct current interrupted, although direct current can be used. Direct current flows or pushes in one direction only when it is moving. Direct current does not necessarily flow continuously, as is sometimes thought, but can be stopped and started at will.

Our analogy of the swing can be used to illustrate how the Federal arc changes direct current to alternating current in such a simple manner if we consider the case where the person pushes the swing each time it comes back. The swing oscillates forward and backward from its normal position of rest. These oscillations or alternations may be taken to represent an alternating current of electricity. The person pushing the swing always pushes forward when the swing is traveling forward; it coming back of its own accord. Therefore, the person may be taken to represent an interrupted direct current, always pushing in the same direction at intervals. So it is with the arc. The direct current is interrupted by the action of the arc in exact time with the alternating current in the antenna and every other alternation is given a push of just the right amount and at just the right time to keep the oscillations going to full amplitude and we get undamped waves.

We shall now consider what takes place within the circuits of a Federal arc converter. The phenomena is, of course, almost instantaneous, but in order to analyze the various relationships they must be treated as occurring very slowly. It will be understood that the antenna and ground are equivalent to inductance and capacity in series forming the well-known "dummy antenna." Therefore, for the purpose of this explanation, we will substitute an inductor and condenser in series across the arc in place of the antenna and ground connections.

First consider the simple arc circuit alone without the inductor and condenser being connected. The direct current from the primary source flows across the arc in one direction and maintains a steady flame as long as the current is uniformly applied. The resistance of the arc varies if the flow of current is varied. Increasing the current decreases the resistance, and *vice-versa.* Now, referring to Ohm's law, it will be seen that the voltage, measured across the arc, will also vary if the flow of current is increased or decreased. Therefore, it may be stated that the voltage across the arc varies inversely as the current, or in other words, if the current is decreased from any cause the voltage will increase and *vice-versa.* Having this law firmly in mind, we will now connect the inductor-condenser circuit across the arc.

Immediately the direct current from the primary source will start to flow in this new circuit in an effort to charge the condenser. It can readily be seen that this amount of current will be subtracted from the arc circuit with the result that the voltage across the arc is increased, which causes more current to flow in the condenser circuit and so on, until the condenser is overcharged, due to the inductance of the circuit, which phenomenon is similar to inertia of solids in motion.

The condenser now discharges in the reverse direction across the arc in the direction of the arc current and again overcharges the condenser in the opposite direction, due to inertia. The next condenser discharge is then in a direction opposed to the local arc current, with the result that when the opposed currents become equal in value the arc is extinguished and de-ionized by the magnetic field. The condenser discharges and is again recharged by the supply current to the point where the voltage is sufficient to reignite the arc and the cycle of operations is repeated. This phenomenon, when established, results in a smooth alternating current in the output circuit having a frequency dependent upon the values of the inductance and capacity employed.

Metallic substances, when heated, give off a metallic vapor containing ions. Soft substances, such as copper, carbon and zinc, under the intense heat of an electric arc, release a great number of ions, so that the space or gap between the terminals is heavily ionized. Any space or gas which is heavily ionized becomes a low resistance conductor of electric current. Ionized gas is very sensitive to the influence of a magnetic field.

It has been stated that the arc terminals are placed in a strong transverse magnetic field, that is, magnetic lines of force are set up at right angles to the flow of current and ions across the arc. This magnetic field assists in extinguishing the arc quickly and restoring high resistance across the gap by throwing the ions out of the arc path, which allows the condenser or antenna circuit to become fully charged.

Referring again to the swing analogy, we know that the push on the swing must be delivered at the right moment and be of the proper duration. These conditions vary with different lengths of swings. It is the same with the arc. The arc must be extinguished at the proper moment and for the proper length of time, according to the wavelength. The wavelength corresponds to the length of the swing, therefore the strength of the magnetic field, and hence the speed of de-ionization must be varied with any change of wavelength. The magnetic field must be increased as the wavelength is decreased, in proper proportion to produce stable operation of the arc.

The arc terminals are surrounded by hydrogen gas to further assist in the de-ionizing process as the high velocity of the hydrogen ion assists the magnetic field. The hydrogen gas also helps in cooling the electrons by virtue of its high heat conductivity. The electrodes are further cooled by means of running water.

Under normal operation an ammeter in the alternating current or antenna circuit will indicate .707 times the ammeter reading in the direct current supply circuit. This ratio, namely $\frac{1}{\sqrt{2}}$ also applies to the corresponding voltages resulting in a theoretical electrical efficiency of 50 per cent for a modern Federal arc converter. This efficiency is nearly realized in practice with large units.

Radio in Australia

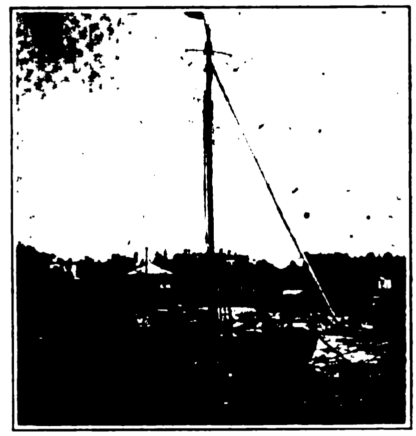
By L. S. Lane

THE radio fan in Australia is faced with regulation which, when compared with those of America, are almost prohibitive. Despite official setbacks, however, there are several radio clubs and a small number of transmitting sets, both radiophone and telegraph, in operation.

To erect a receiving set, crystal only, it is necessary to obtain a license. This costs the equivalent of $5.00. If a valve receiving set is desired, the same fee applies, but in addition it is necessary for the amateur to pass a receiving test of twelve words per minute. Transmitting permits are rarely issued to individuals, only about 12 transmitting licenses having been issued to individual amateurs in the whole of Australia. On the other hand, radio clubs have little difficulty in obtaining these much sought after documents, nearly every club having one.

Radio broadcasting is just becoming popular in Australia, though at present there are only two stations giving regular programs, and in each case only once a week. As regards broadcasting waves, conditions are superior to those ruling in the United States; the waves in use at present are 1100 and 1400 meters. The radio clubs are, however, usually confined to the 200 meter wave. The power of amateur transmitters is limited to 250 watts.

There are several healthy indications that conditions are being improved, and irksome regulations relaxed. Recently the annual license fee was reduced from ten to five dollars. A semi-official promise has been made by the prime-minister that he will follow the lead of Great Britain, and make the obtaining of a license much easier. At present it takes about three months to obtain a license.



Radio Yacht "Kestrel"
Moored at Williamstown, Victoria.

The newspapers and commercial firms are awakening to the possibilities of radio, and some are only awaiting official sanction before commencing the erection of broadcasting stations. A weekly magazine solely devoted to radio has made its debut and received a hearty welcome from the enthusiasts.

A Sydney amateur has succeeded in telephoning to New Zealand, a distance of about 1100 miles, using nine watts. This was received on a regenerative receiver using only one valve.

As regards developments in commercial radio, arrangements have been made by the Amalgamated Wireless, Ltd., for a vacuum tube station intended for direct communication between Australia and England. This distance of 12,000 miles will represent the longest commercial radio service in the world. Prior to the departure from Australia of the director of the company he agreed to write a series of articles for the Sydney *Daily Telegraph.* These articles were written on board the *Sophocles,* transmitted 500 miles by radio to Perth Station, and then mailed to Sydney, where they were duly published.

A New Radio Frequency Amplifier

By E. M. Sargent

This constitutes the entry winning the second prize in the radio frequency amplifier contest which closed October 15, 1922. It is followed by the third prize winner. The fourth prize winner will be published in January RADIO.

WINNERS OF RADIO FREQUENCY AMPLIFIER CONTEST

1st Prize—H. E. Parsons, Can. 5EH (Published in November RADIO).

2nd Prize—E. M. Sargent, 6SC (Published in December RADIO).

3rd Prize — W. J. O'Neill, 9CJX (Published in December RADIO).

4th Prize — Robt. Kerrigan. Will be published in January RADIO.)

A FEW of our eminent citizens at one time or another purchase the Statue of Liberty, the City Hall, or the Ferry Building; others chase the pot of gold at the end of the rainbow, while still others try to get results with a radio frequency amplifier. Your humble writer belongs to class three.

It was about three years ago that this marvelous, new cure-all for receiving trouble first attracted serious attention. If there were a spark coil transmitter in the house next to you and you wanted to receive through it, your local radio engineer would say—"Use radio frequency." If the mosquitoes got too thick and your pipe wouldn't keep them away,—put in radio frequency. No matter whether it was a grounded antenna, a run-down B battery, or ulceration of the wavelength,—"try radio frequency" never failed to inspire the poor victim with new hope.

The writer fell for this new myth along with everybody else, and sunk a good sized chunk of cold cash into apparatus to try it out. There is no need to detail here the building of that first outfit, to tell of connecting it to a loud speaker to prevent possible injury to the only pair of phones,—and to relate the "results" that were obtained. Suffice to say that it was only because of the size of the financial investment that experiments were continued along these lines, and that is probably the reason why it was finally discovered that when used properly radio frequency is a valuable asset to the long distance receiving amateur.

At one time or another, the writer has tried nearly every known form of radio frequency amplification. The set about which this article is written is the one that has proven to be the best of all that were tried. The article deals only with specific cases in which certain distances have actually been covered, and the reader is left to draw his own comparisons with his receiving set and the results he gets.

THE AMPLIFIER

What a radio frequency amplifier will not do:

1. It will not increase the strength of signals from nearby stations.
2. It will not, in itself, eliminate or reduce interference or static. On the contrary, when used with an overhead antenna, it usually increases both.

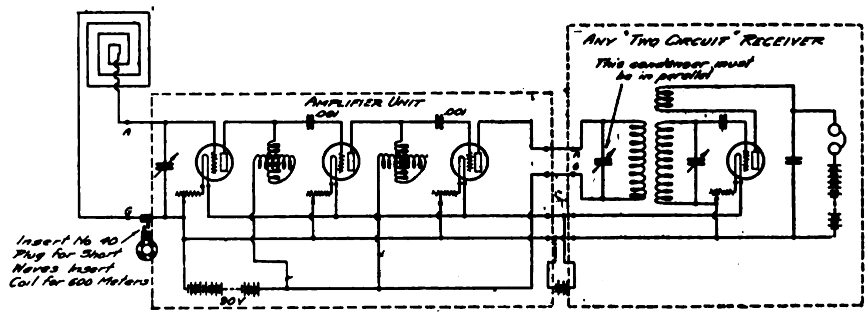


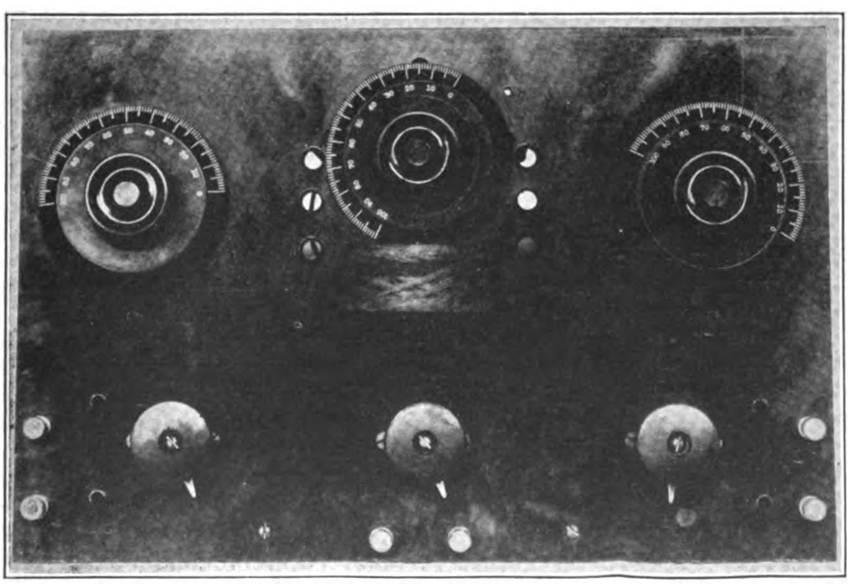
Fig. 1. Circuit Diagram for Radio Frequency Amplifier

LIST OF MATERIAL

3 Paragon Sockets
3 Paragon Rheostats
1 No. 40 Coil Plug (short circuited)
2 .001 mfd. Fixed Condensers
3 C-301 Amplifiers
2 Cymo Variometers
1 Penn 23-plate Condenser
2 45-Volt "B" Batteries
1 No. 42 Panel Plug
1 50-Turn Honeycomb

What a radio frequency amplier will do:

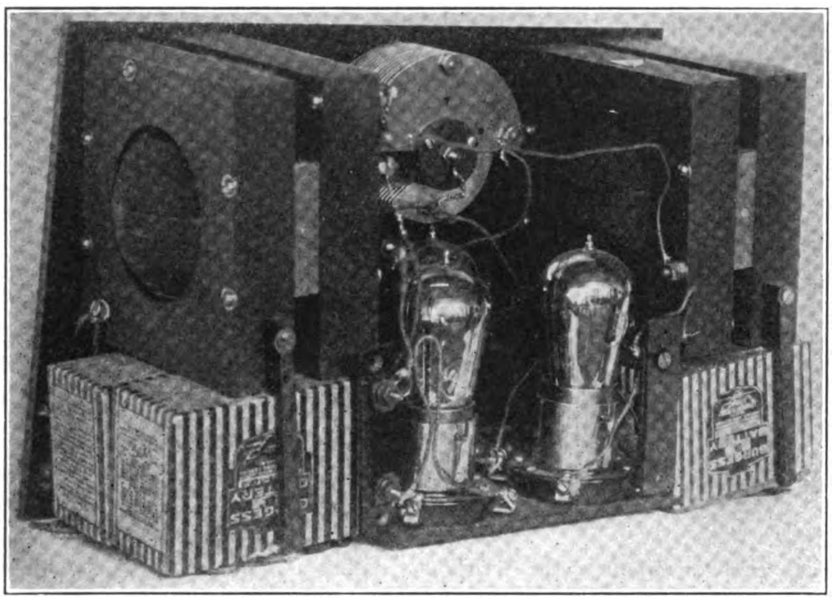
1. It will increase the strength of signals from distant stations and will also increase both the day and night distance over which signals can be received.
2. It will permit the amplification of weak or moderate signals with no corresponding amplification of tube noises.
3. It makes possible the use of loops and other directional antennae which greatly reduce static and interference.
4. It prevents the regenerative receiver with which it is used from radiating any energy out into space through the antenna. This energy radiation from receiving sets is a troublesome problem in many of our cities and the radio frequency amplifier offers a possible solution.



Radio Frequency Amplifier Panel

Fig. 1 shows the circuit of the amplifier. Notice that the amplifier can be used with any "two circuit" regenerative or non-regenerative receiver. It is only necessary to change the primary condenser of the receiving set from series to parallel. Variometers are used for radio frequency amplifying transformers. This does away with the necessity for a potentiometer and allows adjustment for maximum signal strength for each wavelength. The two grid condensers are to keep the plate voltage off the grids. They should be .001 mfd. or larger. The use of grid leaks is optional, none being shown in the diagram. The honeycomb coil is for loading the loop to 600 meters. This should be short-circuited for operation on the lower wavelengths.

The amplifier can be used with an overhead antenna, although this is a doubtful advantage. The antenna and ground are connected in place of the loop and the proper honeycomb coil inserted for the wavelength. When used in this way, 600 meter signals from distances of 500 miles or more will be amplified so much that they will "spill" the detector bulb. Consequently, the interference is so bad that this arrangement is of very little practical value.



Rear View of Radio Frequency Amplifier

Operation

The operation of this outfit is remarkably simple, much more so than the diagram indicates. To receive a given wavelength, first tune the regenerative receiver secondary to the wave. This setting is usually known from experience. Then tune the receiver primary until a resonance click is heard. Next set the two variometers in similar positions and rotate both together until some signal is heard. Then adjust the variable condenser in the loop or antenna circuit for the loudest signal. After this, the exact positions of the two variometers can be found. When the amplifier has been adjusted in this way, it can be left alone and the regenerative receiver operated independently over a small band of wavelengths. This feature greatly simplifies the operation of the set. The amplifier can be calibrated for different wavelengths, and after it has been set for a wave, the regenerative receiver is tuned exactly as if it were directly connected to the antenna.

Care must be taken that the amplifier tubes are not allowed to oscillate. If the variometers are turned too far there will be a click, after which the set will suddenly be silent. The click indicates that one of the amplifier tubes is oscillating, and the oscillations are being amplified to such an extent that they paralyze the detector. The best setting for the variometers and also for the condenser around the primary of the regenerative receiver, is just before this click. It will be found a great advantage to shield both the amplifier and the receiving set. The rheostats are not critical on any of the tubes.

This amplifier was given a thorough test with a loop 18 in. square, consisting of 16 turns. This was found to be about right for 360 meters. For 600 meters, a 50-turn honeycomb coil was connected in series. The regenerative receiver used was one that compared favorably with the Grebe CR-8. No audio amplification was used.

The receiving station was located in San Francisco. Between the hours of 8:00 and 8:30 p.m., the broadcasting station KLP at Los Altos, 30 miles south of San Francisco, was in operation. It was found that by setting the loop in the right position, this station could be entirely cut out and signals from KZN, in Salt Lake City, brought in with fair audibility. This is a distance of 800 miles, and is a feat in the elimination of interference that would be impossible on an overhead antenna. A little later in the evening, KLP gave way to KDN, Fairmont Hotel, San Francisco. This station was four miles due east of the receiving station. Signals from this station were completely eliminated and KOG and KUY in Los Angeles picked up.

The selectivity of the loop seemed confined almost entirely to phone and C. W. signals. On sparks, while the signal strength varied a good deal with different positions, no position was found that would completely cut out any of them. Between the hours of 2:00 and 4:00 a.m. recently, the following stations were copied with the loop on 600 meters. No audio amplification was used:

VAE—Pt. Estevan, B. C.; 800 miles—strong.
NPD—Tatoosh, Wash.; 750 miles—strong.
KOK—San Pedro, Cal.; 370 miles—strong.
NPQ—St. Paul, Alaska; 2400 miles—good.
KHK—Hawaiian Islands; 2100 miles—weak.
NPM—Hawaiian Islands; 2100 miles—fair.
JOC—Otchishi, Japan; 5100 miles—weak.
JCS—Choshi, Japan; 5200 miles—good.
Two boats in Alaska waters—2000 miles—strong.
One boat off Central America—1700 miles—fair.
Two boats off Japan—4500 miles—strong.

Had the radio amplifier been connected to an antenna, the signals would have been many times louder and, interference and static permitting, would have been received with greater audibility than on a detector and three-stage audio amplifier. In this circuit, the tube is more efficient as a radio than as an audio amplifier.

WINNER OF THIRD PRIZE

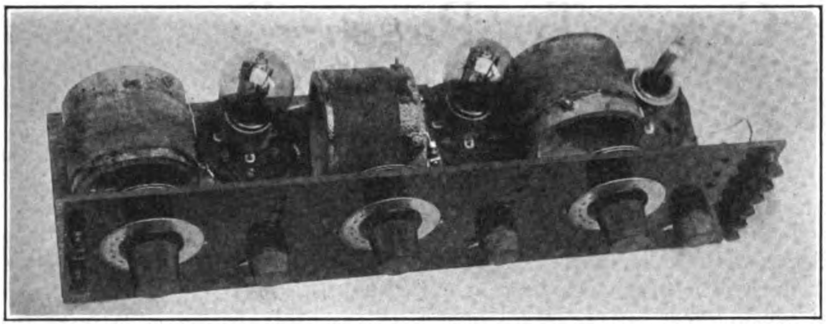
By William O'Neill

The construction and operation of a radio frequency amplifier presents many new features to the average amateur, who, although he has many circuits, etc., for—r.f. has not the firsthand information available about construction and operation. The set described is my idea of the best all-around type that I have had experience with.

It has a minimum number of parts and variable controls which means simplicity and economy and gives maximum amplification per stage, (about twice that of either an untuned air core or an untuned iron core transformer). In regard to simplicity I might say here that if more than two stages are employed the coupling impedances may be mounted on the same shaft or otherwise simultaneously controlled.

The set is a complete unit containing two tuned impedance direct coupled amplifiers and a detector. The antenna input can be taken directly in at the terminals of the tuning condenser of the first stage if desired, although a small coil in series with a large capacity condenser gives much better selectivity.

If a loop is used it should be made of sufficient inductance to dispense with



Radio Frequency Amplifier Built by W. J. O'Neill

the coil normally in shunt with the condenser.

Though unnecessary for code reception, care should be taken to operate the amplifiers at the middle of the straight part of the curve by using proper plate voltage if distortionless voice is expected.

With a single 200 ft. wire aerial I have used coupling of 1½ to 2 ft. with the primary and secondary at right angles, giving extremely fine tuning.

The apparatus may be built into a panel for use with a separate detector or built up on a board for experimental purposes if desired.

The circuit used has been found superior to several others, including the "semi-tuned" intervalve transformers, circuit in which inductive coupling is used between stages with either primary or secondary tuned. If both primary and secondary are tuned the same signal strength and better selectivity result, but the double number of controls necessary usually does not compensate for the advantages.

Tuning spark signals is similar to the familiar three-circuit regenerative set with the exception that all three dials must be set in approximately the same order to transfer through the successive stages. With C. W. the best notes are produced by the autodyne action of either of the amplifiers. This is done by tuning the plate and grid circuits in the same manner as in the ordinary tuned plate sets.

The set is soldered throughout with No. 14 bare wire in order to reduce undesirable capacity effects.

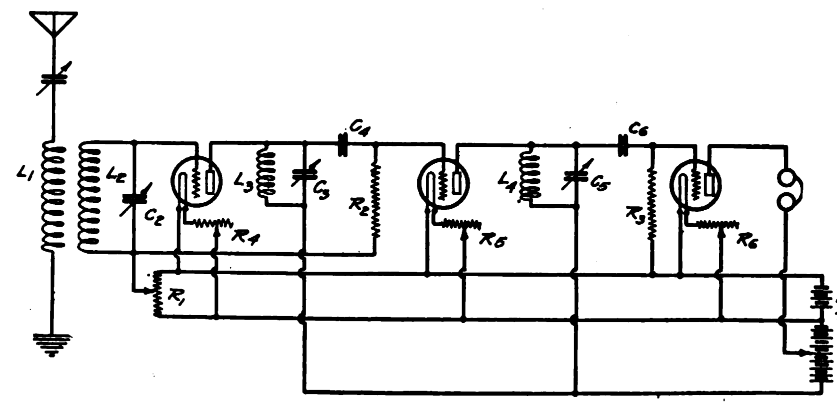
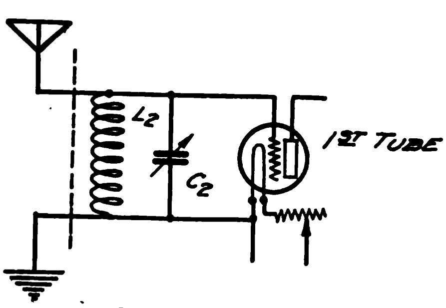


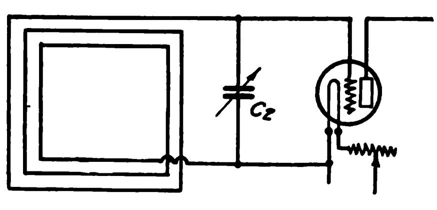
Diagram of Connections for Two-Stage R. F. Amplifier and Detector

C_1—.001 mf. C_2—.0003 mf. C_3—.0003 mf. C_4—.00019 mf. C_5—.0003. C_6—.00025. R_1—200a. R_2—1½ megohm. R_3—½ megohm. R_4—1½ w. R_5—1½ w. R_6—6 w. L_1—40 turns No. 22 d.c.c. on 3-in. tube inside of L_2. L_2, L_3, L_4—65 turns on 3½-in. wood form. Tapped at 40 and 50 turns.

As to the tubes used for radio frequency amplification A-P amplifiers and Myers and Western Electric VT-2s are best, though the latter are the more difficult to obtain.



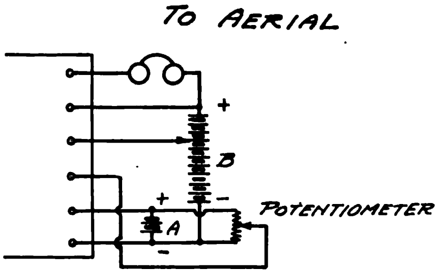
DIRECT CONNECTION TO AERIAL



LOOP ANTENNA

L_2 DISCONNECTED

Methods of Connection



EXTERNAL CONNECTIONS

The following is a list of the materials and cost in this set:

Bakelite Panel—6 in. x 24 in. x 3/16 in.	$ 2.50
Oak Base 7/8 in. x 6 in. x 24 in.	.30
8 Binding Posts	1.75
3 Fada Rheostats	3.60
3 Ga-std. Dials	3.75
3-13 Plate Condensers "Illinois"	6.30
3 Coils	.30
3 W. S. A. Co. Sockets	2.70
2 Grid Condensers—W. E. and GrebeROCB	1.75
2 Grid Leaks	2.00
1 Radio Corporation Potentiometer	2.00
Total	$27.05

From left to right, the instruments in the photo are: Aerial and ground binding posts; inductance in grid circuit of first tube; tuning condenser of same and amplifier tube. The next coil and tube are identical with the first, while the last is the detector. The row of posts are: 1 and 2-phones; 2-pos. amplifier battery; 3-pos. tap for soft detector; 4-potentiometer arm for grid bias control; 5 and 6-"A" battery; 6-negative "B" battery.

RADIO BROADCASTING IN GREAT BRITAIN

"Great Britain will solve the interference problem in radiophone broadcasting by government control and regulation," according to A. P. M. Fleming, C. B. E., manager of the research and educational department of the Metropolitan-Vickers Electrical Company, Manchester, England. Mr. Fleming represented England at the international convention of the Institute of Electrical Engineers and the International Electro-Technical commission at Niagara Falls, just ended.

"We have learned many valuable lessons from the broadcasting experience of the United States." One of the things we have learned is to avoid the establishment of innumerable radio stations, with no plan of co-operation between them. Eight 1½ kw. stations are contemplated and some of these will probably be built this year. These stations will be located in the principal cities throughout the British Isles and will be operated so as to eliminate the chaos usually found where no rules are in force.

"We have no such thing as broadcasting in Britain at present in the sense in which the term is used in America," he said. "Government restrictions have prevented it, on account of the possible interference with the requirements of the navy, mercantile, marine, war services and aeroplane

Continued on page 98

"And It Came To Pass---"

Roundabout Remarks on Radio Remembrances

By Sewell Peaslee Wright

AND it came to pass that in the fullness of time the months wherein static, which is called "X" (and divers other things, though not in print or the presence of ladies!) becometh history, and the cold weather cometh on apace. And every ham, each unto himself, maketh mighty resolves regarding the work to be done this winter. But this merely lendeth atmosphere (saith thou not to thyself words of mockery concerning "hot air," thou who readeth!) to the tale; let us proceed henceforth to the point.

As soon as the first touch of cold weather cometh, a certain ham, who hath had long years of experience, starteth to till the soil for a Radio Christmas. He saith unto his dad that a pair of 5-watters would make a dandy Christmas present, and he letteth his mother know where one buyeth Baldwin phones. His rich uncle is told of the wonders of a Magnavox, and lo, he mentioneth its price, and enlargeth upon his longing therefor.

He telleth his brother frankly that he wisheth a new storage battery for Christmas, and he receiveth a wise smile, which he taketh for an affirmation. Sister he letteth know that his subscription to RADIO is about run out, and that a renewal would pleaseth him mightily. And he looketh over the territory, and he thinketh unto himself, I have missed not one! This Christmas will truly be a radio one, the like of which I have dreamed of for many years. And he rejoiceth exceedingly in the thot.

During the days that passeth when Fall turneth into Winter, and the Yuletide cometh on with a rapidity that scareth Dad's pocketbook into convulsions, and maketh the very small youngsters almost hold their breath in anticipation, he harpeth away on his desires at all times, saying such things as I am glad indeed that I am to get nothing but radio presents this year, and I sure will appreciate my presents this year! And he leaveth catalogs and dealer's ads around with cunning carelessness.

In the fullness of time it cometh to pass that the night before Christmas arriveth on the twenty-fourth of December, and our hero sitteth in front of the fireplace, rubbing his hands in anticipation of the radio Christmas which the next day was to usher in. He fixeth in his mind the words of thanks he will use in expressing his gratitude, and he sitteth there long, thinking kind and joyous thots.

And on the next morning, being Christmas, he ariseth early, yea, he even beateth the alarm clock's clarion note, and he dresseth sketchily and rapidly, and departeth speedily to the lower regions, where he knoweth that his Christmas gifts will be displayed. He shouteth with much glee when the black horn of a Magnavox peepeth out from much tissue paper. He huggeth two 5-watters so tightly that he almost squeezeth the vacuum therefrom. He testeth the new storage battery, and its pep pleaseth him greatly. His Baldwins arouseth admiration and joy beyond expression—he was more than happy; he was fairly oscillating with very gladness. He hooketh the battery and phones and the Magnavox to his set, and turneth on the whole three steps. He picketh up a 'phone station sending chimes, and lo, the volume therefrom was so great that it shaketh the house———. He waketh with a start, as his mother taketh her hand from his shoulder and telleth him to listen to the midnight chimes from a nearby church. It taketh him minutes to realize that it hath all been but a phantasy of the night. He goeth to bed with a hopeful heart, but strange forebodings, for is it not written that dreams go by reverses?

And in the morning he ariseth, even as in his dream, and goeth down stairs likewise — but the likeness between dream and reality stoppeth there with much abruptness.

For when he openeth the packages bearing his name, he findeth that he hath received seven neckties, thirty handkerchiefs (twelve of which beareth his initial in pink silk) five pairs of slippers, Wells' History of the World, in two volumes, a combination garter and sleeve-band set, and fourteen pairs of socks—each pair different in size and color.

YE scribe here draweth the curtain, for it becometh us not to look upon agony of a comrade. Sufficeth to say that the next day the Salvation Army wagon calleth at the door, and the presents goeth into service to be used in a good work.

And if any of ye who readeth these lines hath friends or relatives who rejoiceth in the title of ham or bug, remembereth that to the radio man all things are radio, and rendereth unto him those things that are radio.

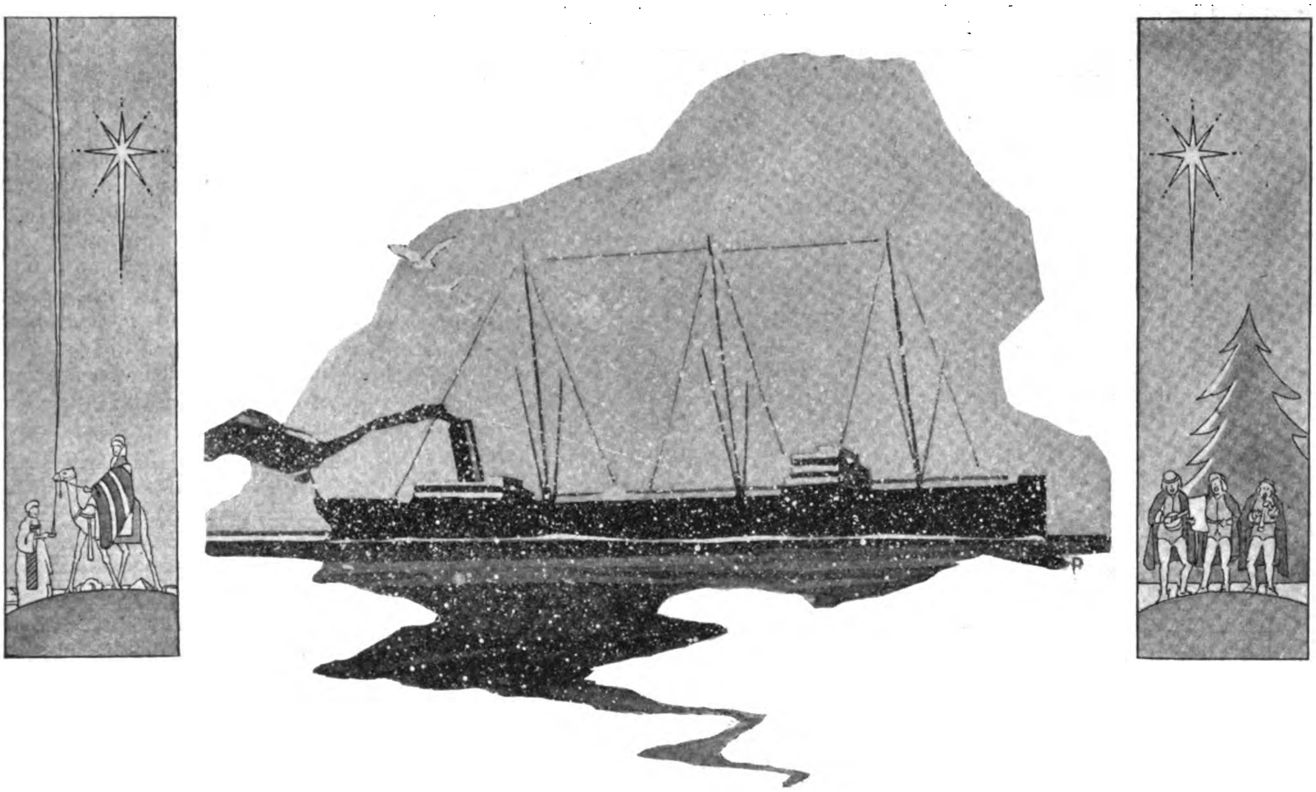
And those of you who wisheth radio gifts for Christmas might marketh this story, and leaveth this issue of RADIO where those who generally remember you will read, and heed. For it is for this latter purpose that it hath been written; ye scribe seriously contemplateth sending carbon copies to some dozen or so himself.

Which proveth that there is a reason for everything—even a yarn like unto this!

RADIO KICK

By O. R. Grissom

This is Radio KICK, the first number is; "it ought to be against the law to have a graphophone in a broadcasting station," second number, will be a good story from some good magazine. Lots of people do not know there are good stories in magazines; we get a little on the side for this. The third number we will number the alph. Numbers are easier to get than letters, giving a man two chances to get the call right where he only had one before. When giving the call letters give corresponding numbers, i.e. KICK, 11-9-3-11.



Christmas Phantoms

by Earl Ennis

WITH her wheel-house slightly awry, and two empty davits on her port side, the tanker *Susan Reynolds* skewered southward through the dull placidity of a copper sea, on the tail of a tropical monsoon. Only the lingering yellow haze along the distant horizon remained as a reminder of the two days of hell in which the vessel had wallowed.

"Bob" Norris, radio operator, arose from the floor where he had been patiently mopping up the spillage from his storage cells, and cursed the judgment that had sent him down along the South American coast, when he might have remained comfortably at home.

"Doddering ass, that I am," he growled to himself. "As English Joe used to say: 'I'm a ripping, blooming, bleeding, bally blighter.' "

Thereupon, having expressed himself like a true American, he thrust the matter entirely out of his mind, and set about washing his hands, whistling a cheerful chantey of the sea, the while. This done, he dropped down before his instrument, and listened briefly for a chance distress call, as required by the regulations.

In the parlance of his craft there was "nothing doing." The whip-crack of the static, omnipresent pest of the tropics, resounded in the receivers. Up the coast, the naval station at Point Loma, argued with a distant destroyer, in the high querulous whine of Uncle Sam's official voice. But on the wave length on which ships usually summoned assistance there was only blank silence.

"Ho-hum," yawned Norris.

He slid one ear out from under the cap of his receivers, opened a drawer and took out a magazine, and cocked his feet up on the table. "Let's see," he went on to himself, "she was about to marry . . . ."

He paused in the act of thumbing the pages . . . . Then he shot bolt upright, the magazine falling unheeded to the floor. With a single motion he fed up his detector lamp, and twirled the condenser knob that gave him his wave-length changes, until the sound that had broken into his reverie came sharp and distinct. It was the bubbling drone of a radiophone's "carrier" wave. Not unusual off the States, but two hundred miles off Southern Mexico, quite another matter . . . . .

"Hello—*Susan Reynolds!*"

The voice broke in his ear. Norris' eyes opened in surprise.

"Hello—*Susan Reynolds* . . . . Call Captain Hamish to the phone, at once, please!"

The operator sat motionless with astonishment. Then he flipped a switch and the generator of his transmitting set hummed into life.

"WWMQ — *Susan Reynolds*—r..r.. received—, who—who?" he snapped back in Continental code, demanding the identity of the other.

The answer that came back was disconcerting.

"None of your damned business," growled the voice. "Get Hamish on that fone—quick!"

There was a surly nastiness about the tone that aroused every grain of fighting instinct in Norris. He glared at his glowing tube as though it had a personal responsibility in the matter. Then his hand sought the key again.

"Listen angelface," he drawled, in precise, staccato code, "if you want to do any business with WWMQ, better cough up a sine!"

The carrier wave was right on his heels, the voice surlier than ever.

"Don't get funny," it said. "I don't have to sine. Better see what Hamish thinks before you pull a bloomer!"

There was a cocksureness about the words that jarred Norris. Furthermore there was a note of menace in them that he did not like. He swallowed his impulse to snap back an insulting retort. Instead he squinted at the instrument. Then, being a very cautious and also a very canny young man, he laid down the receivers and went up on the bridge.

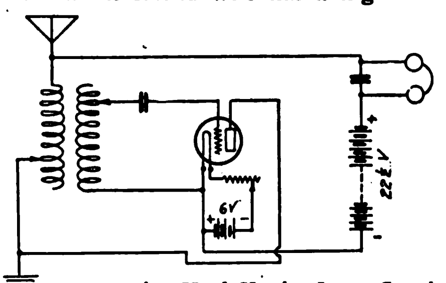
Continued on page 46

A REGENERATIVE HOOKUP FOR THE LOOSE COUPLER AND VACUUM TUBE

By CHAS. R. FRYE

One of the greatest barriers that arise when the ordinary radio enthusiast wishes to change from a crystal to a vacuum tube detector outfit is the price of an efficient tuner. Without a good tuner he knows that he will not get good results, so he usually backs and decides to quit the radio game for life.

If, however, he does get a vacuum tube detector and uses it with a variometer, variocoupler, or tuning coil, he will soon become discouraged because he can not get the distant stations as well as his friend who has a high class



Regenerative Hook-Up for Loose Coupler and V. T.

outfit. If he has a loose-coupler, he may try it in a circuit that is commonly used, but even this will not give him satisfaction.

Now if you happen to be one of these fellows, do not get discouraged because in this article there is a ray of hope. If you have a loose-coupler you can use it as your tuner. If you have not, build one (the navy type is preferred because the scratching is not experienced as it is with the ordinary type when the slider contact passes over the turns of wire on the primary coil).

Here are a few suggestions for building a loose-coupler. Wind 60 turns of No. 22 double cotton covered wire on primary coil and 60 turns of No. 26 double cotton covered wire on secondary coil. Tap primary every five turns and the secondary every ten turns. It is advisable to put secondary coil on rods because if there is any up and down or side motion it is very hard to tune in those distant stations.

The next thing to consider is the detector. If you have a mounted detector you can use that even though you may have to make a few changes. Of course your detector does not have to be mounted, but it seems that having everything behind the panel is the style now. In addition to the loose-coupler and detector you will need phones, phone condenser and batteries.

After hooking up everything according to diagram try to tune in some station that you are familiar with. If you do not get good results at first, do not get discouraged. You probably do not know how to tune your loose-coupler. Since all loose-couplers are not made exactly the same, you will have to experiment a little until you find out how to tune yours. After finding out you will never have any trouble in tuning those far-off stations.

Just to show you the results I get here in Pasadena, Calif., I will mention a few stations that I have heard. They are: KLP (Los Altos), KZM and KLX (Oakland), KDN and KUO (San Francisco), KYG and KGG (Portland), KQW (San Jose), KVQ (Sacramento), KWG (Stockton), and KDYL and KZN (Salt Lake City). I have heard ships up and down the coast and as far away as Hawaii. The near-by commercial and amateur stations come in comparatively as loud as the broadcasting stations.

You may think that my set is an exception, but when I tell you that several boys using this circuit have received these stations, and some farther away, you will know that it is not an exception. The beauty of this little outfit is that it costs very little to construct and gets results that some of those high-class sets do not get.

AUTO TRANSFORMERS FOR AUDIO FREQUENCY

By DONALD K. LIPPINCOTT

MOST articles about the transformers to be used with audio frequency amplifiers contain a statement something like this: "The impedance of the primary coil should be equal to that of the tube with which it is used. The secondary should be wound for the highest possible voltage."

The statement, if I interpret it correctly, means that the designer of the instrument designs the primary circuit according to the ordinary electrical formulas, and then winds on all the wire there is room for and calls it the secondary, the ratio of turns usually being about 1:3½.

The inference from the above near quotation is that a ratio of 1:4½ is about 30% better than 1:3½, and this is very nearly true. What few people realize is that any 1 to 3½ transformer can be converted to the higher ratio with very little difficulty.

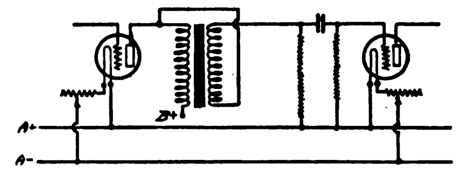
The answer, of course, is the auto transformer connection. The hook-up must be changed a bit too, but no real fan objects to that.

First examine carefully the transformer you intend to convert, and note which binding posts connect with outside and inside ends of primary and secondary winding.

All ready then: Connect the *outside* of the primary winding to the *inside* of the secondary. Then hook up as shown in the diagram. Outside of secondary to grid through a grid condenser. Inside of primary to positive B battery. Common primary-secondary lead to plate.

It will be noted that this hook-up has features in common with both reactance coupled and inductively coupled amplifiers. Its disadvantage is that it frequently requires a grid leak—connect it from the grid to the positive side of the filament, *not* around the condenser, and make it just heavy enough to stop the howl. The pencil-mark type is best because of its easy adjustibility.

There is another advantage in the auto transformer connection beside the increased voltage on the grid, and that is that it responds to a wider band of tones. The reason for this is two-fold. The first is that the closer coupling broadens the tuning. The second is that the core loss and resistance drop,



Auto Transformer Hook-Up

which ordinarily broaden out the primary tuning but have little or no effect on the secondary, are here introduced into the secondary circuit and are utilized both as voltage drop and to flatten out the response curve.

It will be noted that the diagram shows a resistance connected from the outer end of the transformer to the filament, ahead of the grid condenser. This is of the same type as a grid leak, and again the readily adjustable pencil mark is recommended. With the amplifier hooked up, detune until the music is coming in rather faintly. Then make your pencil mark, increasing its density until it begins to cut down the strength of the signals. As heavy as possible without lowering the efficiency —that's the way to leave it. Here again the idea is to broaden the response band and render the music with less distortion.

The amount of additional audibility that the arrangement will give depends on the original design of the transformer and on the tubes with which it is used, but it is an improvement in quality in almost every case.

THE MYSTERY BOX

The W. W. Hodkinson Corporation is about to release "The Mystery Box," a single reel feature produced by J. R. Bray and dealing with radio. This film presents a complete explanation of radio in its closest relation to the average person, and concludes with a prophesy of successful inter-planetary communication. Detailed and valuable information is given concerning all the essential principles of radio, including visualization of apparatus and instruments in use. Along with this there are numerous interesting and amusing episodes in regular motion picture photography which round out the explanation in very realistic and attractive fashion.

Inductance Design

By Jesse Marsten

To figure the inductance of a coil is a task that many amateurs sidestep because of the mathematics involved. Such mathematics as appears in this article is comparatively simple and can be skipped by the reader who is satisfied with knowing "how" without learning "why." The accompanying curves will quickly tell the inductance without lengthy calculations.

FROM time to time there appear in in the radio periodicals various articles dealing with the design of inductance coils. In general these articles take up the matter of the single layer solenoid and develop the standard formulas into very simple, practical engineering formulas facilitating quick design.

These articles point to a definite tendency—the simplification of formulas and design methods to assist the engineer and designer to calculate coils with a minimum of time and effort. However, in these articles the formulas given apply to special shapes and types of coils, and, as there are numerous shapes of coils which the engineer has to design, there will be a multiplicity of formulas, each applying to a definite shape, which makes matters a bit unwieldy and not so easy. Where an engineer has to design spirals, single and multilayer solenoids, multilayer coils having square and rectangular sections, etc., he has the added job of choosing the formula to fit the type of coil in hand, which obviously contributes much lost motion. What is desired is a single formula which is applicable to all shapes of coils with reasonable accuracy.

Such a universal formula for inductances has been developed by Prof. Morgan Brooks of the University of Illinois. The formula holds for all shapes of coils in which the winding is a close one. It is a semi-empirical formula based on the theoretical proposition that the inductance of a coil is a function solely of the amount of wire used and the geometric configuration of the coil. The theoretical formula for the inductance of a coil may be written as follows in terms of the number of turns and the coil dimensions:

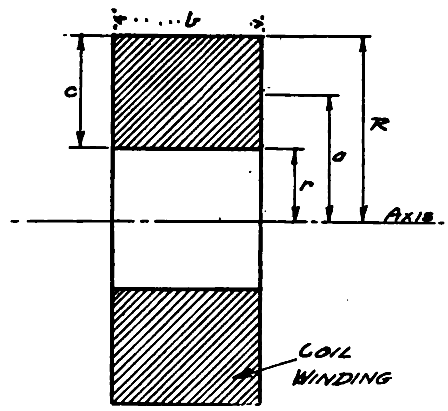


Fig. 1. Notation Used in Brooks' Universal Formula

$$L = \frac{(2 \pi a N)^2}{b + y}$$

where

L=inductance in henrys.
a=the mean radius of the coil in cms.
b=the length of the coil in cms.
πa^2=the area of the flux path within the coil.
y=the length of the flux path outside the coil.
N=the number of turns on the coil.

The term y, the length of the flux path outside the coil, is of course the "nigger in the woodpile." It is different for all types and shapes of coils. In the Brooks' universal formula there is included another factor instead, called the "Shape Factor," which so modifies the above theoretical formula as to take into account this flux path for any shape of coil. This "shape factor" is the empirical part of the formula. The Brooks' universal inductance formula will be found to be sufficiently accurate for all engineering purposes and is given by the equations:

$$L = \frac{Cm^2}{b+c+R} \times \frac{F' F''}{10^9} \ldots\ldots (1)$$

$$L = \frac{0.366 \left(\frac{Ft}{1000}\right)^2}{b+c+R} \times F' F'' \ldots (2)$$

Equation (1) gives the inductance in terms of dimensions in centimeters,

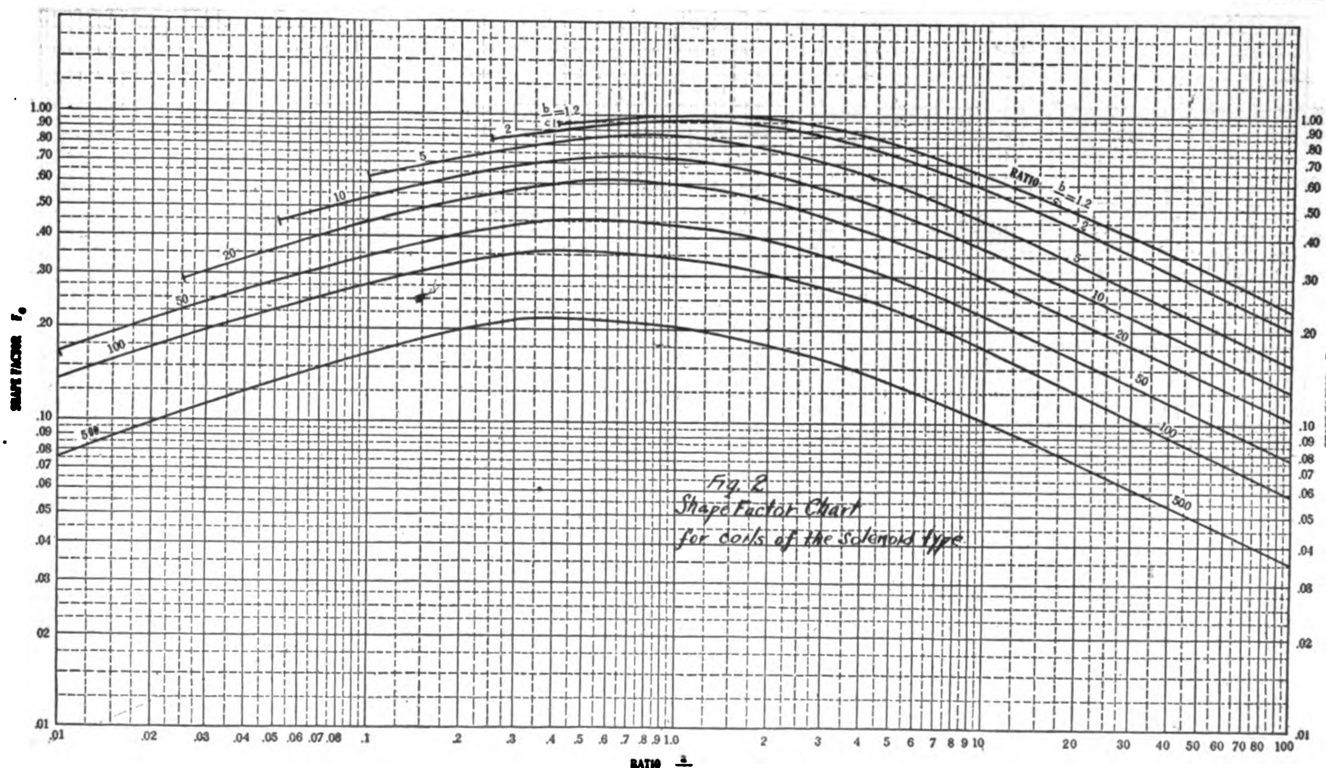


Fig. 2. Shape Factor Chart for Solenoid Coils

while equation (2) gives the inductance in henrys in terms of dimensions in feet and inches. The notation in the formulae is as follows; and is illustrated in Figure 1:

a is the mean radius of the winding.
b is the axial length of the coil.
c is the thickness of the winding.
R is the outer radius of the winding.
Cm is the length of the coil winding in centimeters.
Ft is the length of the coil winding in feet.
F' and F'' are the "shape factors" given by equations 3 and 4.

$$F' = \frac{10b+12c+2R}{10b+10c+1.4R} \quad \ldots\ldots\ (3)$$

$$F'' = 0.5 \log\left(100 + \frac{14R}{2b+3c}\right) \quad (4)$$

It is not necessary actually to calculate these shape factors from the above formulae, for curves are given which give the "shape factors" at a glance. These curves are here shown in Figs. 2 and 3. Fig. 2 gives the shape factor for coils of the solenoidal type, that is cylindrical types where the axial length is greater than the thickness of the winding. Fig. 3 gives the shape factor for coils of the disc type, rings and pancake types where the radial thickness, c, of the coil equals or exceeds the axial length of the coil. It will be seen that the curves give the net shape factor, or the product of F' and F''. The shape factors are given as functions of the ratios of a and b, and b and c. Hence it is merely necessary to obtain these ratios from the coil dimensions and find F'

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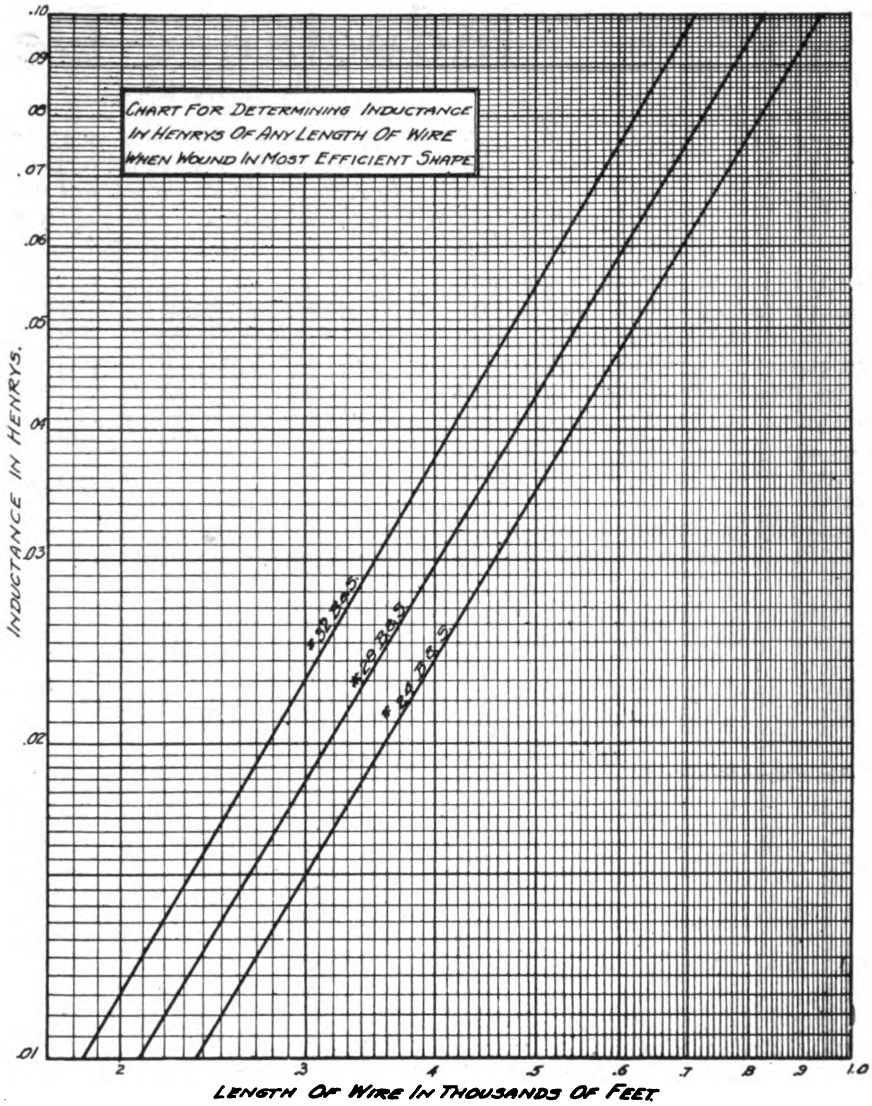


Fig. 4. Chart for Determining Inductance

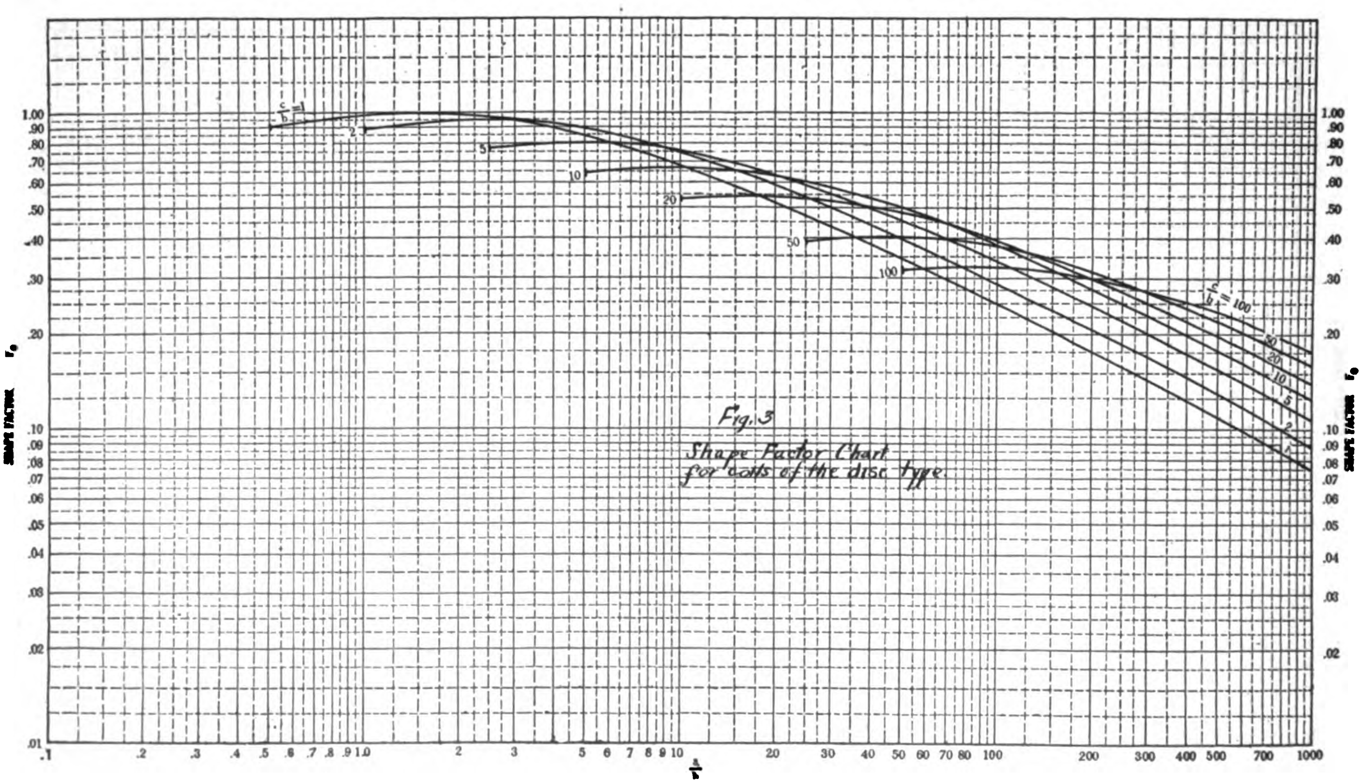


Fig. 3. Shape Factor Chart for Disc Coils

Operation And Care of Motors And Generators

By D. B. McGown

This, the first of a series of practical articles, is concerned with direct current machines. The second, to be published in an early issue, will deal with alternating current equipment. The author, who is assistant radio inspector at San Francisco, has a knack for simplifying complex subjects.

BASICALLY, a motor is a machine that converts electrical power into mechanical power. A generator is the converse. The term motor, electrically, may be applied to any type of machine that accomplishes the theoretical conditions laid down in the definition, but actually this is generally limited to the ordinary type of rotating machines which are used for power supply. The name generator as applied to include all

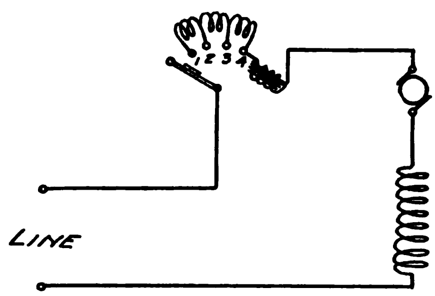


Fig. 1. Series Motor Connection

types of a.c. and d.c. machines for the generation or production of electrical energy, is similarly limited to a rotating machine, which is turned by some form of outside motive power.

We will first consider the series motor, connected as in Fig. 1. The line is connected through a series starting resistance, direct to the armature, and thence through the field to the other side of the line. When this type of motor is started, the starting lever is moved to point 1, and held there for a short time, the duration of the starting period depending on the characteristics of the load and the size of the motor. After the machine has gained speed, the starting lever is gradually moved over, until the starting resistance is cut out of the circuit, and the motor connected directly across the line. This lever is held in place by a magnet in series with the armature, against a spring, which tends to return it to the off position, and, if by chance the current should be turned off, or the circuit through the motor opened, there will be no chance of a short circuit, or sudden rush of current.

This series motor's armature rotates in the magnetic fields set up by the series field winding, and, as it is rotating, there is a secondary current set up therein. This is referred to as the back electromotive force, ("back e.m.f."). That is, the motor armature, while rotating, acts as though it were a generator armature, in that it actually generates current in its windings, but this current is directly proportional to the speed of the machine, i.e. the greater the speed, the greater the value of the back e.m.f., and therefore, the less the value of the current flowing through the whole motor circuit from the line. Conversely, the slower the speed of the motor, the lower the back e.m.f, and the greater the current drawn from the line, which tends to again speed up the motor. At zero speed, therefore, the current would have nothing to hinder its path, except the low ohmic resistance of the windings, and if the full working voltage were to be impressed on the terminals of the machine it would be liable to burn out.

A series motor, therefore, "pulls" harder, the lower the speed. So at minimum speed, theoretically, its power would be infinite, if an infinite current could be supplied and carried by the windings. This is of immense advantage in certain classes of work, where it is essential to have enormous torque at the start, and where a reasonably high speed is also wanted after the motor has finally overcome the inertia of the load, and gotten it to running. Such loads are encountered in electric railway work, electric automobiles, and the like. The series motor will try to reach infinite speed, if allowed to run idle, and therefore it is not well suited to intermittent loads, as in radio motor-generators, requiring a shift from full load to zero load almost instantaneously.

For such loads, another type of d.c. machine is usually used, known as "shunt wound," so named from the fact

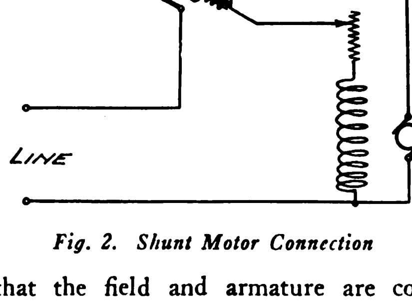


Fig. 2. Shunt Motor Connection

that the field and armature are connected in shunt to one another, and then across the line. The fundamental circuit of this type is shown in Fig. 2. Here, the line is connected in the final, or running position, point 4, directly across the armature, without the field winding in series, while the field is excited by the line current as well, and is also connected directly across the line, but with a resistance in series, to limit the current. The action of the starter for this type of motor is identical with that for the series motor, but, as the back e.m.f. generated by the armature is independent of the armature current, more constant speed is obtained. The actual functioning of the armature is the same as the armature of the series wound motor, but is limited in its action by the independent control of the field rheostat. The weaker the field, the

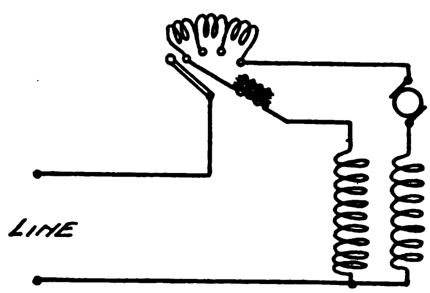
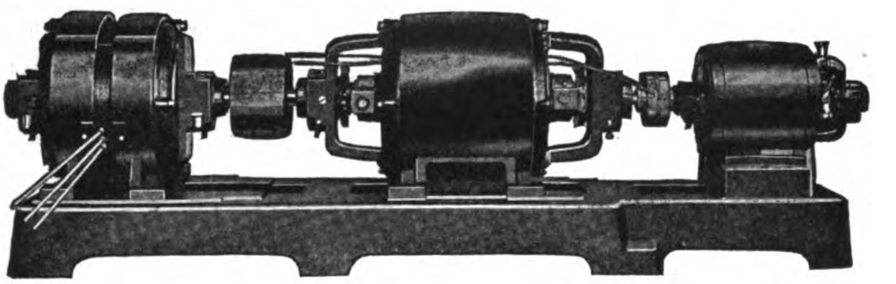


Fig. 3. Compound Motor Connection

greater the power generated, if the machine is operating at constant speed or load. If the load is variable, the greater the speed, the weaker the field. This is effected by a reduction in the back e.m.f., which occurs every time the field current, and consequent density of the field flux, is reduced, and the net result is to increase the armature current in proportion to the weakening of the field. A reduction of speed is taken care of in the reverse order, i.e., by increasing the density of the magnetic field, until such a point is reached that saturation takes place, beyond which no increase of field current will help, due to the iron's carrying all the magnetism (so to speak) that it is able.

A different type of motor connection which involves a combination of the other two types is the "compound" wound machine. This has the heavy series windings on the field coils, in series with the armature, and also the shunt windings in parallel thereto. This type of motor is shown diagrammatically in Fig. 3. This type of motor possesses the advantages of both a shunt and a series wound machine, and is especially desirable when the load is rapidly changed. The speed of this type of motor is regulated by the strength of the shunt field, when running idle, and the instant the load is thrown on, the increase in the current in the series field permits the full power of the motor to be utilized as soon as it is needed. The speed control rheostat is placed in series with the shunt field, and acts in the same manner as the field rheostat of the shunt motor. Another type of compound wound machine is the differentially compounded motor, which, however, is seldom used. It is so connected that the field flux *decreases* as the load increases, and may be made so that it even may increase in speed when the load is increased.

The speed of these various types of motors depend on several factors. First, in a series motor, the speed is determined, within limits, by the applied load, while the shunt motor's speed is limited by the field current, which changes the density of the magnetic field in which the armature turns. Stated mathematically, the speed of a series wound motor varies inversely as the impressed load. A shunt wound motor, when loaded within reasonable limits of power, does not change its speed with changes in the power, provided this load is changed gradually, as in ordinary mechanical operations. But where sudden variations of the load are encountered, as in radio work, it will not remain at constant speed. Few people realize that the motor turning over an ordinary generator, as is used to run the a.c. generator for a spark transmitter, is performing the hardest kind of service that electrical equipment is subject to. When it is considered that with the sending key open there is practically no load, and that the closed key gives a full load, it can be easily seen that the intermittent operation of the key, as is essential to form the signals of the telegraph code, throws the load on and off with great rapidity, and in effect is almost like a hammer blow to the armature when the load is thrown on, and the sudden release of the key throws almost as severe a strain on the mechanism.



Typical Motor-Generator Set for Radio Use

Direct current generators are the converse of motors of similar types. A generator is supplied with power, in the form of rotational effect, from some source of outside power, as a gas engine, steam turbine, water turbine, etc., and it generates electric current by the motion of the armature or field conductors through a magnetic field, which sets up a current in these conductors, which, after being led through suitable electrodes, or collectors, is used for various purposes for which it may be adapted.

Direct current generators are connected like the motors, as series, shunt, or compound wound machines. The series type has not found very general application, as it must be used on circuits having a constant current, as for example for street lighting, and must be provided with regulator which can be adjusted to compensate for small changes in the load.

Shunt wound generators are adapted for constant potential circuits, as for example, on ordinary lighting circuits, using incandescent lamps in parallel, where the potential must remain constant, or serious trouble will occur, due to the lamps burning out. However, if the load is raised to such a point that it tends to even slightly overload the machine, a rapid decrease in voltage will result, which is naturally undesirable.

Again, as with the motors described, the compound type of generator is the most used, and most desirable type of generator for average work. It possesses a series and shunt field, like the motor, and is usually so wound that it maintains a constant potential at the terminals of the machine, no matter what the load conditions are within normal limits, but can be so designed that it will give even an increase in voltage as the load rises. Compound wound machines are used generally for a source of direct current supply. The regulation, as the self-adjustment of the voltage is termed, is usually good, and little attention need be paid to the machines beyond the normal care necessary for correct lubrication, etc.

Radio generators, as used on the plate circuits of vacuum tubes, are usually compound wound, and usually give extremely satisfactory service. In some of the smaller sizes, where the voltage drop on load is not so important, they often are shunt wound.

One special type that deserves mention, owing to its being used in small portable vacuum tube radio transmitting sets, is the "dynamotor." Dynamotors are so constructed that they are, as the name suggests, both dynamos and motors. Fig. 4 shows the schematic connections for the ordinary dynamotor; the motor end is supplied with d.c., and runs at the speed, and under the conditions determined by the designer; the generator end is connected to windings, which are placed in the same slots as are used for the armature windings of the rotor end, but, of course, carefully insulated therefrom, and the same field is used for both circuits, i.e. the shunt field of the motor end serves for the same field as is used for the generator. The windings of the generator are proportioned so as to give either a higher or lower voltage, as may be desirable, which is then taken from the output side in the same manner as if the machine were an ordinary generator.

The dynamotor possesses several important advantages, and some almost as serious disadvantages. It can be made light, and is of convenient form, and where a light or intermittent load is used, it will operate with good satisfaction. It possesses only one set of bearings, and is contained within one complete housing, and is reasonably efficient. The chief defect lies in the impossibility of any effective system of voltage regulation on the output side. As the field strength is fixed, by the winding of the motor end, no variation of this is possible, without disturbing entirely the operation of the machine as a whole. The machine is built to give a constant potential, and a constant current, and will do so, provided it is not seriously overloaded, but no regulation by any outside

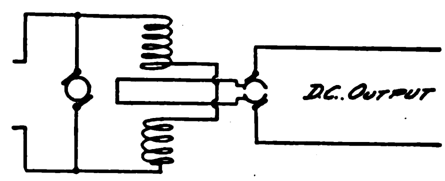


Fig. 4. Dynamotor Connection

method is practicable, except the very poor system of lowering the supply voltage. While this can be done, and some regulation obtained this adjustment can be only carried on within very narrow limits, which are usually too narrow to be of much value, as the capacity of the machine drops as soon as the voltage is lowered. A series resistance, in the supply circuit would accomplish the same result, of course, with the same rather unsatisfactory action.

SECOND DISTRICT CONVENTION

An annual affair that is the culmination of all radio for the season is held every year by the Second District Executive Radio Council at New York City. This one will be the third of its kind, and everyone who attended last year's Show and Convention can vouch for the success of the affair. Next year the Convention will be held at the Hotel Pennsylvania, March 1st, 2nd and 3rd. It is planned that any of the Radio Clubs affiliated with the Council will have booths at the Convention, and there will also be some of the historic radio sets on view. The Convention will be open to licensed amateurs and their friends only.

Are Shorter Wavelengths Worth While?

By Walter Emmet

The "New West" in radio is down among the comparatively unknown shorter wavelengths. The discoveries of the future will be in this realm. Hence it behooves the progressive amateur to become familiar with this region through reading such surveys as this.

THE recent outburst of interest in the super-regenerative circuit of Armstrong points the way to new demands for short waves among radio experimenters and designers.

Hertz showed directional properties of very short waves in 1887, Ladd and Stone in 1901 and Marconi in 1922. These waves behaved like light waves. The shorter the electric wave the closer the family resemblance became and the more accurately could one predict its exact behavior. If it struck a metal screen it was regularly reflected. If it met a prism of pitch or sulphur it was correspondingly bent like a light ray going through a prism of glass. In all possible experiments the electric wave, as it became very short, showed that light and electric waves differed only in wavelength; they had the same velocity in space and both could be projected by proper reflectors like a beam of radiation almost as narrow as a search light.

Any thoughtful student of radio history who is not familiar with the early tendencies in radio would fail to understand the drift away from short waves, which has not ended with 24,500 meters for the 1000 kw station at Bordeaux, France (LY), or recently projected stations calling for 30,000 meters. Such frequencies can be heard directly in the head receivers without any heterodyne by many persons.

The deciding factor which gave a steady direction to this development was the requirement of greater power. Spark stations stopped with about 70 kw in the antenna in 1910. The arc, the "timed" spark, the alternator and finally the vacuum tube respectively have been called upon to radiate energy until today approximately 200 kw is reached.

Large electrical structures, in aerial, and ground or counterpoise are necessary to take up this vastly increased energy flow. Hence the natural wavelength, which should rarely be more than half the traffic wavelength, called for longer waves. These in turn offered a lower resistance due to radiation, or were inefficient relatively to short waves, but the current was greater, and the current squared, determined a net gain in radiation from an engineering point. Commercially these structures are like the prehistoric monsters of the coal age —any sudden economic development cheapening transmission would render them an incumbrance and they will disappear. An efficient static reducer would scrap most of them in the immediate future, as one thousandth part of their energy will suffice for all transoceanic radio communication.

Many pioneers tried modulating a stream of sparks which in the case of Elihu Thompson's direct current oscillator of 1892 gave practically a stream of interrupted arc discharges. This method gives from 5,000 to 50,000 "jigs," sparks or wavetrains per second and clear articulation—with low power.

Collins, Fessenden and others, in their early radio telephone experiments, used waves much shorter than 1000 meters, which then was considered long. Today it is considered just on the verge of medium waves. More power for longer distances soon necessitated the use of 1500 meters. Fessenden's high frequency alternator gave this. It bridged Brant Rock, Mass., and Babylon, L. I., by radio telephone, but there was no commercial development from it, in spite of its being a record at that time.

Soon after this, new work between Machrihanish, Scotland and Brant Rock caused the wavelength to be raised to more than double the above value, while the power and the natural period of the antenna in all transmitting stations went up together, in order not to lose radiation. The radio designers looked "knowing" but they were only making a virtue of necessity: they had to increase the wavelength with the power, for practical reasons.

Further experiments by Fessenden brought up questions whose answers would determine the general design of transmitters in the light of the data accumulated by Austin and Cohen. There was a best wavelength for a given distance, on account of absorption, bending, earth losses, etc., in an electromagnetic wave. "Fading" and "static" were all-important factors whose effects could only be averaged by extensive experiments. Fessenden found that one did not get the best all around reception over long periods by using the longest available wavelengths. Four thousand meters gave better results than 8000, and it is only again after 15 years that the Dutch engineers, through tests between arc stations in Java and Holland, have come to decide on 4000 meters as better than longer waves. In the latter case, static seemed to become more violent.

The U. S. Government in 1910 and again in 1912 shoved the amateur into the wave "pocket" below 200 meters. Suddenly those who wanted distance—and always more distance—bitterly complained of the drab outlook of their prospects in making new records. They very seldom if ever ventured under 200 meters, however, and many preferred to creep up around 350 meters. None seemed to draw the conclusion that they were in a safe harbor, electrically speaking. Experimenters like Armstrong and Bolitho dove for results and we have the super-heterodyne and the oscillator-quencher, which became the super-regenerator in the U. S. Others nourished vague hopes of being ultimately assigned a longer upper wave limit, but this immediately encroached on the international ship-wave of the time.

Knowing what careful experimenters can contribute to practical knowledge, it is the acme of irony to find that the "lost province" of amateur radio below 150 meters was taken over by the government, largely because the amateurs were too preoccupied after 1919 to use C. W. high-power tubes after W. C. White's suggestions for experiments with ultra short waves. In England they had longer waves and their experimentation was closely regulated.

SHORT WAVES AND STATIC

Static is the cancer eating at the heart of radio communication. Any new departure must first be judged in the light of its effect on static. The position of the short wave is singularly strong in regard to immunity conferred on radio apparatus from static. There are at least six types known and classified but they all will break up a telephone or broadcast speech where music or code would not be seriously affected. Static is the greatest enemy to be overcome in broadcasting.

When static comes in, most "reducers" balance it out or localize it while leaving the side tones and carrier waves undisturbed. For long waves this is a hundred times as difficult to do without distortion as with very short waves.

Short waves have had a final endorsement in the remarkable results obtained by Armstrong in America and Bolitho in England by the use of unbalanced oscillating circuits working at 50 meters and under. These circuits "run away," 10,000 times a second or more for broadcasting reception and are prevented from "spilling over" into steady oscillation by a "quenching circuit" consisting of an oscillator which undoes the work of the

Continued on page 66

Power Supply for Vacuum Tube Transmitters

By Charles K. Fulghum

Herein is presented a comparison of various practical methods for obtaining non-pulsating high voltage direct current for vacuum tube oscillating circuits employed for radiophone or C. W. work. The treatment covers batteries, d. c. generators and pre-rectification methods, but excludes circuits using alternating current as a power source.

Batteries

DRY batteries may be used as a source of power for vacuum tube detectors or amplifiers employed in wavemeter calibration or external heterodyne circuits. Detector tubes usually will oscillate on 50 volts without "bluing" and 200 volts may be used with amplifiers. Plate current of from 10 to 20 mills-amperes may be secured for temporary purposes from a block of dry cells costing from $10 to $15.

Small storage batteries are more economical, as the initial cost is from 40c to $1.00 a cell and as the cost of recharging is low. A battery of the Plante type can be made by the experimentor for less than ten cents a cell, using large test tubes as containers and strips of sheet lead as electrodes.

The use of batteries of either type is recommended only where oscillating circuits of small power are to be used temporarily. Occasionally small 'phone or C.W. transmitters may be operated on power derived from batteries, but where the installation is permanent, some other source of power should be used.

D. C. Generators

Generators for radio use are high voltage machines operating at from 350 to 2000 volts with loads rarely exceeding 3 amperes. As a rule they are not required to operate over extended periods of time, but when this service is required of them especial care should be taken to see that the load does not exceed 75 per cent of their rating. This precaution should be observed for three reasons: insufficient driving power, the temperature rise factor, and because operation at abnormal loads gives rise to "swinging" and "fading." The first factor may be eliminated by correct design.

All generators heat up to a certain degree. As long as the load is not increased the temperature will remain constant, but increased loads, especially if abnormal, cause the temperature to rise rapidly with resulting deterioration of the insulation, which will sooner or later mean a burnt out generator. The amount generators will heat in ordinary operation depends, of course, on the allowance the manufacturer has made for the temperature rise factor. As an example, the generators manufactured by the Electric Specialty Company of Stamford, Connecticut, are "figured on a basis of about 1 hour full load at 40 degrees C. rise. For continuous operation (four hours or more) allow 70 to 80 per cent of rating given. All machines will deliver 25 per cent over load for one half hour." Similar data may be obtained from other manufacturers.

Generators in operation require proper oiling, freedom from dust, and maintenance of the commutator and brushes in good condition. If sparking at the brushes develops the machine should be shut down and the trouble corrected.

All leads should be well insulated, and, if possible, enclosed in rigid or flexible metallic conduit to avoid possibility of shock. The generator and attendant driving power, which is usually a motor, ought to be placed in a room separate from that occupied by the transmitting equipment proper. Otherwise, in mounting the motor and generator, care should be taken to see that no vibration can be conducted through the walls or floors to the transmitting equipment, as vibration of the tube elements cause extraneous noises in the radiated signal.

The advantage of the high voltage direct current generator over other equipment are few and are usually derived in special cases where expense is not considered. The current obtained must, for the best transmission, be "filtered," and the construction of a filter for this purpose is as costly as the construction of one for use with other equipment.

High voltage generators rated at from ½ to 1½ k.w., delivering from 350 to 2000 volts, may be obtained for from $75 to $250. Similarly, generators rated from 25 to 300 watts operating at from 350 to 500 volts cost from $25 to $60. This, of course, excludes the cost of driving power.

Pre-rectification Methods

One of the most satisfactory methods of obtaining a high voltage direct current is by the "pre-rectification" method. Briefly, this consists in stepping-up alternating current of 110 or 220 volts, by means of a suitable transformer, to potentials slightly greater than those required by the tubes to be operated. Both halves of the cycle of this high potential alternating current are then rectified and the pulsating direct current obtained passed through a suitable filter circuit before being used on the plates of the tubes.

Three methods of rectification are available: electrical, chemical, or mechanical. Electrical methods of rectification make use either of the one-way conductivity of a gaseous medium due to ionization, or to the electron flow from heated bodies. Of the methods devised, i.e., rectification by kenetrons, S tubes, magnetrons, and arcs either of the Cooper-Hewitt or open air type, only kenetron and S tube rectification have found practical use in amateur installations. The instability of the arc does not warrant its use for this purpose, and magnetrons are, as yet, unavailable. However, kenetrons and S tubes are easily obtained, and, with properly designed equipment, offer an excellent means of obtaining high tension direct current. The initial expense of either type of equipment is practically the same, but, due to the unusual life of the S tubes (at least three times that of similarly rated kenetrons), the latter are recommended.

The best circuit for either type of tube seems to be the "split secondary" hook-up, which calls for the use of a transformer with a secondary designed for twice the required voltage with a mid-tap in the secondary winding. The circuit is so common that comment is unnecessary, and available data may be had in practically any publication on the subject.

Equipment employing either type of tube requires little attention, once the initial adjustments are made. Both kenetrons and S tubes will hold up under extreme overloads for short periods of time, but overloading the tubes should be avoided and operation at the rated loads maintained if a maximum tube life is to be expected. The cost of this equipment is usually from one-third to one-half that of similarly rated generator equipment, and the operating expense is slightly less.

Electrolytic rectification has gained favor because of its low cost. The equipment is similar to that used in vacuum tube rectification, with the exception that electrolytic rectifiers are used instead of vacuum tubes. The action of the rectifier is caused by the formation of oxide films on strips of aluminum immersed in a suitable solution. The solutes commonly employed are sodium borate, sodium phosphate, and certain compounds of phosphoric acid. Sodium borate (borax) has been found as good as any.

Aside from its cheapness, electrolytic rectification possesses certain disadvantages. The equipment is far from being compact, and it must be located in an easily accessible place, for it not only requires constant attention while in operation but the plates must be frequently cleaned and the electrolyte renewed.

Mechanically, an alternating current can be rectified by the "synchronous commutator" method, which, though found in but few installations in this country, is possible of development. The initial cost of the equipment would probably be slightly greater than that of vacuum tube equipment, but the life of the apparatus is indefinite and it requires only the care that any commutator equipped device should receive. The device itself, if designed to operate from an alternating current circuit, requires a synchronous motor to drive it. Current is taken from the 110 volt mains and stepped-up to the required voltage. By means of a commutator device driven by the motor, this high voltage current is rectified. Similarly, direct current from the mains or from a storage battery may be converted into an alternating current, its voltage then raised by a transformer, and the alternating current then rectified. This possibility makes the device of interest to users who are isolated from an alternating current supply. The apparatus is possible of wide variation in design.

Summarizing, it may be said in favor of pre-rectification equipment that the expense is less, both initial and operating, it requires less attention, it is usually more compact, it possesses none of the disadvantages of mechanically-driven apparatus, and it permits the use of alternating current for lighting the filaments of the transmitter tubes. While alternating current can be used for this purpose with tubes supplied with direct current from a generator, there is usually noticeable in the radiated signal an alternating current "hum," while with pre-rectification equipment this "hum" is automatically balanced out. Alternating current for filament heating is not only cheaper than direct current, but by using properly designed filament heating transformers the current flowing from the plate to the filament is carried equally by all portions of the filament, thereby prolonging the life of the tube.

The direct current obtained from generators or from pre-rectification equipment is pulsating in nature, and to prevent this pulsation from being impressed on the radiated signal it is necessary to "smooth it out." A circuit for affecting this change is known as a "filter" circuit, of which at least two types are in common use.

As originally developed with kenetron rectification, a large condenser shunted across the high voltage direct current leads was used to reduce the voltage fluctuation. According to Dr. Goldsmith, in his work "Radio Telephony," "If the current drawn from the charged condenser is comparatively small (which will be the case if the condenser is very large and a small current at high voltage is drawn therefrom), the potential difference at the terminals will remain appreciably constant." It is, however, neither theoretically nor practically possible to obtain in this manner an absolutely constant potential. If, however, the amateur wishes to use condensers only for this purpose, the use of the Mershon electrolytic condenser, placed on the market by the American Radio and Research Corporation, is recommended. The capacity of this condenser is given as 38 micro-farads, and, aside from the advantages of high capacity and compactness, it is self-healing when punctured by abnormal potentials. Oscillographs show very little voltage fluctuation when this condenser is used as a filter.

However, for the best "smoothing out" action, a choke coil of several henrys placed in the positive high voltage lead with a condenser of high capacity shunted across the leads between the choke and the plate connection should be used. Better yet, a choke coil in each high voltage lead with a condenser shunted across the leads on either side of the choke may be used, and the voltage fluctuation with this arrangement is practically nil. For the design of such circuits and formulae for the calculation of the constants of the condensers and chokes, the reader is referred to an article by Dr. Hull in the February, 1916, "General Electric Review."

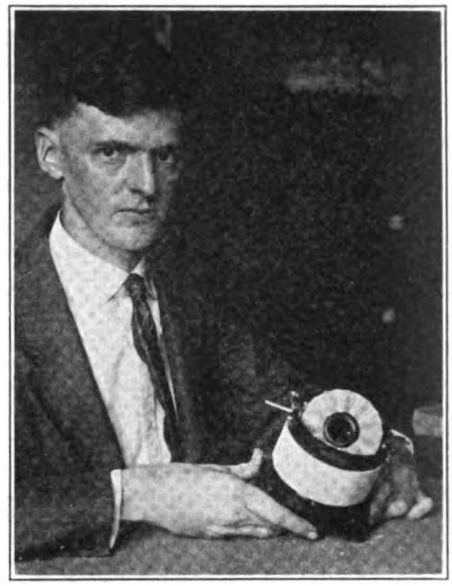
HOW A RADIO RECEIVER WORKS

A telephone receiver consists of a permanent magnet, which acts upon a metal diaphragm. Around the poles of the magnet are wound fine coils of wire, which vary the magnetic attraction upon the diaphragm and thereby cause it to vibrate at the frequency of the "audio" waves. The alternating current resistance effect of the coil to the carrier frequency, which is 875,000 cycles per second at 360 meters, is very high. The voice frequency varies from 300 to 1,200 generally, and it is the superimposed voice envelope which is the current actuating the diaphragm.

In order to shunt the carrier frequency across the headphones, which are in series with the circuit of the receiving set, a small condenser is placed in parallel to the headset. This will not permit audio frequency to get through, but forces it to circulate through the headphones.

VARIO-COUPLER WITH ZERO CAPACITY

An interesting departure in the design of a vario-coupler has been made by Alfred Crossley, radio engineer with the Bureau of Engineering, U. S. Navy, who has substituted a 40-turn spider-web rotor for the usual form of secondary coil. This gives maximum coupling when the plane of the spider-web



Vario-Coupler with Spiderweb Rotor

is parallel to the plane of the cylindrical primary and minimum when at right angles.

The base, instead of being made of bakelite, uses hard rubber containing less than 1 per cent of free sulphur. It is claimed that this vario-coupler is extremely selective and gives particularly good results with radio frequency amplification as it has an electro-static capacity of less than 1 micro-microfarad at zero coupling and 5 micro-microfarad at maximum coupling.

WIRELESS WONDERS

Attendance at our meeting house
Was limited to one starved mouse;
Until the thought struck Deacon Snow
To make us good by radio.
The folks they all turned out for fair
To get religion from the air;
But Deacon must have crossed his wire—
'Cause that dern box up in the choir
Yelled out, "Babe Ruth is now at bat,
Dusted the plate off with his hat.
Strike one—the crowd in great suspense;
Busted a homer to the fence."
A fool kid whooped right out, "Eeyow!"
And Deacon mopped a clammy brow;
But our folks 'ten church as they should
Since science came to make us good.

—M. H. R. in Louisville Courier-Journal.

NEWS OF THE BROADCASTERS

K. F. D. B.

By Ralph M. Heintz

SEVERAL months ago the Mercantile Trust Company of California, wishing to serve its patrons and business associates with financial news, market reports, expert advice, stock and bond market quotations and news of such nature, conceived the idea of establishing this service through the agency of the radiophone. As the bank's scope of business covers the Pacific Coast west of the Rocky Mountains, as well as several of the Pacific Islands, the power needed was quite large. Plans were immediately laid for a station capable of putting 1000 watts into the antenna to cover this entire area should need arise.

Because of the fact that variable powers were necessary, the master-oscillator power-amplifier system was selected as being the simplest arrangement for fulfilling the various needs. The master oscillator is a complete set in itself and has been used for some time awaiting the completion of the power amplifier. When used directly on the antenna it has an output of 50 watts and serves as an auxiliary set when only short distances are to be covered. It is equipped with its own generator and power supply as well as its own system of control. It is provided with one 50 watt tube, as oscillator, and one 50 watt tube as modulator. A 50 watt tube

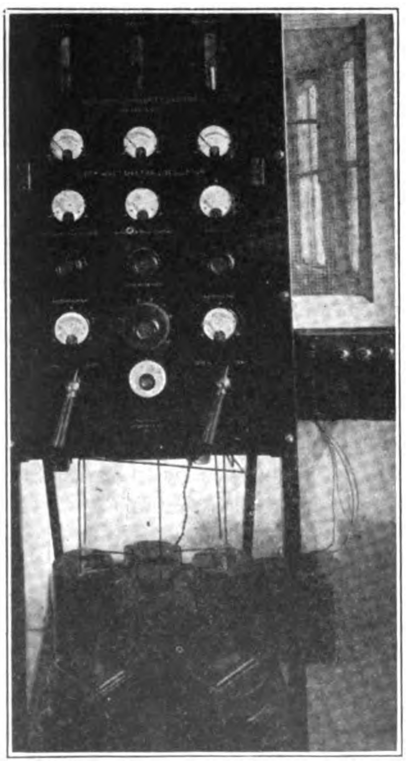


Fig. 1. Master Oscillator

is capacity-choke-coupled to the modulator tube as a speech amplifier. The circuit is known as the tuned grid reverse feed-back. This circuit was chosen after preliminary experiments as being the best suited to the needs and is certainly as efficient as any circuit so far tried. It has the advantage of ease of tuning, which is especially desirable where several wavelengths are used.

Each tube is provided with its own filament voltmeter, filament control and plate milliameter. The remaining two meters are the output radio frequency ammeter and plate voltmeter. An oil variable condenser con-

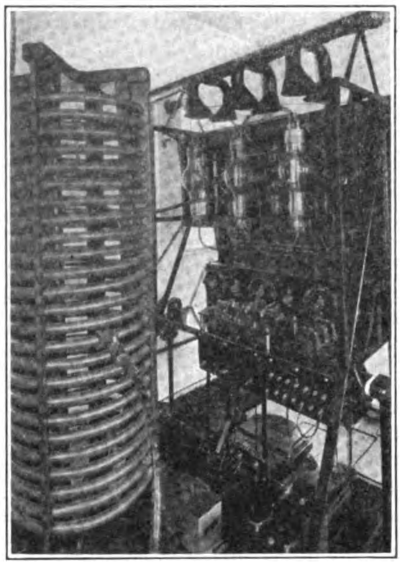


Fig. 3. Rear of Power Amplifier

trols the grid and is operated by the center knob shown on the panel. Above this knob is the field rheostat control. The outside knob varies the field by 350 ohm steps, the inner knob acting as a finer adjustment between the larger steps. This makes it possible to accurately control the plate voltage. On the lower shelf are located the filter reactors and filter condensers. There are four of these reactors, each of 20 henrys value. These are bridged by two condensers, each of 6 mfd. capacity. The remaining reactor is the constant current plate choke. The lefthand handle at the bottom of the panel controls the wavelength switch which makes it possible to instantaneously change the wavelength. The righthand handle is the "Send and Receive" switch. It not only controls the circuits of the master oscillator but also of the power amplifier. This switch is provided with a dashpot which offers resistance to movement toward the "send" position providing a time lag for the filaments to come to full brilliance before the plate potential is applied. This set is also provided with a relay and chopper, giving a 600 circle note for I. C. W. telegraphy. This relay is worked from an ordinary telegraph key, or bug, and breaks the grid circuit of the oscillator tube for C. W. telegraphy. The chopper is connected in the microphone circuit and operates through the modulator tube. The generator supplying the plate of this set is of 500 watts capacity. It is mounted on rubber legs and is practically noiseless in operation.

The master oscillator and receiving equipment are in a separate room electrostatically shielded from the power room. A soundproof partition serves to exclude the generator noise. The power room contains the two generators and power amplifier.

The power amplifier is provided with six 250 watt U. V.-204 tubes, each with its own filament rheostat. The tubes are mounted on a spring cradle so as to relieve the tubes from jar and generator vibration. The grids of each tube are provided with a radio frequency choke to minimize intervalve oscillations.

Fig. 3 shows the filter reactor of 40 henrys and plate reactor capable of accommodating two amperes at 2000 volts. There are four filter condensers each of six microfarad capacity shunting the fifth reactor.

The filament transformer is one of 1 kw output, which is in turn fed by a 1 to 1 ratio transformer in order to doubly isolate the filament supply from the line. The 3 kw generator is capable of supplying 2000 volts at 1½ amperes. This generator is also electrostatically shielded from the power amplifier. The main inductance is wound of 1 in. copper tubing, 25 turns, 14 in. in diameter, and is located directly back of the power amplifier out of the field of the various transformers and chokes.

The amplifier is controlled by a motor driven time lag relay which is in turn controlled by the time lag changeover switch on the master oscillator set. A time lag of five seconds takes place between the time when the filaments are lighted and the plate potential is applied. As a safety measure each filament is supplied with a relay which in turn operates a second relay, so that, should a filament fuse blow or a filament burn out, the set is automatically shut down. It is quite apparent that should one of the six tubes burn out there would be danger not only of overloading the filaments of the remaining five but the plate current may also rise to a point which might prove dangerous, due to the fact that the oscillatory cir-

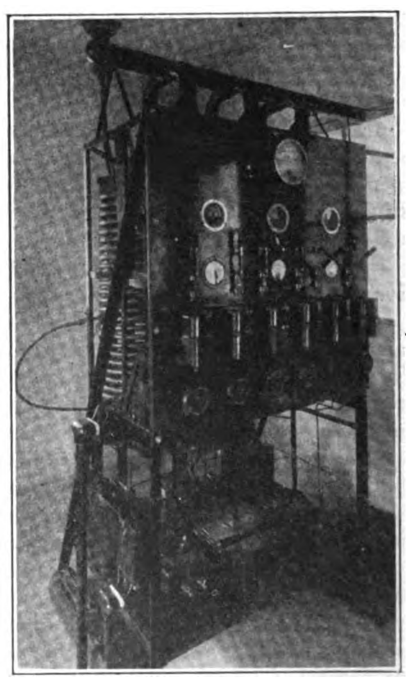


Fig. 2. Power Amplifier

cuit may become detuned. This arrangement also gives warning when starting up that a certain filament is not lighted, so that the operator can locate the trouble.

The entire station is controlled remotely through the agency of six push-button switches so that the operator need not rise from his seat. The station is also provided with a system of inter-connecting switches whereby the small master oscillator set can be made to operate as a 50 watt transmitter; also the power amplifier may operate independently as a transmitter, using one, two

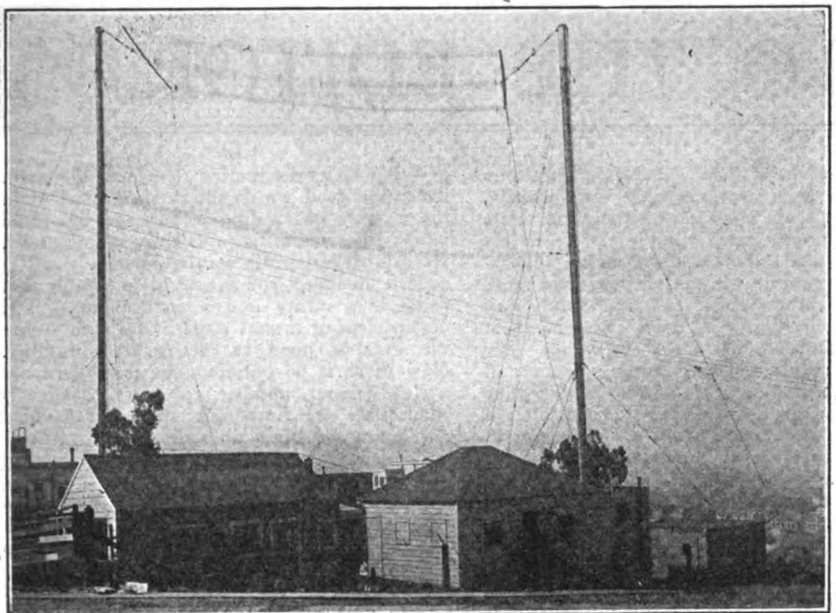


Fig. 4. Site of KFDB

or three tubes as modulators and one, two or three tubes as oscillators. When used in this way a separate 100 watt speech amplifier is used. The simultaneous operation of these two sets will in no wise conflict and broadcasting on two different wavelengths, say, 360 and 485 meters can be carried on at one time. A single cage antenna at right angles to the main antenna is in this case used for the 50 watt set.

The receiving equipment consists of a Colin B. Kennedy Company Universal receiver and two step amplifier.

The antenna is supported by two 110-ft. poles, spaced 90 ft. apart. The antenna itself is composed of three 14-in. cages spaced evenly on 24 ft. spreaders, while the down-lead is No. 0000 stranded conductor. The counterpoise is arranged fanwise, radiating from the station house. It is 100x150 ft. in area, composed of No. 12 wires spaced 3 ft. at the outside supporting cable.

Fig. 4 conveys a fair idea of the general layout of the station.

The station building is of reinforced concrete of Class A construction throughout. The building to the left of the station house is the studio, of which Fig. 5 is an interior view. The studio is 18 ft. x 24 ft. in size and its walls and ceiling are draped in loose folds, following the practice of the better broadcasting stations in the east. The studio is carpeted over heavy felt wadding so as to deaden the sound. A grand piano stands in one corner and is provided with its own pick-up michophone. Other microphones besides the portable ones are hidden from view back of the drapes. The output of these microphones is amplified by a 10 watt "push-pull" speech amplifier which acts directly on the grid of the main speech amplifier tube. Microphones of special design are used for picking up the broadcast program. These microphones make use of a somewhat new principle whereby the effect of the natural period of the diaphragm is eliminated.

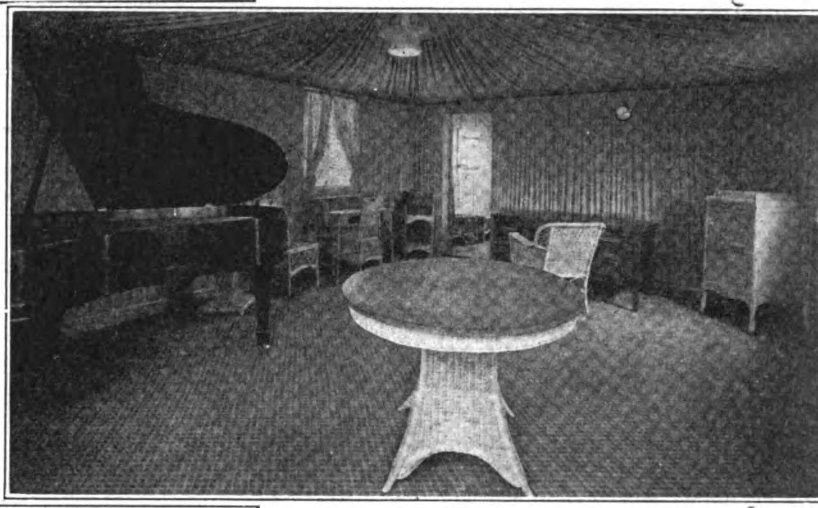


Fig. 5. KFDB Studio

ELEVEN NEW STATIONS

Eleven more broadcasting stations, to function on a 360-meter wave, are announced by the Department of Commerce:

Adler's Music Store, Baker, Ore.

Alabama Polytechnic Institute, Auburn, Ala.

Amarillo Daily News, Amarillo, Tex.

Louisiana State Fair Assoc., Shreveport, La.

Meier & Frank Co., Portland, Ore.

Paramount Radio Corporation, Duluth, Minn.

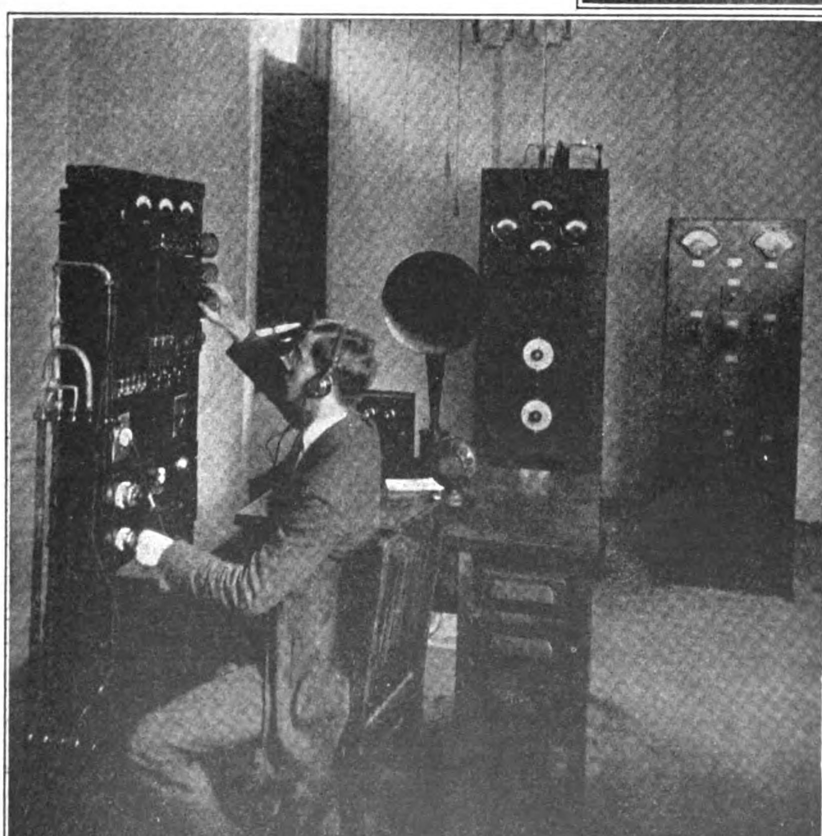
Rathert Radio & Electric Company, Cresco, La.

The Fair Corporation and the Chicago Daily News, Chicago, Ill.

Bishop N. S. Thomas, Laramie, Wyo.

Waterloo Electric Supply Company, Waterloo, Ia.

West Texas Radio Company, Abilene, Tex.



500 Watt Western Electric Radio Telephone Equipment in the Wanamaker Broadcasting Station at Philadelphia, Pa., by Means of Which Music From the Wanamaker Grand Organ Has Been Heard at Berkeley, Calif., and San Juan, Porto Rico.

LETTERS TO THE EDITOR

Proper Procedure in Calling

Sir:

Many amateurs, especially those operating C. W. or I. C. W. types of transmitting equipments, seem to pay no attention to the Regulations covering the proper procedure in calling and signing off. Article XXV provides that "The call shall comprise the signal — . — . — the call letters of the station called transmitted *three* times, the word from, (de) followed by the call letters of the sending station transmitted three times." (Article XXV, Regulations of the London Convention, Pg. 33, Radio Laws and Regulations.)

The system for answering the call is precisely the same, except the call of the station answering send its call only once, followed by K, the invitation to transmit.

The CQ signal is also permitted, and is substituted for the call, or answer, as may be pertinent in an individual case.

Now, I would be very glad to know by what process of reasoning, or other mental gymnastics the larger number of C. W. and similar station operators perform when they send countless calls, a half dozen DE signals, and sign off anywhere from six to a dozen times, and then often repeat the whole process over again, *without pause* or interval.

I have been informed that several operators "thought" that C. W. stations were entitled to such privileges, as they usually had trouble in calling, owing to their sharpness of tuning. Such ideas, thoughts, or other hazy notions are entirely erroneous, and C. W. stations are no more entitled to call endlessly than are any other classes of stations. They are all actually governed by the Regulations, equally, and should abide by them.

In other words, no stations, C. W. or otherwise, shall call, according to law, in any different manner than that set down by the above-mentioned paragraphs.

Respectfully,
D. B. McGowN,
Asst. Radio Inspector.

Oct. 24, 1922.

The Passing of the Spark

Sir: May I take this opportunity of replying to "A Reader" and "Belligerent Ham," and many others who have not put their thoughts in writing? For I am sure that many, many of the genus "Ham" feel as these two.

Both of the above letters remind one of the drowning man grasping at the proverbial straw. They have read the handwriting on the wall and they fear its consequences. But I believe there need be no fear. The spark is going to pass,—the sooner the better for all concerned—although during the long winter evenings one will miss the note of a really good spark set.

The spark must go as the open-mufflered motor in cities has gone. It simply does not belong any more, except as "A Reader" points out, on ships for the purpose of calling assistance when in distress, and the chopper may beat it out there. The spark has outlived its usefulness. Now it is close to becoming a nuisance, not only to the broadcast listener, but to the amateur as well.

Undamped sets may crowd together in a limited waveband and handle traffic—lots of it. How much traffic can you handle with a 1 kw. spark going half a mile, even ten miles away, if you are anywhere near its wave? Very little, if any, I am sure. Half a dozen, perhaps more, C. W. transmitters that have been working DX satisfactorily, must leave their messages on the hook while one spark, only one, mind you, clears his traffic. Is that fair, Mr. Spark, to keep everyone waiting while you get off your messages? I think it rather selfish. Change your spark "trans" into a C. W. "trans" (G. M. Best will be glad to tell you how), make your "OT" into a C. W. inductance, go out and sell newspapers for the cash to buy a tube or two, put in some sort of a well-filtered d.c. arrangement, and work *with* the C. W. man and not against him!

"C. W. is no good," you say—"Sparks handle practically all the traffic"—"Most of the C. W. reports are heard, not worked." My answer is, "Look up your back numbers of 'QST' and turn to the Traffic Section." I don't think you need any more convincing argument than last month's traffic report. And the season has hardly commenced!

You don't think low-powered C. W. is reliable. If not how is it that when 6ZAC calls 6ZAF all ZAF has to do is say "i i ga"? "But that is on 375 meters," you say. All right, then, can you handle two-way traffic with 3ALN the way 6XAD does on 20 watts? Can you shoot three messages straight to 4BF in mid-summer? Can you— But I could go on and on with such instances. Yes, they are remarkable, but before very long such records are going to be commonplace and on power input way under 1000 watts.

Now as to the matter of interference with broadcast reception. "A Reader" has expressed himself much better than "Belligerent Ham." Mr. "Ham" admits that he can hear sparks a mile away when he is tuned to 360 meters, but when his bulb is oscillating the spark causes practically no annoyance. True, but do you know what you are doing to Mr. Novice who lives on the corner and is listening to the same DX broadcast station? You have constituted of your receiving set a perfectly good heterodyne and Mr. Novice cannot understand why there is such a squeal on the said station's wave. Also, you have spoiled the quality of your own reception by having your bulb oscillating, and the modulated wave from the transmitter is distorted.

Due to the wise heads who formulated the Pacific Plan, we have averted, forever I hope, the potent wrath of the broadcast listener, and verily his strength is huge. Let us abide rigidly by the Pacific Plan, and stamp out the ignorant ham who disregards it as we poison the gophers in our gardens, for, like the gopher, he will destroy our flowers if he is allowed to continue.

About the a.c.-C. W. set. Mr. "Reader" is right about their interference-causing qualities. They do cause a great deal of interference locally, but not on 360 meters, and they are not causing irate broadcast listeners to write to their congressmen that the amateur should be eliminated. Also I believe that following the development of the synchronous rectifier for high-powered C. W. stations we will have less of this a.c.-C. W. QRM. It is perfectly possible to filter the d.c. from a synchronous rectifier and use it for voice. 6EN has definitely proved this.

Mr. "Belligerent Ham," I do not believe that the average person does know that you are only too glad to relay messages for him and he will undoubtedly be interested, but the only way to retain this interest is to deliver the message. We are all glad to relay messages, but how many of us deliver the message to the addressee? Very often, too, a relayed message consumes greater time in arriving at its destination than does the mail, hence the good we do the novice, apart from the novelty of sending a message by radio which soon passes, is practically nil. Frankly, we are of very little service to him.

Mr. "Reader," you are right in saying that radio is a utility and a convenience. The government of these United States is to secure the greatest good to the greatest number. Now there is no question but that there are a far greater number enjoying broadcasts than there are Amateurs. In order to hold our place we must do something to justify our existence, and in so doing we must not interfere with the pleasure of the broadcast listeners. No, I hold no brief for the broadcaster, but I do know that it lies within the power of the broadcast listening public to put us out of existence. That we must not allow! Never! We must hold together and defend ourselves, leaving no loophole in our armor. I greatly fear that the spark transmitter is the Achilles heel of amateur radio.

We *are* doing our country a service and we must let the public know it. That service is this—We are preparing ourselves to be the nerves of our Army and Navy in the time of a national emergency. Without communication, and especially radio communication, the greatest army and the strongest navy would be powerless. My task in the last war was instructing men in radio communication and I know that radio operators cannot be made in a day. You know it too. If you really want to be of service to your country and justify your existence as an amateur, grab the next chance you get to go to one of the summer training camps and take up Signal Corps work, or join the Naval Reserve. You will never realize how much good it will do you until you have tried it.

In conclusion let us remember these few points and observe them: We must justify our existence (Not forgetting that the American Indian was the first in this country as was the amateur on the air). We must not offend those who have it in their power to put us out of existence. We must hang together; and CARRY ON!

BROOKE SAWYER, 6XAS,
First Lieut. Signal Reserve Corps.
South Pasadena, Calif.

The Other Side

Sir: May a long-suffering "novice" break into your columns in answer to "A Belligerent Ham" and "A Reader" whose letters appeared in your November issue?

Just where these correspondents get the idea that sparks do not interfere on 360 or 400 meters I do not know. Nor do I understand how anyone who has ever tuned a receiving set can take such a ludicrous position. If they know anything at all about radio, they know that sparks *do* interfere. I wish they could tune-in with me at almost any hour of any day or night. They would get a practical demonstration of spark interference.

As to the fault being in the receiving station, I frankly admit that single-circuit tuners are used in a large proportion of "novice" stations. But this, mostly, is the "novice's" misfortune rather than his fault. At any rate, it is the present condition and can not be brushed aside, for the "novice" can no more afford to change from single-circuit to something better than the spark air-hog can afford to change to C. W. Yet "A Belligerent Ham" and "A Reader" want

Continued on page 108

NEWS OF THE RADIO CLUBS

HARMONY AT SAN DIEGO

By 6XAD

"*Peace*: a state of quiet; freedom from disturbance; harmony between persons or parties . . . . ." Thusly does friend Webster define that elusive thing, commonly known as . . . "*peace*"!

For some time there has been a sort of friction in the Southland—centering in and about the charming city of San Diego. It has been lamentable—for it involved many operators in that locality. "Good men—tried and true"—were drawn in the vortex of *un*-rest, and—as a direct resultant—the night airs became jammed and efficient work on the air was rather more by accident than anything else!

Through the courtesy of The Anthony Co., Ltd., of Los Angeles, Major J. F. Dillon, Lex Benjamin, W. W. Lindsay and the writer sallied forth from Los Angeles in a splendid Packard twin-six—on a certain cheerful day in October—bound for the southern city.

'Deed and it was a wonderful drive! Hon. Macdonald, Chief Operator at KFI, conned the speeding land ship! 'Nuff sed! At times we *barely* hit the highest spots in the long, long road! !

The courteous hospitality with which we were welcomed will e'er be remembered by me!

Dragged-out details are always wearying! Hence—suffice it to say that Major Dillon, as Radio Inspector-in-Chief of the 6th District, made a masterly speech at the especial meeting of San Diego amateurs that had been called for the occasion. It was brief—to-the-point—and explained the situation in even less than the proverbial nutshell! Major Dillon strongly advocated PEACE, and he subtly let it be inferred that if PEACE did *not* ensue . . . . !

And he was right!

The air—the *ether*, if you like—is NOT for any *one* body of men! It is a medium that is used for the inter-exchange of signals between ANY men—in the U. S.—provided that in the transmission of signals, the laws of the U. S. are obeyed!

The idea that any dis-affected group of operators can, because of some fancied—and FOOLISH!—little grievances among themselves, so "glom" the air that no one can work with any degree of satisfaction—is, to say the least, ridiculous! Jealousy in both sexes of the human race is—alas—one of the chiefest factors of human misery! Is it not then a GREAT pity that this same demon should enter into the otherwise harmonious life of *radio operators* in the Southland?

There are two Eminent Medicos in San Diego—each with his "following" of amateurs. Far be it from me to even attempt to dissect their "differences"—BUT: I would beg of them to bury the rusted, old hatchet! I would beg of them to remember the good cause of *efficient radio!* I would say—herewith—to both of them:

Gentlemen! — — — FORGET IT!"

There are tales without end—in San Diego! (And many tales that have no *beginning*—that I could discover!) These do not spell "efficiency"! Rather have they a disastrous tendency to . . . . disrupt!

Although it is a horrible bromide'ism—I venture to bring to various memories the FACT that:

"*United*—we stand! *Divided*—there is Hell to pay!"

This coming radio season promises to be a . . . . . wonder! Shall we, of the Southland, not ALL pull together?

Luis Rexach (4OI) of the Porto Rico Radio Club of San Juan, P. R., has put the club on the radio map with his 100-watt C. W. set. Through his station the club established communication with 4FT at Atlanta, Georgia, on September 15th. This station was also copied on September 20th by Gerald Wilson, 6BCA, at San Jose, Calif., while it was sending to 4FT, a distance of about 4000 miles! By means of two other new stations it is hoped to maintain regular traffic schedule. An endeavor is being made to establish communication with amateurs in South America, so "soon we will have traffic from South America to Hawaii through Porto Rico and California. These are not 'chimeras,' but positive things" writes Joaquin Agusty (4JE), president of the club. The club has 302 members, most of whom are studying the club's free course in radio as translated into Spanish by 4JE.

The Long Beach (Calif.) Radio Research Association has undertaken the ambitious project of endeavoring to communicate via radio with the Victorian section of the Wireless Institute of Australia at Melbourne. Arrangements are being perfected by Robert J. Portes, 2500 Elm Ave., Long Beach, and H. Kingsley Love of Melbourne so that these tests may be carried on during December, code transmission to be carried on from Daugherty Field. Other clubs or amateurs interested in this work are urged to write Mr. Portes for complete details. A part of the expense of cabling confirmations is to be raised by a $5.00 from all participating and a part by a contribution from the Pacific Radio Trade Association.

PACIFIC PLAN REVISIONS

At a representative meeting of Sixth District radio club members at Los Angeles, Calif., Oct. 14th, the Pacific Plan was amended so as to allow a DX listening-in period from 7:30 to 8:00 p.m. and broadcasting and pure C. W. transmission from 8:00 to 10:00 p.m. daily without interference from spark or I. C. W. transmission. With delegates present from nearly every radio club in California, this action was made unanimous. Resolutions were adopted urging every amateur to observe this courtesy. This action was taken with the understanding that all broadcasting should be discontinued at 10 p.m.

These revisions in the previous plan of ceasing spark transmission between 7:30 and 9:00 p.m. were sponsored by the radio clubs of Central California at the request of Major J. F. Dillon, Radio Inspector for the Sixth District. They represent a compromise between the demands of concert fans that broadcasting continue till midnight and the desire of amateur operators that non-interference broadcasting be continued from 8:00 to 9:00 p.m.

Under their provision all amateur and broadcast transmission will be stopped from 7:30 to 8:00 p.m. in order that Eastern stations may be heard. Each club is to select traffic officers whose duty it will be to warn violators of the rule of no-spark or I. C. W. operation between 7:30 and 10 p.m., that they are in danger of losing their license.

During the convention emphasis was placed upon the necessity for rigid observance of this rule. The hope was expressed that every amateur would voluntarily respect this agreement. Otherwise there is danger of the most rigorous restriction of amateur activities.

SOME GOOD D. X. WORK

By LESLIE B. GRAHAM

On the afternoon of Sunday, Oct. 1, 1922, Frank M. Curtin (7SZ), Edmund B. Craney (7AEG) and Leslie B. Graham (7BM) made a trip to the summit of Mount Spokane for the purpose of making some radio receiving tests. We left Spokane about three o'clock in the afternoon and arrived at the summit of Mount Spokane, a distance of 35 miles, in time to make camp and erect an antenna before dark.

Our antenna was attached to two trees about 65 feet apart. From one end of the antenna our lead-in was brought in a slanting position to the front wheel of our car. The total length of the antenna, including the lead-in, was about 100 feet. The height of the two pine trees was about 15 ft. It was impossible to obtain a good ground connection and as a substitute we laid out about 65 ft. of rubber-covered wire to the end of which we connected a small coil of bare copper wire. The small coil of wire was buried about six inches in damp ground. Immediately after hooking up the set we gave it a short test during which we heard WGY Schenectady, New York. After this test we finished making camp and ate our lunch.

The receiving set which we used was a single circuit regenerative tuner with two steps of amplification. The following stations were heard during the night:

STATION	LOCATION	TIME
WGY	Schenectady, N. Y.	6:10 P.M.
KFBK	Sacramento, Calif.	8:30
KFAN	Moscow, Idaho	8.45
Avalon	Catalina Island	9:00
9ZAF	Denver, Colo.	9:10
KUS	Los Angeles, Calif.	9:15
KDKN		9:25
KFC	Seattle, Wash.	9:28
KGG	Portland, Ore.	9:55
8APW	East Cleveland, Ohio	10:08
7LU	Greybull, Wyo.	10:11
7SC	Seattle, Wash.	10:12
9APD	St. Louis, Mo.	10:15
6BXD		10:20
7ZD	Bozeman, Mont.	10:22
KLZ	Denver, Colo.	10:27
4BV	Wilmington, N. C.	10:34
KZN	Salt Lake City, Utah	10:37
KFKA		10:40
CJCA	Edmondton, Alta., Can.	10:45
CFCN	Calgary, Alta., Can.	10:53
6BSA		11:19
7AEA		11:21
7HR	Eugene, Ore.	11:24
9AWM	Chicago, Ill.	11:25
6BEG	Los Angeles, Calif.	11:28
9AMQ	Kansas City, Kan.	12:03 A.M.
9AOG	Lawrence, Kan.	12:10
9CFI		12:19
7GA	Portland, Ore.	12:22
7RA	Seattle, Wash.	12:25
6AVG	San Francisco, Calif.	12:21
3MK	Norfolk, Va.	12:29
6BES		12:31
8BO	Detroit, Mich.	1:01
5D1	Houston, Texas	1:10
7RN	Cashmere, Wash.	1:45
6BUD		1:48
7AR	Portland, Ore.	1:52
6AO	Hayward, Calif.	1:55
8AU	Detroit, Mich.	1:59
9BD	Vancouver, B. C., Can.	2:01
7AD	Seattle, Wash.	2:07
9CBA		2:09
8CW	Pittsburgh, Penn.	2:15
9ABG	St. Paul, Minn.	2:19
6PT	Salt Lake City, Utah	2:26
1HAS		2:34

6ASW	Gonzales, Calif.	2:55
9HCR		2:59
6AED	San Diego, Calif.	3:03
9RF	Denver, Colo.	3:09
6ASJ	Oakland, Calif.	3:24
5UC		3:30
1AH	Norfolk, Mass.	3:38
9DHN	Joliet, Ill.	3:44
9BXT		3:47
9BCF	Fort Dodge, Ia.	3:48
9BTT		3:54
9AB	Chicago, Ill.	3:55
9BX	Chicago, Ill.	3:55½
9BHK	Dallis Center, Ia.	3:56

All the times given above are Pacific time. The total number of stations heard during the night was 62, which we believe to be a record for one night's work. The elevation of Mount Spokane is approximately 5,800 feet.

We broke camp about four o'clock in the morning and returned to Spokane. As yet we have been unable to verify all of the calls heard, but we expect to hear from all of them very soon.

SOME STILL BETTER RECORDS

By HOWARD A. COOKSON

While enroute from San Francisco to Honolulu as operator on S. S. *China*, I listened in on 200 meters with a detector and one-step a. f. amplifier and logged the Eastern calls heard as follows:

October 22—449 miles west of San Francisco for China: 5PX, 9BED, 9ANQ, 9AWM, 9CXP, 9DHB.

October 23—845 miles west San Francisco: 5BN, 7ZB, 7EN, 7NY, 7AEM, 7RI, 8SP (Fairmont, West Va.), 8XE (State College Pa.) calls 9GK, 9BED, 9DBL, 9AJH, 9DXN, 9AXU, 9PN, 9BJI, 9BIZ, 9XE, 9ZAF, 9BDS, 9FM, 9ZN, 9XM, 9GK, AD7. (Hear 8XE and 9GK Chicago working all evening.)

October 24—1210 miles west San Francisco: 5ZA, 5CV, 5EO, 5ABH, 7BK, 7DP, 7SC, 7TQ, 8AIO (East Pittsburg, Pa.), calls 6KA, 8BWA (Akron, Ohio) calls CQ, 8YU (Dayton, Ohio) calls CQ, 8NB (Rochester, N. Y.) calls 9??, 9DK, 9AWN, 9BDS, 9AOG, 9CKM.

October 25—1602 miles west San Francisco: 3BLF (?), 4HH (Tampa, Fla.), 4BV (Wilmington, N. C.) calls 9CNS, 5HA, 5ZA, 5NK, 5EO, 5SM, 5EK, 7ADF, 7RN, 7SC, 8XE (State College Pa.) calls CQ, 9BJ (Chicago), 9BK (Chicago), 9BJI, 9AXD?, 9CMK, 9CNS calls CQ all night, 9AWM calls 5EK, 9ZAF, 9AYI, 9BCY, 9AUL, Qsa with 1CMK, 9BDS, 9ZN, 9BDE?, 9GK (Chicago) copied working with an "8". Msg says "Want you here often sig 9DKB" 9GK very consistent and QSA.

October 26—1963 miles west San Francisco: 5XAD (Orange, Texas), 9XM (Madison, Wis.) very Qsa and clear. Copied the following "9XM test 9XM test pse card fm any stn beyond 1200 miles from Madison, Wis., test de 9XM Qrx for amateur NA 9XM." Several other "Nines" heard but unable to read acct strong DC induction from ship's generator.

October 27—Honolulu harbor.

Copied 8AQO all evening. 8AQO is at Cazenovia, New York. I copied the following: "8AQO test Cazenovia New York pse crd 8AQO test 8AQO test amateur 8AQO test Cazenovia New York test 8AQO test 8AQO at Cazenovia New York 8AQO test 8AQO" . . . Sigs quite QSA and clear.

Figures from the bridge give Cazenovia 5100 miles from here. Also copied 9AL (Toronto, Canada) and 9GK (Neenah, Wis.).

8AWP (Syracuse, N. Y.) was also heard but was unable to copy.

5ZL (Little Rock, Ark.) and 9AWM (Sleepy Eye, Minn.) also heard.

9YF (location unknown) heard working with 9YU.

It might be interesting to note that my partner, Mr. Van Auken, read 6CC (Gridley, Cal.) ten feet from the phones at 6 P.M. our time while it was still daylight.

I did not log the "Sixes," but will do so west of Honolulu. I heard almost all of them every night. 6KA came in 1900 miles of San Francisco, more QSA, than KPH.

We leave Yokahama homeward-bound Dec. 5th. I will listen on 200 meters from 3:30 to 6:30 a. m. San Francisco time.

Central California Broadcasting Schedule---*Effective Nov. 1, '22*

San Francisco Bay District

Daily Except Sunday

KUO—9:00 to 10:00 A.M.—Examiner
KFDB—10:00 to 11:00 A.M.—Merc. Trust Co.
KZY—11:00 to 12:00 A.M.—A. P. Rad. Sup. Co.
KLS—12:00 to 1:00 P.M.—Daily News—(Warner Bros.).
KDN—1:00 to 2:00 P. M.—Fairmont Hotel.
KFDB—2:00 to 3:00 P.M.—Merc. Trust Co.
KSL—2:00 to 3:00 P.M.—Emporium.
(Except Wednesday)
KUO—3:00 to 3:30 P. M.—Examiner.
KPO—3:30 to 4:30 P.M.—Hale Bros.
KDN—4:30 to 5:15 P.M.—Fairmont Hotel.
KUO—5:15 to 6:45 P.M.—Examiner.
KZM—6:45 to 7:00 P.M.—Hotel Oakland.
KLX—7:00 to 7:30 P.M.—Oakland Tribune.
———7:30 to 8:00 P.M.—DX Listening-In Period.
KFDB—9:00 to 10:00 P.M.—Merc. Trust Co., with program furnished through co-operation of Pacific Radio Trade Association.

SUNDAY

KUO—9:00 to 10:00 A.M.—Examiner.
KLX — 10:00 to 11:00 A.M. — Oakland Tribune.
KPO—11:00 to 12:15 A.M.—Hale Bros. (Radio Church).
KLS—12:15 to 1:00 P.M.—Daily News—Warner Bros.
———1:00 to 2:00 P.M.—Open Time.
KUO—2:00 to 4:00 P.M.—Examiner.
———4:00 to 5:00 P.M.—Open Time.
KUO—5:00 to 5:30 P.M.—Examiner.
KRE—5:30 to 7:30 P.M.—Hotel Claremont—Berkeley Gazette.
AGI—8:00 to 10:00 P.M.—Presidio (420 meters).
KFDB—8:00 to 8:30 P.M.—Merc. Trust Co.
KDN—8:30 to 10:00 P.M.—Hotel Fairmont.

MONDAY

KPO—8:00 to 9:00 P.M.—Hale Bros.

TUESDAY

KLX—8:00 to 9:00 P.M.—Oakland Tribune.

WEDNESDAY

KUO—8:00 to 9:00 P.M.—Examiner.

THURSDAY

KJJ—8:00 to 9:00 P.M.—Rad. Shop, Sunnyvale.
KRE—8:00 to 9:00 P.M.—Hotel Claremont—Berkeley Gazette.
(On alternate weeks)

FRIDAY

KDN—8:00 to 9:00 P.M.—Hotel Fairmont.

SATURDAY

KSL—8:00 to 9:00 P.M.—Emporium.
KLS—8:00 to 9:00 P.M.—Daily News—Warner Bros.
(On alternate weeks)

Inland Stations

Daily Except Sunday

KQW—1:00 to 2:00 P.M.—Herrold Lab. San Jose.
KFBK—3:00 to 4:00 P.M.—Kimbal-Upson, Sacramento.
KWG—4:00 to 5:00 P.M.—Portable Wireless, Stockton.
KJQ—5:00 to 6:00 P.M.—Gould, Stockton.
KFBK—6:00 to 6:30 P.M.—Kimbal-Upson, Sacramento.
KXD—6:30 to 7:00 P.M.—Modesto Herald.
KVQ—6:30 to 7:30 P.M.—Hobrecht, Sacramento.

MONDAY

KXD—8:00 to 9:00 P.M.—Modesto Herald.
KJQ—9:00 to 10:00 P.M.—Gould, Stockton.

TUESDAY

KWG—8:00 to 9:00 P.M.—Portable Wireless, Stockton.

WEDNESDAY

KQW—8:00 to 9:00 P.M.—Herrold Lab., San Jose.
KVQ—8:00 to 9:00 P.M.—Hobrecht, Sacramento.
KJQ—9:00 to 10:00 P.M.—Gould, Stockton.

THURSDAY

KFBK—8:00 to 9:00 P.M.—Kimbal-Upson, Sacramento.

FRIDAY

KWG—8:00 to 9:00 P.M.—Portable Wireless, Stockton.

SATURDAY

KVQ—8:00 to 9:00 P.M.—Hobrecht, Sacramento.

SUNDAY

KJQ—10:00 to 11:00 A.M.—Gould, Stockton.
KXD—1:00 to 2:00 P.M.—Modesto Herald.
KWG—2:00 to 3:00 P.M.—Portable Wireless, Stockton.
KVQ—6:00 to 7:00 P.M.—Hobrecht, Sacramento.
KFBK—8:00 to 10:00 P.M.—Kimbal-Upson, Sacramento.

6ZAC SETS NEW "WORKING" RECORD

By CLIFFORD J. DOW

All world's records gone to smash! October 29th, Sunday a.m., 6ZAC worked 9AWM, Lloyd Berkner, Sleepy Eye, Minn., for an hour, exchanging three messages, and compliments, etc., without once asking for repeats from either station.

The distance is roughly 4,400 miles. 9AWM was using one 250 watter on one-third power, radiation 3.5 amps. ZAC used one 50 watter, with a.c. on plate, radiation 4 amps. There was NO CALLING for half an hour at a time. We merely called once or twice, and excellent QSO was maintained throughout the hour. The time was between 5:40 a.m. and 6:40 a.m. CST, it being daylight half an hour before we said "GM" and went to breakfast. QSS negligible from both stations.

The second world's record to be broken was the longest relay by amateur stations that has yet been put across. A message was received from 6CC, to 6ZAC, saying: "Greetings from amateurs half way round the world. (Sig) 4OI." The message originated in Porto Rico, and was QSR'ed via ARRL stations across the U. S., and via 6CC to 6ZAC.

Exceptional DX for September and October

By Major Lawrence Mott, (6XAD)

It is not with any intent of bragging that I publish the following list—and a remarkable one, *for this season of the year*—but it is given to the great amateur fraternity in order to prove, indubitably, that DX *can* be achieved through heavy QRN, and despite adverse conditions! I would furthermore compliment—and thank—my kind correspondents from the far-distant places, and I would also call attention to the fact that many of them have received me after the sun had risen in the East. Another salient point is that many of the stations reporting me used only a detector!

And . . . . . . in *working* the many DX stations I used NO steps of amplification—either!

The list:

1AKG, 1BBK—1-step, 1BKA, 1CJA, 1CPN, 1BYN.

1CBO, 1BOQ, 1GV, 1LA.

2BII, 2BME, 2BUE, 2BZJ.

2CJA, 2BRC, 2AFV—detector, 2KF, 2LT, 2AEH—detector, 2ASC—detector, 2AJF—detector, 2AGH, 2APD—2-steps, 2AJC, 2AWF, 2BYC, 2CIN—detector, 2CJE—detector.

3AGZ, 3ARO, 3AWH, 3BIJ, (3BLF), 3BSF, (3CC), 3GC, 3OH.

3BLU, 3CC, 3JJ—detector, 3PZ, 3OT—1-step, 3ADU, 3ANJ, 3XM, (3BHM)—1-step, 3BIT, 3BLF—1-step, L. Causy-Norfolk-Va.—detector.

(4BF)—1-step, (4BV), 4FZ—detector, 4JY.

5AC, (5EL), 5HK, 5KC, 5FI—detector, 5AEC, (5TM).

(5QS), 5TM, 5RH, (5UO), (5TM), (5ZA), 5VO, (5XAD), 5XV—detector.

6BMY—detector, 6ZAC.

(7LR), 7OE, (7JF), 7LR, (7ZU).

8AAW, 8ADH, 8AFY, 8AGZ, 8ASL, 8AWB, 8BEO, 8BFM, 8BKM, 8BXC, 8CGX, 8CKO, 8CQH, 8CYU, 8DAE, 8KG, 8ON, 8TG.

(8AB)—2-steps, (8HJ), 8GP—detector, 8JP, 8SE—detector, 8VH, 8VQ, (8VY), (8ZO)—detector, (ZY), 8AM, 8ADN, (8AQF), 8ATX, (8AWP)—aerial only—no ground, 8AXN, (8BCY), 8AZD, 8AGO, 8BEP, (8BHE), (8BKE), 8BMQ—detector, 8BNZ — detector, (8BUM), (8BUX), 8BVD—detector, 8BZD, 8CAK—detector, 8CAL, 8CEF — detector, 8CNB, 8CXF, 8CKO, (8CPX), 8CTP—detector, 8CZN—detector, 8CZZ, 8YAE—detector, (8HJ), (8AQZ), (8AGF), (8ASV), (8AXM), (8CAZ), 8BQB, 8CZZ, 8BMM, 8BO.

9AOE, 9BKJ, 9BXT, 9CAH, 9CIP, 9CJC, 9CNS, 9CP, 9CTF, (9CTR), 9DKB, 9DWK, (9EI).

9AXA, 9DFB, (9EI), (9ZAF), (9YAJ), (9DR), (9EI), 9FK, (9FM), 9FV, (9PS), 9UC — detector, (9UU), (9ZN), 9AFN, 9AAP, 9ADL, 9AFN, 9AJH — detector, (9APS), 9APW, 9AQR, (9AWM), (9AYS)—detector, 9AYH, 9BIK, 9BIJ, 9ZN, 9FM, 9BFT, (9GK), (9DF), (9DL), (9KP), (9UU), (9ZL), (9AFB), (9AJM), (9AJS), 9ALF, (9AMB), 9ADL, 9AMH, (9AWL), (9AYH), 9BCF, (9BDS), (9BED), (9BHD), (9BJV), (9BJI), (9BLC), 9CBF, 9ALF, (9DZY), 9CXP, (9CTR), 9DNC, (9DZY), (9DLY), (9CNS), (9WDR), (9XAF), (9XAQ), 9BDS, 9BHD, (9BJV), 9BQW—detector, 9CDV—detector, 9CVL—detector, 9DJO, 9DMH, 9DSD, 9DVL—detector, 9DVW — detector, 9DZY, 9DTE, 9DTU, 9CLZ, 9CTR, (9XAC).

("AD7")

CANADIAN:

3KO—Chatham, Ontario.
3GN—Ingersoll, Ontario.
3DS—Kitchener, Ontario.
4BV—Saskatchewan, Canada (Loreburn).
4DY—Winnipeg.
9AL—Toronto.

AND:

report, dated Oct. 10th, from Savannah, Ga., H. E. Hansen. Operator on a coastwise ship, that he heard 6XAD when his vessel was 60 miles off the port of Savannah, Ga.—in full *daylight!*

R. L. Byrum, State College, Raleigh, North Carolina.

Map Showing Some Work by 6XAD

Another DX Record

Sir: A short time ago I sent you a list of calls for the "calls heard" column in your magazine. In that list was included the call of 4OI. Since that time I have obtained the address of 4OI and have communicated with him. Radio 4OI is Mr. Luis Rexach of San Juan, Porto Rico, (Box 319).

I copied 4OI at 8:10 P.M. (Pacific time), September 20th, 1922, when he was sending with 4FT (Mr. Donald McParsley, Box 113, Wilmington, N. C.). Radio 4OI uses 2 50-watt tubes and gets 3.5 thermocouple amperes, using tube rectifiers in a Radio Corporation circuit; his antenna is 100 feet high. For reception I used a single circuit tuner with one tube only (it happened to be a Cunningham amplifier tube used as a detector) and a 1-wire antenna 20 feet high and 100 feet long.

The time and details of reception, such as time, wave, etc., have been positively confirmed by Mr. Rexach. Radio 4OI is about 4000 miles from my station. This is a record in amateur reception that has only been surpassed by the reception and transmission records of 6ZAC, Mr. Dow of Hawaii.

Yours very truly,
GERARD WILSON, 6BCA.
363 South 11th St., San Jose, Calif.

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

L. B. Turner, Pat. No. 1,422,013: July 4, 1922. Thermionic Apparatus applicable for Wireless Telegraphy and other Purposes.

A combination of two tubes, *1* and *2*, is arranged so that the plate *13* of one is connected through a high resistance to the grid *12* of the other, and plate *14* is similarly connected, through a signaling source *e*, to the grid *11*. By proper adjustment of the resistances R_1, r_1, R_2 and r_2, it is possible to obtain high amplification, due to the cascade arrangement from one tube to the other which serves to reamplify the signals. Any suitable translating device may be connected across any of the resistances.

H. W. Nichols, Pat. No. 1,422,822: July 18, 1922. Radio Transmission.

In order to modulate the waves transitted by the antenna circuit *1-2-3*, supplied by a source *16*, without the necessity of handling all the modulating energy at a transmitter *14*, this transmitter is made to affect the impedance of the output circuit of one or more thermionic relays *7* in parallel. The output circuit is connected in parallel to a portion of the antenna circuit, so that that portion of the energy which may pass through this parallel path is modulated. The output circuit of the bank of amplifying relays *7* cannot be directly placed in the antenna circuit due to the high impedance of this output circuit, and therefore the parallel arrangement is used. In this way only a very small power is handled at the microphone or other transmitter *14*.

David G. McCaa, Pat. No. 1,423,345: July 18, 1922. Signaling Method and Apparatus.

Continuous oscillations to be detected in an absorbing circuit *A* are made to combine with oscillations locally produced by an oscillator tube *V* so as to influence a translating device *T* in the output circuit of the tube. The oscillations produced by tube *V* are preferably of the same frequency as that received, and detection depends upon the alternate neutralization of the two sources of oscillations, and cumulation, at audio frequency. This effect is produced by the aid of a transformer having coils P_1 and P_2 inductively connected to coil S_2 in the tube circuit, and a commutator *D* arranged when rotated to make either P_1 or P_2 active. These are oppositely wound so that when said P_1 is active, the energy transferred to S_2 is in phase with that generated by tube *V*, but if coil P_2 is active, the energy so transmitted is 180° out of phase.

Claude R. Fountain, Pat. No. 1,424,091: July 25, 1922. Radioelectron Oscillator.

A dynatrone arrangement of large capacity is described, in which the electrodes *12, 14, 15, 16, 17* and *13* are annularly arranged and in such a way that a vacuum may be maintained between the inner cylindrical electrode *12* and outer cylindrical electrode *13*. For purposes of cooling, also, and for vacuum sealing, the entire device may be immersed in an insulating liquid, such as oil. The source of electrons is the series of filaments *14, 15*, heated from the terminals of a power transformer *6*. Bombardment by the electrons of the outer cylinder *13* causes secondary emissions. The extent of the bombardment is controlled by electrodes *12* and *16* which are in circuit with the transmitting system *5, 9, 10, 11*, as well as by the potentials applied to electrodes *17* and *13* from the d.c. source *1-2*. The resulting oscillations are impressed on the oscillating circuit *4-7*.

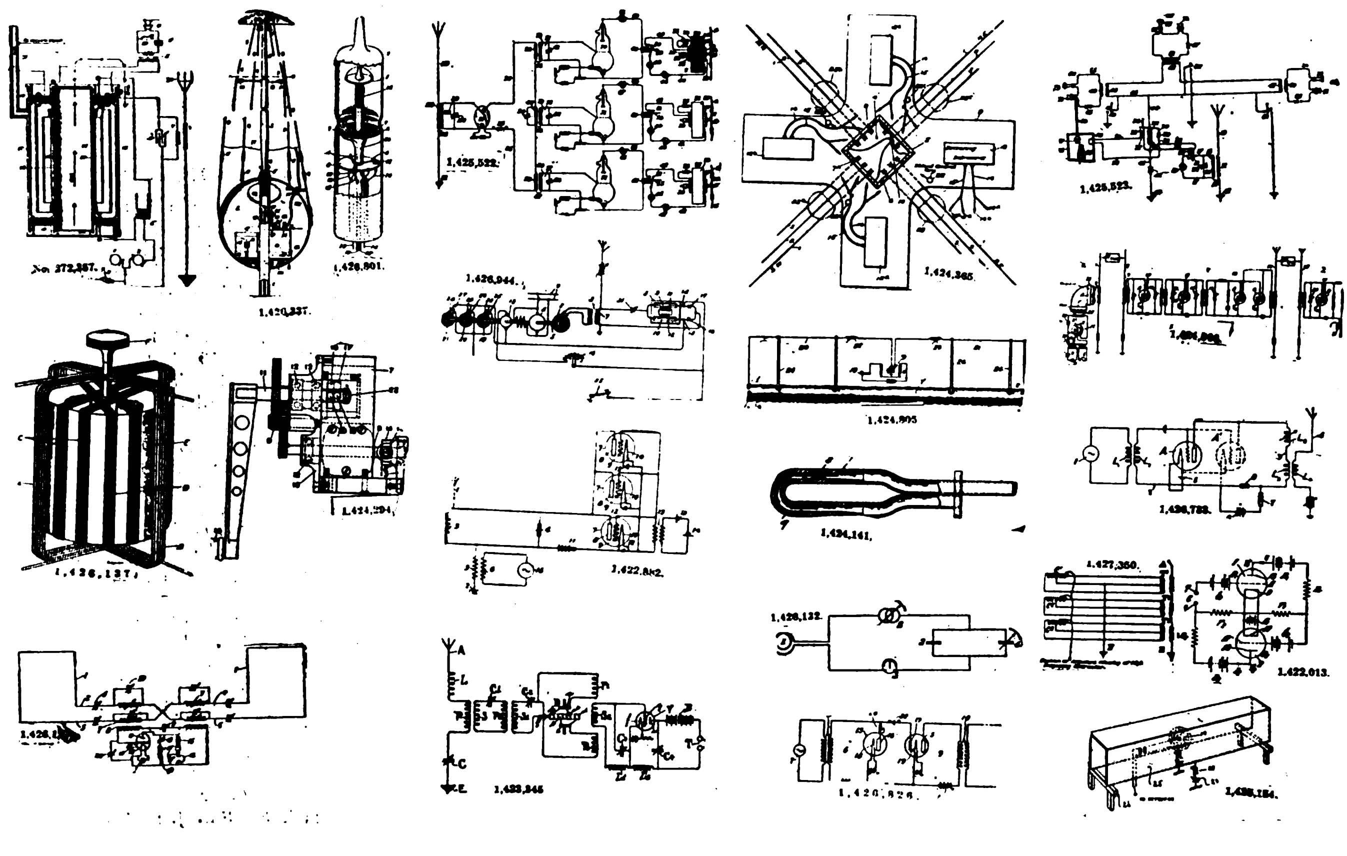
L. F. Fuller, Pat. No. 1,424,141: July 25, 1922. Electrical Oscillation Generator.

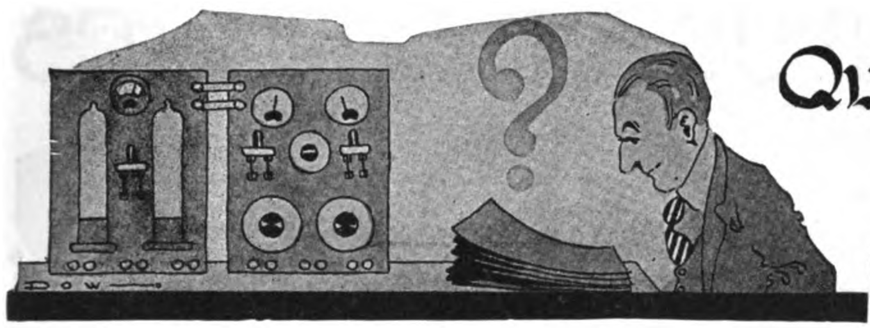
An arc generator is described, in which there is a carbon cathode *3* and a metal anode *4*, operating in an atmosphere of hydrogen. The anode *4* is in the form of a hollow tube through which cooling fluid may be passed, and due to its smooth outline, the liability of carbon projections forming thereon of appreciable extent is materially reduced.

E. H. Loftin and H. H. Lyon, Pat. No. 1,424,365: August 1, 1922. Radiosignaling.

A directional receiving system is described, in which use is made of groups of antennae *1, 2, 3* having divergent directions. These antennae are low, and may in fact be buried conductors, and those in each group are of

Continued on page 100





Queries & Replies on C.W. practice

by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

I have a number of British tubes, Type LT-2, which I wish to use in a radio frequency amplifier circuit, as I understand that these tubes are particularly well suited for radio frequency work. Will you please publish a circuit using three of these tubes as radio frequency amplifiers, to work with a loop and suitable detector?

H. H. B., Vancouver, B. C.

The circuit is shown in Fig. 1. The LT-2 tubes burn at an exceptionally low filament voltage and current, and since you probably wish to use the amplifier in connection with your regular receiving set, which has American tubes, I presume, I have shown the filaments of all three tubes connected in series, across six volts. A filament rheostat of 3 ohms or more should furnish sufficient resistance to control the tubes without danger of burning them out. The chokes should be large enough to keep all radio frequency out of the B battery circuit; ½ to 1 henry will do.

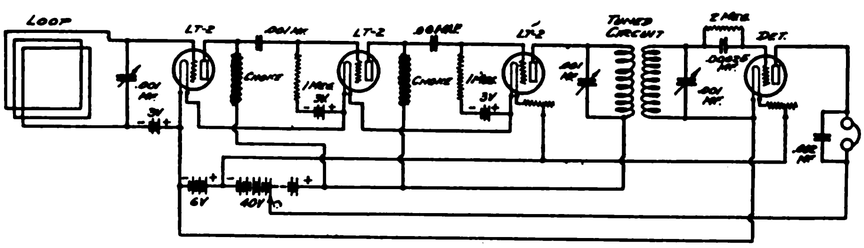


Fig. 1. Three-Tube R. F. Amplifier Circuit

How many turns on a 4 in. tube will be necessary to cover a wavelength range of 150 to 500 meters with an .001 mfd. condenser, as shown in the sketch. Will it be necessary to short the milliammeter when using the buzzer?

R. W. K., San Francisco.

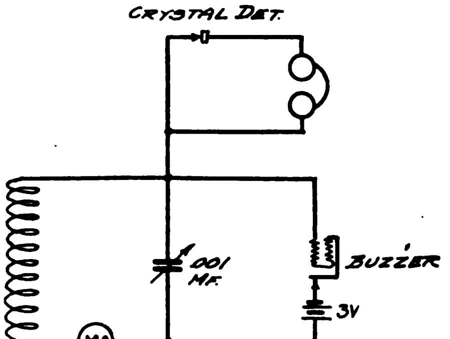


Fig. 2. Wavemeter Circuit

The wavemeter circuit you sent is shown in Fig. 2. Fifty turns on a 4 in. tube, with taps at the 15th and 30th turns will enable you to cover the range you desire. The milliammeter can be left in the circuit, as it is of very low resistance, and will not interfere with the operation of the tuned circuit.

Please publish a circuit using three honeycomb coils, five tubes, two radio frequency and two audio frequency transformers, using variable condensers.

G. M. F., Los Angeles, Calif.

The circuit you wish is shown in Fig. 3. You will have to use more than three honeycomb coils if you wish to take advantage of the regenerative feature for receiving C. W. telegraph stations; five are shown in the sketch.

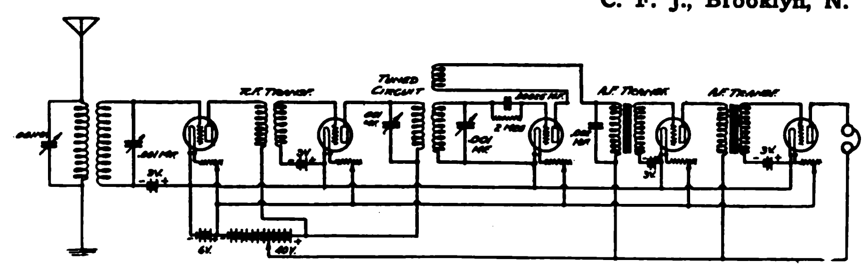


Fig. 3

I am enclosing the hook-up of my set. Please tell me why it does not receive signals from a distance, or loudly.

J. C. S., Santa Clara, Calif.

Separate B batteries, as you have shown them, are not necessary. One battery will do the work. You have provided no means of making the grids of your amplifier tubes negative with respect to the filaments. This can be accomplished as shown in the corrected sketch, Fig. 4. A variable condenser across the secondary is not necessary when you already have a variometer in the grid. A .002 mfd. phone condenser is necessary, in shunt across the primary of the first audio frequency transformer.

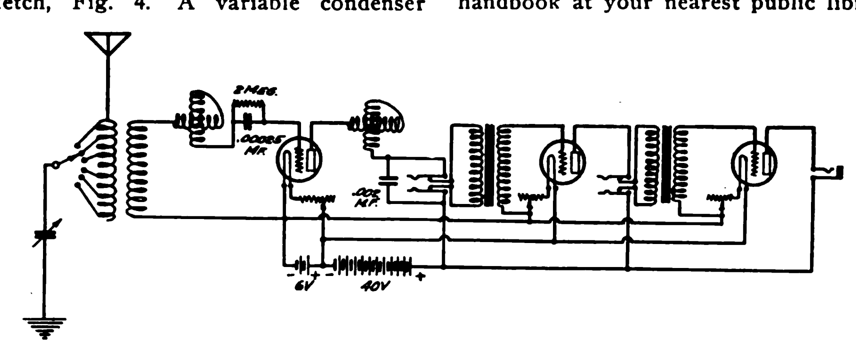


Fig. 4

Kindly advise as to the best method for nickel-plating some brass fittings, with a dull nickel-plate.

C. F. J., Brooklyn, N. Y.

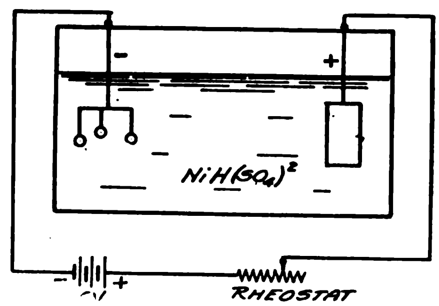


Fig. 5. Nickel Plating Battery

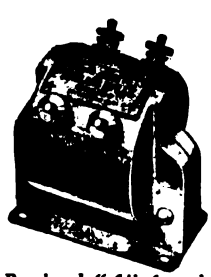
In a wooden or non-metallic container place a saturated solution of nickel ammonium sulphate, known commercially as double nickel salts. As shown in Fig. 5, the anode is of pure nickel and the cathode is the article to be plated. The current flowing through the battery depends upon the size of the piece to be plated. Brasswork should be thoroughly cleaned before plating. You had better consult a nickel plating handbook at your nearest public library.

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS

THE BRADLEYOMETER

Another application of the compression resistance principle has been made by the Allen-Bradley Company, Milwaukee, in the Bradleyometer, a new potentiometer embodying graphite discs operating under pressure. In placing the Bradleystat filament rheostat on the market, the Allen-Bradley Company had applied a principle they have been using for twenty years in the manufacture of rheostats and motor starters for industrial purposes. The smooth current control obtainable with this type of resistor was especially desirable for radio circuits, where the sensitive units require the finest of adjustment.

The Bradleyometer



Rauland "All American" Shielded Transformer

In the Bradleyometer this same idea has been utilized with the result that a potentiometer with all the desirable control characteristics of the Bradleystat, is available.

Two columns of discs are assembled in the porcelain container, each column with a separate and independent pressure plug extending through the top cover plate. The pressure knob rotates through 180 degrees, and through a special shaped cam applies pressure to one column in one direction of rotation and to the other column in the other direction. As pressure is applied to one of the columns the pressure is released on the other.

The resistance of a column of the discs varies with the pressure, so that the action of the Bradleyometer is to decrease the resistance in one column and simultaneously increase the resistance in the other column. The total resistance of the two columns remains constant, as in any wire-wound potentiometer, while a connection between the two columns serves the same purpose as the slider of a wire potentiometer.

The Bradleyometer controls the resistance gradually as the pressure is increased or decreased on the discs. This provides for an even balancing of the potential in the plate or grid circuits, wherever the Bradleyometer may be connected. No foreign noises are introduced into the circuit. The Bradleyometer accomplishes the full range in control with 180 degrees rotation of the knob. It is made in 200 and 400 ohm capacity.

Bryant Radio Receiver

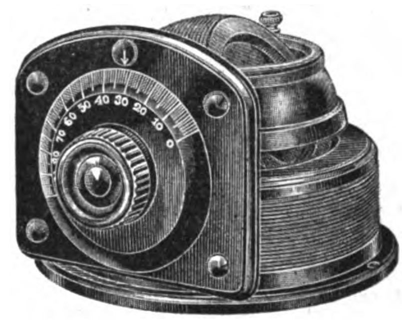
BRYANT RADIO RECEIVER

A receiver of unique design, consisting of detector and two stages of audio frequency amplification, is announced by the Bryant Radio Co. of Palo Alto, Calif. As may be noted from the illustration, the panel is set at a 45 degree angle, thus adding to the compactness of the set and to convenience in tuning. Tuning is accomplished by rotating one dial and change from one to two stages of amplification by turning a switch. All connections are at the back and the "B" battery is inside. The circuit is a special one developed by the Bryant engineers to eliminate spark signals, this set being intended primarily for broadcast reception in the home.

A NEW COUPLED CIRCUIT TUNER

The Atwater Kent Manufacturing Company of Philadelphia have developed a new tuner with the idea of simplifying operation and still retain maximum performance. It takes the place of a variometer and variocoupler in a coupled-circuit receiver, accomplishing the results with but one adjustment.

Tuning of antenna circuit is unnecessary. Three binding posts are provided on the back for adjusting the instrument to the particular type of antenna being used. Once this adjustment is determined, no further adjustment is necessary for broadcast reception. It is unaffected by body capacity at the dial knob. All insulating parts are sturdily made of moulded condensite.



New Coupled Circuit Tuner

The manufacturers state that at their summer laboratory in Kennebunkport, Maine, using this tuner, in conjunction with a standard circuit and 2 stages of audio frequency amplification, Broadcast Concerts have been clearly received from Porto Rico, Davenport, Iowa, Chicago, and many other distant points. The instrument can be used with a crystal detector and the crystal detector later discarded when a more pretentious set is desired.

SHIELDED A. A. TRANSFORMERS

One of the hits of the Chicago Radio Show was the completely shielded "All-American" transformer made by the Rauland Mfg. Co. of Chicago. This embodies a standard transformer, designed to give maximum amplification without distortion, completely shielded in a nickel-plated glass case. The shielding is claimed to make it possible to mount the transformers close to one another without induction disturbances or howling.

This transformer is made up in three ratios: 3-1, 10-1, and 5-1. The first named is recommended for the third and fourth stages, although the others can be used for as high as three stages without howling.

Los Angeles Radio Show

LOS ANGELES RADIO SHOW

Los Angeles held its first Radio Show October 9th to 15th. In point of interest on the part of the trade, it proved very successful, there being represented more than fifty firms, manufacturers and dealers. The exhibits were located conveniently on the large roof of the Arnold Building and were housed in very attractive booths. Working demonstrations of apparatus were most interestingly afforded by most of the exhibitors and, although there was very little in the way of actual novelty, the standard equipment shown was of wide variety and excellent character.

Exhibit at Los Angeles Radio Show. The Kolster Decremeter on Center Showcase Is Available for Amateur or Commercial Testing Purposes.

The exposition was held under auspices of Southern California Broadcast Association, the Radio Trade Association of Southern California and Southern California Radio Association. Largely owing to the fact that the principal reliance for publicity was upon mention of the Show in broadcasting programs, there was very little attendance of the general public, most of the visitors being those who possess receiving sets and are accustomed to listen-in on the daily broadcasts.

NEW RADIO CATALOGS

Essex Mfg. Co. of Newark, N. J., have issued a loose-leaf catalog of parts used in assembling crystal and tube receivers, together with complete tuner, detector and amplifier units.

The Handbook of Radio Facts from Frank A. D. Andrea of New York City supplies the technical explanations of design and construction of efficient radio receiving sets. It is invaluable to anybody who wants to "roll his own."

Radio Catalog No. 58 R from the Electric Appliance Co. of San Francisco is intended only for dealers, as this house sells to the trade. It lists the products of standard manufacturers. This jobber maintains a technical service department ready to assist the dealer in building his business.

The Mazda Radio Mfg. Co. of Cleveland, Ohio, has issued a series of leaflets illustrating and describing their high-grade radio parts which include vernier condensers, resistance pile type rheostats, sockets, plugs, jacks, knobs and dials.

BOOK REVIEW

Modern Radio Operation by J. O. Smith—138 pages 6x9. Published by Wireless Press, Inc., New York City, and for sale by Pacific Radio Publishing Co., San Francisco. Price $1.75.

This is a book for the transmitting amateur, especially the one who is interested in C. W. telegraphy and telephony. The author is widely known as 2ZL, a pioneer in C. W. work. Starting with general comments on broadcasting, he soon gets down to detailed descriptions of the condenser transmitter, "constant current" modulation and such stations as WDY, WGY and WJZ. The chapter on receiving equipment gives typical circuit diagrams for crystal and tube sets, including the Armstrong super-regenerative. Tube fundamentals and characteristics, types of C. W. t:ansmitters, and the work of such amateurs as 2ZL, 1ZE, 8ZG, 9ZG, 5ZA and 6XAD form the subjects of three chapters. Complete details are given for a 5-watt V. T. transmitter with electrolytic rectifier. Brief account is given of commercial C. W. work and considerable general information for the amateur. This text brings into convenient form the facts that have hitherto been available only in radio periodicals. The treatment is descriptive and commentive. Theory and mathematics have been eliminated so that any amateur can gain an excellent idea of the accepted practice in C. W. transmission.

Amateur Radio Directory and Call Book, edited by Walter B. Spiegel—116 pages, 6¾x 9½. Published by Radio Directory and Publishing Co., 45 Vesey St., New York City. Price $1.00.

Herein is a complete list of all amateur stations in the United States, including special license and broadcasting stations. By its use the name and address corresponding to any call letter may be located. It is, of course, invaluable to the transmitting amateur.

The Armstrong Super-Regenerative Circuit, by Geo. J. Eltz, Jr.—52 pages, 6¾x9½, paper cover. Published by Radio Directory and Publishing Co., 45 Vesey St., New York City. Price $1.00.

The ambitious amateur looking for an understandable treatment of the theory and operation of a super-regenerative receiver will find this book more helpful than most of the material yet published. This treatment is based on the fact that the action of the circuit is dependent upon the negative resistance being greater than the positive. Three cases are discussed in detail: variable negative, variable positive and simultaneous variation of both positive and negative. The hook-up and explanatory notes are given for each case, together with excellent pictures of a receiver employing the second method. Variometer control is used in each case. The text is concluded with a comparison of advantages and disadvantages of each method and a list of parts necessary to construct the sets.

How to Retail Radio, by the editors of *Electrical Merchandising*—226 pages, 5½x8. Published by McGraw-Hill Book Co., New York City, and for sale by Pacific Radio Publishing Co., San Francisco. Price $2.00.

Radio is such a highly specialized line of electricity that the would-be retailer has to make a special study of the subject to insure success. Here is a book for the dealer, a book telling of tested plans, methods and policies in selling radio equipment. It covers such topics as financing, location, store equipment and arrangement, buying radio, getting customers, advertising, displaying goods, training salesmen, demonstrations, installation and service, "hook-ups," speeding up sales, establishing a club room for amateurs, business records, overhead, turnover. It admirably fills its purpose.

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station

By 8RY, A. C. Bates, Burton, Ohio:
On Oct. 1st, 4bv de 6xad, 8 bum de 6xad, 9zn de 7zo, 7zo de 9avs.

By 2AZC, 68 South Side Ave., Freeport, N. Y.
All C. W.—1aso, 1acz, 1ae, (1agh), (1ajp), 1 aju, 1aon, (1axi), 1ayg, (1ays), (1azl), (1azw), (1bbs), (1bea), (1bgf), (1bkp), 1bpj, 1brq, 1boa, 1ccz, 1cgo, 1cho, 1cmp, 1cmr, (1cne), 1cpo, 1crf, (1fb, 1jt, 1or, 1xx, 1ze, 3aln, 3aqr, (3aqx), (3bgt), 3bhm, 3bif, (3blf), 3bnu, 3brw, 3co, 3cs, (3dt), 3hg, 3mk, 3ot, 4bf, 4bq, 4bx, 4dx, 4ea, 4ft, 4gk, 4lp, 4no, 4lj, 5bf, 5ek, 5kc, 5sk, 5sl, 5sm, 8ack, 8afd, (8akp), 8anb, 8aab, (8asl), 8awh, 8awt, 8ax, 8azd, 8azf, 8bda, (8bfl), 8bfm, 8bra, 8brk, 8bel, 8bem, 8bjk, 8bjx, 8bku, 8bko, 8bon, (8bfx), 8bha, 8brt, 8bsh, 8bss, 8btr, 8bot, (8bwa), (8cak), (8cgo), 8cgk, 8cgp, (8cgu), 8cen, (8ci), 8cjh, (8ckm), 8cmy, 8cnl, (8con), 8cra, 8cur, 8dak, 8hw, (8sb), 8sp, (8vy), 8zaf, 8zg, 9ags, 9ajh, 9aph, (9aps), 9as, 9awh, (9ays), (9bed), 9bqp, 9bzy, 9dge, 9dpl, 9fm, 9gl, 9ii, 9ky, 9kp, 9lq, 9uh, 9uu, 9xac.
Can.—3bv. All stations bearing mi 10 watt C. W. pse qsl.

By 6HX while on ship from New York to San Diego
Sept. 11, 1922. (120 miles south of New York)—Spk:8ew, 8bda, 9uh, 9bya. C. W.: 1bbw, 1chj, 5kc, 8vq, 8vy, 8bgg, 9nu, 9nx, 9bf, 9dky.
Sept. 12. (350 miles south N. Y.)—Spk.: 1cdm, 8ew, 8bda, 9zn. C. W.: 1fb, 3aln, 4bf, 4ft, 5es, 5kc, 8aqo, 8cmi, 9ii, 9zvf, 9aps, 9awn.
Sept. 13. (615 miles south N. Y.)—C. W.: 8ab, 8wl, 8wr, 8aqo, 9ii, 9nx, (768 miles south N. Y.)—C. W.: 8aau, 4jk, 4nv.
Sept. 14. (815 miles south N. Y.)—Spk: 1cni, 2ad, 2om, 4bs, 8bda, 9zn. C. W.: 1fb, 1bbs, 1bqa, 2bml, 2bsc, 3fs, 3od, 3ta, 3ala, 4bs, 4ea, 4nt, 8ok, 8alo, 8aqo, 8bla, 8cdz, 8cjh, 8cur, 9ox, 9ajh, 9dyn.
Sept. 15. (1050 miles south N. Y.)—Spk: 2om, 8bda, 9zn. C. W.: 1ajp, 3nu, 3aln, 3blf, 4ft, 4nt, 4st, 4tu, 5es, 5wc, 5za, 8vq, 8vy, 8wr, 8aim, 9ii.
Sept. 16. (1500 miles south N. Y.)—C. W.: 4bf, 9iu.
Sept. 17. (1750 miles south N. Y.)—C. W.: 4bf.
Sept. 18. (At anchor, Cristobal, Canal Zone) —C. W.: 4bf, 5eq, 5zt.
Sept. 19. (Off Cape Malai), Pacific Coast—Spk: 2omf, 9zn. C. W.: 1ajp, 4bf, 4gh, 8afd.
Sept. 24. (1739 miles from San Diego)—C. W.: 2fu, 4bq, 5be, 5px, 8wr. (Several spks in but lightning storm makes it impossible to copy any spk sigs.)
Sept. 25. (1450 miles from San Diego)—C. W.: 5di, 6jd. (1200 miles from San Diego)—Spk: 5hd. C. W.: 5kc, 5qi, 9yx, 9awm.
Sept. 26. (1200 miles from San Diego)—C. W.: 2fp, 5st, 6bes.
Sept. 27. (1000 miles from San Diego)—Spk: 6ke, 8bda, 8cmi, 9rw, 9amk, 9dgw. C. W.: 2fp, 2gk, 6zf, 6jh, 6bes, 8box, 8cgx, 9zn, 9zaf.
Sept. 28. (770 miles from San Diego)—Spk: 6aau. C. W.: 5cy, 5vy, 5za, 6cp, 6zf, 6ahr, 6avd, 6beg, 6bjq, 6boe, 9zaf.
Sept. 29. (455 miles from San Diego)—Spk: 6ao, 6qr, 8bda. C. W.: 2fp, 5za, 6en, 6zf, 6bjy, 8bke, 9dx, 9awm, 9dpl, 9zaf. (275 miles from San Diego)—Spk: 6aqu, 8ze, 9pn, 9dhi. C. W.: 5zh, 9amb, 9dtm.
Oct. 4. (Alongside dock at San Pedro, Cal.) —C. W.: 4lx, 5xd, 5za, 7tq, 9ps, 9anq, 9awm, 9cns, 9dsm.
Oct. 6. (100 miles south of San Francisco)—2fp, very qsa.
List is dated according to 75th Mer. time.

By 9DR, 1930 Stevens Ave., Minneapolis, Minn.
C. W.: (1ajp), (2brb), 2fp, (3bnu), 3dc, 3ot, 8vw, 4bq, (5be), 5cy, (5dl), 5ek, 5fv, 5ir, (5kc), (5nr), (5px), 5qi, 5qs, 5sf, 5sk, 5un, 5uo, 5va, 5yv, 5zg, 5zh, 6cu, 6ea, 6eb, 6en, 6jd, 6ka, 6ma, 6zg, (6arb), 6azj, 6boe, (6bsa), (6xad), (7lu), 7xc, (8ab), 8ai, (8bo), 8ci, 8fi, (8ib), 8kg, 8sb, 8sp, 8ue, 8uk, (8vy), 8zy, (8zz), 8abb, (8adt), 8afd, 8afy, 8aim, (8aio), (8akp), (8asl), (8asv), (8axb), 8axm, 8axs, 8azd, 8bda, 8bef, (8zfm), 8ben, 8bgo, (8bho), 8bjx, 8bke, (8bkn), 8bnj, (8brq), 8btl, (8buc), 8bux, 8bwa, 8bwk, 8cak, 8cdz, 8cgx, (8cko), (8con), 8cpd, (8ctn), 8cur, (8cyt), 8daf, 8zaf, 8zag, 8zje, (9cp), (9et), (9ew), (9ii), (9mn), (9ps), (9uu), (9abv), (9amb), (9aqm), (9ays), (9ayy), (9bvp), (9bxc), (9bxt), (9cfi), (9dah), (9dhq), (9dkb), (9dsm), (9dug), (9dun), (9dzb), (9yak), (9zaf), Canadian 3cb, (4bv),
Spark: 5jf, 5xac, (8ze), (9cp), (9pe), (9zc), (9zn), (9arr), (9bmn), (9bws), (9bxc).

By 9AQR, 3115 Olive St., Kansas City, Mo.
C. W.:1fb, 2apd, 2fp, 3bij, 3bnu, 4bf, 4bq, (4eh), 4hw, 4kf, (5bq), 5eg, 5hl, 5jl, 5la, 5lb, 5mn, (5nv), 5px, 5qi, 5sm, 5xac, 5xad, 5xk, 5xv, (5za), 5zh, 6bf, 6cp, 6en, 6gx, 6ka, 6xb, also fone, 6zg, 6abx, 6ajh, 6boe, 6bqc, 7lu, 7zu, 8sb, 8sp, 8uk, 8wr, 8zz, 8afy, 8akp, 8apt, 8azd, 8bdb, 8bef, 8bjc, 8bjf, 8bwa, 8cab, 8cjh, (9uc), (9aog), (9asd), (9aua), (9bed), (9byz). Can.: 3ko, 4bv, 9al. Spk: 7gs.

By 6AKW, Route No. 1, Lancaster, Calif.
6gr, 6gf, 6fh, 6ala, 6tu, 6qy, 6gx, 6arc, 6cc, 6rd, 6hc, 6bsa, 6bjx, 6bcr, 6ib, 6km, 6cp, 6bol, 6bmd, 6ark, 6bju, 6acr, 6qr, 6ic, 6zx, 6zf, 6ze, 6zg, 5za, 5zh, 6xjb, 6xb, 7lu, 7jw, 7fq, 7th, 7sy, 7zg, 7zb, 8atu, on Sept. 24, '22, abt. 9:35 p.m. P. S. time. 9ac, 9amb, 9dug, 9ws, 9dtm, 9cjj, 9zaf, 9awm, on Sept. 24, '22, at 9:57 p.m. P. S. time. 9zd.
Also these broadcasters: whz, klz, kgg, kfck, kgyf, on Oct. 1, '22, at 8:00 p.m. P. S. time; kgy, kyg, kzn, kgw, bn4, kdyl, kfaf, klx, kwg, kjj, kuo.

By 6BQZ, 1912 West 23rd St., Los Angeles, Cal.
C. W.: 5za, (6ak), (6cc), 6cp, 6ge, 6gr, 6gx, 6nx, 6rm, 6uw, (6aat), (6abx), 6ada, (6aeh), (6agp), 6aiv, 6ajh, 6aqq, 6arb, (6asj), 6atq, 6awp, 6awt, (6bcd), (6bcj), 6bcr, 6bgd, (6bjy), 6bkb, 6bmd, (6bqf), 6bql, 6bsa, 6za, 7aea, 7lu, 7sc, 7pf, (7tq), 7mf, 9amb, 9awm, 9cms, 9dtm, 9zaf.
Spark: 6ic, 6tu, 6ahf, (6ajh), 6bju

By Claude Perkins, 347 So. Fremont Ave., Los Angeles, Calif.
Sparks: 5xd, 6ac, 6ak, 6ar, 6au, 6bp, 6cc, 6cs, 6cy, 6eg, 6ex, 6gr, 6gx, 6hc, 6gy, 6hv, 6ku, 6kz, 6nh, 6nx, 6or, 6qt, 6su, 6tu, 6tw, 6uf, 6vh, 6vx, 6aad, 6aeh, 6aes, 6afu, 6ahf, 6ahq, 6ahr, 6aiv, 6ajh, 6ajr, 6amk, 6aqk, 6aqf, 6arb, 6asf, 6ata, 6atp, 6atu, 6zq, 7mf, 7sc.
C. W.: 5za, 6zb, 6zf, 6zm, 6zz, 6zap, 6awt, 6zam, 9ac, 9amb, 9ayu, 9dtm, 9zaf, 9aja, 6gx, 6ku, 6aeh, 6atp.

By 7VX, 5411 South L St., Tacoma, Wash.
C. W.: 6ak-tone, 6cc, 6cp, 6cu, 6ea, 6eb, 6fh, 6ft, 6gx, 6ka, 6km, 6ku, 6nx, 6rd, 6rr, 6ti, 6xh, 6zf, 6zs, 6zx, 6aat, 6abx, 6ajf, 6ajh, 6alu, 6apw, 6aqw, 6arb, 6asj, 6awp, 6awt, 6awn, 6avd, 6atc, 6bcj, 6bcr, 6beg, 6bes, 6bir, 6bjq, 6bkb, 6bko, 6bkr, 6bqc, 6bqg, 6boe, 6bmd, 6bmn, 6bsa, 6bsc, 6bum, 6xad, 7dx, 7hr, 7jf, 7jw, 7lu, 7mf, 7na, 7nn, 7nj, 7ny, 7oe, 7oz, 7qw, 7rn, 7sc, 7sy, 7th, 7tn, 7tt, 7zb, 7zk, 7aea, 7afa, 7afw, 7adp, 7ugf, 9awm, 9zaf. Can.—C. W.: 4bz, 5ct, 9ac. Can.—Spk: 5cn, 5do, 5dx, 9bd.
Spark: 6ao, 6cc, 6fh, 6ff, 6gr, 6hc, 6hf, 6ic, 6ke, 6km, 6ol, 6qr, 6tu, 6up, 6vx, 6aav, 6abw, 6abv, 6abx, 6acr, 6aey, 6ahf, 6ajh, 6akt, 6ala, 6alv, 6amn, 6amz, 6ani, 6ars, 6ark, 6avs, 6avu, 6avv, 6avb, 6bak, 6bgy, 6bip, 6zae, 7fi, 7fg, 7ge, 7iw, 7jf, 7kj, 7mu, 7nn, 7nw, 7oh, 7of, 7ot, 7rc, 7sf, 7tw, 7ve, 7vf, 7vo, 7wg, 7zg, 7zk, 7zu, 7aea, 7aem, 7abs. All correspondence answered.

By 6BQD, 4517 W. 17th Drive, Los Angeles, Cal.
C. W.: 5un, 5za, 5zh, 6cp, 6gr, (6gx), 6gy, (6abx), (6aeh), (6ajh), 6arb, 6atc, 6atv, 6awt, (6bcd), (6bcj), 6bcr, (6bjy), (6bkb), 6bqf, (6bql), 6xj, 6zb, 7lu, 7mf, 7oz, 7tq, 9amb, 9dtm, 9xaq, 9zaf.
Spark: 6gr, 6tu, (6ahf), 6ajh, 6akl, 6bju, 6zae. Anyone hearing 6BQD on spark or C. W. pse. QSL.

By 6AGK, San Diego, Calif.
Spark: 6cc, 6fh, 6gr, 6gt, (6ic), 6if, (6km), 6oh, 6ol, (6gk), 6qr, 6tm, 6to, 6ty, (6up), 6vx, (6aak), 6aau, 6aic, 6abw, 6abz, 6act, (6akt), 6alv, 6amk, 6aqz, 6avb, 6avm, 6avr, (6awx), 6bae, (6bjg), (6bnv), (6bpz), (6bvd), 7ot.
C. W.: 5za, 5zh, 6bf, 6br, 6cp, 6ea, 6ec, 6ef, 6fh, 6ft, 6gx, 6lv, 6ly, 6qa, 6aat, 6ahp, 6ahq, 6apw, 6aqz, 6arb, 6arv, 6atq, 6avv, 6awt, 6bcd, 6bed, 6beg, 6ben, 6bjz, 6bjr, 6bmd, 6boe, 6bpz, 6bqc, 6bqd, 6bqg, 6bqo, 6bqz, 6brg, 6brk, 6bsa, 6bvq, 6bzj, 6zf, 7hr, 7lu, 7afw, 9amb, 9awn, 9dtm.

By 7SG, Midson, Wash.
C. W.: 4hw, 5acf, 5acu, 5ek, 5fv, 5hb, 5ke, 5nk, 5nn, 5px, 5sk, 5sm, 5tj, 5tm, 5uk, 5uo, 5vy, 5xad, 5xu, 5xy, 5za, 5zag, 5zaw, 5zg, 5zh, 6aag, 6aat, 6ahq, 5ajh, 6ak, 6alu, 6amh, 6anp, 6aqw, 6asj, 6atc, 6atj, 6atq, 6atu, 6av, 6avd, 6avn, 6awt, 6bcj, 6bdw, 6beq, 6bes, 6bfy, 6bic, 6bjc, 6bjy, 6bko, 6bmd, 6bmx, 6bod, 6bpf, 6bpz, 6bqc, 6bqd, 6bqf, 6bqg, 6bqp, 6btb, 6bum, 6bun, 6cc, 6cp, 6cu, 6eb, 6en, 6gr, 6ka, 6lo, 6ov, 6pi, 6rd, 6tj, 6gd, 6tw, 6xad, 6xh, 6zx, 6zz, 6vf, 7aad, 7ad, 7aft, 7afw, 7agn, 7aiu, 7bb, 7bj, 7cz, 7du, 7hm, 7lu, 7nn, 7nv, 7oe, 7qf, 7ri, 7rn, 7sc, 7sy, 7th, 7tg, 7tq, 7wm, 7wx, 7ya, 7zh, 7zk, 8ach, 8bfx, 8cp, 8cmi, 8cpm, 8cur, 8ib, 8lk, 8xe, 8zz, 9aap, 9abu, 9afd, 9ajh, 9amb, 9ami, 9amq, 9anf, 9anq, 9api, 9apw, 9ark, 9ars, 9aul, 9avz, 9awm, 9aws, 9baz, 9bcb, 9bef, 9bey, 9bg, 9bji, 9bjv, 9bri, 9bsz, 9btt, 9buw, 9bxq, 9cca, 9ccv, 9cgk, 9cmk, 9cns, 9cuc, 9cxp, 9dcf, 9dge, 9dky, 9dsm, 9fm, 9gk, 9gl, 9ii, 9km, 9pi, 9qf, 9vl, 9xac, 9xaq, 9xl, 9yw 9zaa, 9zaf, 9zx, bt8, kdpw, wwx, klz, fone. All heard Oct. 12, 13, 14 and 15 on one step and one wire aerial 20 ft. high. Will answer all correspondence

By 6EC, Orange, Calif.
C. W.: 4bv (Can.!), 5be, 5gx, 5px, 5uo, 5za, 6bf, 6br, 6cc, 6cp, 6fh, 6gv, 6pl, (6rd), (6aag), 6aat, 6aan, 6abx, 6acr, (6arp), 6ahq, 6aie, 6ajh, 6aoi, 6apw, (6aqw), 6arb, 6atc, (6atq), 6avu, 6awt, (6bbe), 6bcj, 6bcp, 6begf, (6beq), 6bbs, 6bic, 6bir, 6bje, 6bjg, 6bjq, 6bjt, 6bjx, (6bjx), 6bjz, 6bko, 6bmd, (6bnv), 6bob, 6boq, 6bpq, 6bpz, 6bqc, 6bqd, 6bqf, 6bqp, 6bqz, 6brd, 6brg, 6brk, 6bum, 6bzg, 6xj, 6xg, 6za, 6zs, 6zx, (6zf), 6zap, 7ad, 7lu, 7afw, 7xc, 7zb, 7zo, 9ao, 9uu, (9wd), 9amb, 9ape, 9awm, 9bly, (9dte), 9dtm, 9xaq, 9zaf.
Spark: 6gr, 6gt, 6if, 6qk, 6qr, 6up, 6vx, 6ahu, 6aic, 6ala, 6ald, 6atf, 6avr, 6awx, 6baj, 6bjg, 6bju.

By 7ZU, Billings, Mont.
C. W.: 5acf, 6anx, 5di, 5dy, 5ek, 5hk, 5if, 5jl, 5kc, 5lb, 5la, 5nv, 5oi, 5px, 5sm, 5uk, 5za, 5zg, 5zh, 5zw, 6aby, 6arb, 6aoi, 6atq, (6abx), 6acr, 6aw, 6aat, 6ard, 6awt, (6amh), 6bqc, (6bqg), 6bvj, 6bxe, 6boe, 6bmd, 6bk, 6bco, 6bic, 6bcr, 6cc, 6cd, 6cp, 6en, 6gx, 6ki, 6vv, 6xad, 6xaj, 6xj, 6zb, 6zm, 6zz, 7aeg, 7aea, 7agc, 7amc, 7aof, 7ex, 7fq, 7hm, 7jf, 7lu, 7tn, 7xc, 7zo, 8bcy, 8bke, 8vy, 9ayj, 9anq, 9abv, 9awm, 9ava, 9ays, 9aos, 9aog, 9ami, 9amb, 9aar, 9apw, 9aci, 9awn, 9aws, 9aiy, 9bbf, 9bcf, 9bjv, 9bxt, 9bf, 9bzz, 9bju, 9bgh, 9bxa, 9bmi, 9bkp, 9bu, 9bud, 9bui, 9 bed, 9bsz, 9bji, 9bhd, 9bzi, 9cmj, 9cfi, 9cjj, 9ck, 9ckm, 9cmk, (9cns), 9ctr, 9ccs, 9crm, 9dky, 9dqe, 9dzq, 9dgm, 9dtm, 9dsd, 9dig, 9dr, 9dkx, 9dte, 9dbl, 9dkq, 9dcf, 9dxl, 9dr, 9ew, 9fm, 9gk, 9ii, 9kky, 9nu, 9pi, 9ps, 9uu, 9ve, 9wc, 9xac, (9xaq), 9xl, 9yae, 9yaw, 9yaj, (9zaf), 9zaa, 9zn.
Spark: 5fv, 5is, 5tj, 5za, 5fv, 6aou, 6ani, 6acr, 6awh, 6apd, 6bzc, 6cc, 6gr, 6ic, 6kn, 6tx, 6zz, 7awa, 7ge, 7ks, 7pf, 7th, (7wg), 7ya, (7zg), 7awa, 9aso, 9av, 9ayw, 9acw, (9aig), 9amg, 9aza, 9awf, 9axu, (9bix), 9bgs, 9bwj, 9bxy, 9bd, 9bix, 9bxc, (9btx), (9ctw), 9cew, 9dtx, 9dkq, 9dky.
Voice: (4bv), 5zg, 6xg, 7xi, 9gk, (9cns), (9pi), 9zaf.
Canadian Stations: 4bv (C. W.), 9bd (C. W.), 9ac (C. W.).

By 6IX, Arcata, Calif.
(Can.) 5bq, bt3.
6cc, 6cn, 6pi, 6rm, 6uw, 6xp, 6xh, 6zz, 6aeh, 6agu, 6ahp, 6ajf, 6ajh, 6aou, 6aqw, 6asq, 6atc, 6atg, 6atq, 6atv, 6aun, 6auu, 6avd, 6avg, 6baf, 6bcr, 6bdw, 6bes, 6bjj, 6bjy, 6bkb, 6bki, 6bko, 6bmu, 6bol, 6bqg, 6bqz, 6brf, 6btb, 6bty, 6bug, 6bum, 6xas, 6zac, 6zaf, 6zal, 7bj, 7bs, 7jf, 7jw, 7mn, 7nn, 7ny, 7oe, 7pf, 7rn, 7sc, 7tq, 7wf,, 7wm, 7xi, 7zb, 7zk, 7aad, 7aft, 7afw, 9gk, 9io, 9xp, 9awm, 9bji.
Phone: 6btb, 6zal, 6sa.

By 6BUH, Salt Lake City
C. W.: 5dc, 5la, 5tj, 5uo, 5za, 5zh, 6abx, 6ad, 6ajh, 6ajs, 6apw, 6aqw, 6atg, 6atq, 6auu, 6avr, 6aww, 6azw, 6bas, 6bcj, 6bes, 6bjq, 6blc, 6blq, 6bqd, 6bqz, 6brg, 6bts, 6bum, 6cc, 6lf, 6lh, 6lo, 6rd, 6uw, 6xad, 6xav, 6xj, 6zz, 7ab, 7aem, 7afw, 7bj, 7lo, 7lu, 7ot, 7pr, 9afd, 9amb, 9aul, 9awm, 9baz, 9bey, 9bji, 9bud, 9buo, 9bvo, 9bxa, 9bxq, 9ccv, 9cfy, 9cmd, 9cns, 9dge, 9dn, 9dsm, 9dte, 9dtm, 9gk, 9lif, 9pi, 9pn, 9xaq, 9yw, 9zaf, 9zx, 9awl.
Spark: 5za, 6lx, 7wg, 7zg, 7zu, .
Phone: kfaf, kfi, 5za. Anyone hearing 6BUH pse QSL to 438 D. St., Salt Lake, Utah.

By 7TT, 7126 54th Ave. S. E., Portland, Ore.
Canadian—C. W.: 4bv, 5ct. Spk: 5cn, 9bd.
U. S.—C. W.: 5za, 6bj, 6bq, 6en, 6cu, 6cp, 6ec, 6gr, 6hp, 6ka, 6ku, 6lv, 6pi, 6rd, 6up, 6uw, 6vm, 6abx, 6aeh, 6ahf, 6ajf, 6ajh, 6aln, 6apw, 6asj, 6atc, 6atq, 6awt, 6bcj, 6beg, 6bko, 6boe, 6bpz, 6bqc, 6bqg, 6bqz, 6brf, 6bsa, 6bum, 6xad, 6zg, 6zf, 6zaf, 7ad, 7if, 7iy, 7lu, 7mf, 7om, 7se, 7th, 7tn, 7tq, 7xc, 9awm, 9tm, 9zaf, 9amb, bt3.
Spk: 6tu, 6acr, 6ark, 7fr, 7ge, 7ya. Anybody hearing 7tt C. W. Plse QSL.

By 6AOU, 626 16th Ave., San Francisco, Calif.
All C. W.: Canadian—3bv, 3hh, 4bv, 9ac. American—4eh, 5aa, 5eg, 5fv, 5im, 5nk, 5tj, 5xd, 5xs, 5za, 5zap, 5ek, 8qk, 8acg, 8asv, 8bfl, 8bnu, 8xe, 9anq, 9aog, 9aps, 9apw, 9amb, 9ajh, 9avz, 9aul, 9avz, 9awm, 9axu, 9ays, 9bji, 9bxg, 9bvo, 9cfy, 9cns, 9dfb, 9dge, 9djm, 9dky, 9dkq, 9dsm, 9dr, 9fm, 9gk, 9ct, 9ii, 9ps, 9pn, 9uu, 9ve, 9xac, 9xaq, 9xan, 9xai, 9yaj, 9zaf. Would like to hear from above stations by card.

By 6AWT, 653 Union St., San Francisco, Calif.
C. W.: 4lk, 4bv, (5di), 5ek, 5pb, (5px), 5sb, (5sf), 5uk, (5uo), (5xd), (5za), (6cu), (6ea), (6eb), (6en), (6ft), (6pi), (6zs), 6zz, (6aeh), (6alu), (6apw), (6bbc), (6bfp),

Continued on page 44

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CALLS HEARD

Continued from page 42

(6boe), (6bpz), (6bqd), (6bqz), 6zac, (nrrs) (7bb), 7dp, (7iy), (7hm), 7jf, (7jw), (7lu), 7mw, 7na, 7nn, 7oe, 7oz, 7qn, (7sc), 7th, 7tn, (7tq), 7wm, 7xc, 7xi, (7zb), 7zk, 7zo, 7zu, (7aea), (8cf), (8ib), 8lv, 8nb, 8yd, (8bfm), 8bfp, 8bke, 8bxh, (9ac-Can.), 9cp, (9dp), 9kp, 9ps, 9yi, 9yu, 9zn, 9afd, 9ajp, (9amb), 9ami, 9anf, (9anq), (9aog), 9aon, (9aps), (9apw), 9aul, 9awm, 9ays, 9ayu, 9bed, 9bek, 9bxc, (9cns), 9cuc, 9dtm, 9xaq, 9yaj, (9zaf), kfi, kfc, kzn, kfay, wgm.

By 7TH, Walla Walla, Wash.

Can.—Spark: 4ec, 5dx, (9bd), (5cn). C. W.: (4bv), (5ct).

U. S.—C. W.: 5di, 5vn, 6ak, 6cc, 6cp, (6cv), (6ea), (6eb), 6en, 6ft, 6gx, 6qm, 6rm, (6nx), 6aat, 6aag, 6aeh, 6ajh, 6alu, 6apw, 6aqw, 6arb, 6atc, 6atq, 6awt, 6bcd, 6bcj, (6bic), 6bjc, 6bko, 6bmv, 6boo, 6bpz, 6bqc, 6bqp, 6bqz, 6brf, 6bsa, 6bum, 6bun. Spark: 6ec, 6ic, (6iv), 6qk, 6qr, 6tc, 6vx, 6amk, 6ang, 6ani, 6ala, 6alv, 6bju. C. W.: (9ps), 9amb, 9ani, 9anq, 9aog, 9avz, 9awm, 9bqw, 9bxa, 9bxt, 9ccv, 9cfy, 9dtm, 9zaf,. All stations hearing my 10 watt C. W. ple QSL.

By 6OO, 88 Peralta Ave., San Francisco

8vy, 8asv, 9wd, 9zn, 9amb, 9aap, 9bji, 9cns, 9dtm, 9xaq, 9zaf, 7lr, 7rn, 7zn, 7zb, (6agp), (6apw), 6cc, 6zh, 4hh. All C. W. on 1 step amplifier.

By 6ZY, Honolulu, Hawaii

4bq, 4bx, 4eb, 5di, 5jw, 5kc, 5ks, 5px, 5zh, 5za, 5aat, 6abx, 6abu, 6ak, 6ath, 6aoi, 6awt, 6apw, 6ahq, 6ajh, 6asj, 6ar, 6arb, 6alu, 6atg, 6bxy, 6brx, 6br, 6bar, 6bqc, 6bpz, 6bql, 6bun, 6bzc, 6bsa, 6bfe, 6cu, 6cp, 6cc, 6cp, 6en, 6ec, 6ea, 6eb, 6ex, 6gx, 6jd, 6ka, 6mbc, 6mdm, 6pi, 6xad, 6xwi, 6zh, 6zx, 6zm, 6ze 6zs, 6zq, 6zg, 7kj, 7lu, 7mf, 7xc, 7zo, 8ab, 8ah, 8alt, 8abr, 8bg, 8bfm, 8bpl, 8bss, 8bda, 8ib, 8kg, 8oh, 8ok, 8ow, 9aap, 9ac, 9aja, 9awm, 9aph, 9arz, 9aps, 9aog, 9alt, 9ao, 9amb, 9ags, 9bbf, 9bno, 9bbl, 9bec, 9bed, 9bjv, 9bzi, 9cns, 9cpb, 9dhb, 9dsm, 9dq, 9dpl, 9dg, 9dtm, 9dph, 9ps, 9uu, 9zaf, wuba.

Spk: 6ahf, 6en, 6up, 6bju, 6bfe, 7nn.

By 6ZAC, Wailuku, Maui, T. H.

C. W.: 2fp, 2gk, 4bq, Can. 4bv, 5acf, 5nk, 5px, 5sf, 5tj, 5za, 5zh, 5zaw, 6ak, 6aeh, 6ajh, (6abx), 6ahq, (6asj), 6asr, 6avd, 6brf, (6bsa), 6bpf, 6bpz, 6bqc, 6bqd, 6bju, 6brc, (6cc), (6ea), 6ec, (6en), 6cu, (6cp), 6jd, (6ka), 6ku, 6pi, 6rd, 6rm, (6tq), (6xj), 6xad, 6zb, 6zf, 6zx, 6zaf, (6zg), (7sc), 7sy, (7ot), (7xi), 7zb, 8bum, 9amb, 9anq, 9aph, 9aog, 9awm, 9bey, 9bji, 9dsm, 9gk, 9mf, 9xaq, 9yaj, 9zaf.

Spk: 5za, (6ex), (6aqu), 6tc, 9yak.

By 7ADF, Montesano, Wash.

C. W.: 4bv (Can.), 5ck, 5ct, 5cn, 5ct, 5dic, 5mc, 5td, 5va, 5za, 5zp, 6aal, 6aat, 6abm, 6abu, (6abx), 6afw, 6ahp, 6ajf, 6aps, 6arf, 6ars, 6atc, 6atg, 6atq, 6awe, 6awp, 6awt, 6bcd, 6bcj, 6bcr, 6bic, 6biw, 6btb, (6bum), 6ak, 6bc, 6bg, 6br, 6bo, 6bq, 6cc, 6cu, 6dj, 6ea, 6gf, (6gr), 6ku, 6po, 6pi, 6uw, 6vm, 6vv, 6xj, 6zf, 6zs, 6zu, 6zx, 7aad, 7abh, 7abx, 7aea, (7aem), 7afw, 7agx, 7bk, 7bj, 7bx, 7dp, 7ic, 7iy, (7ke), 7la, 7lf, 7lr, 7lu, 7mf, 7mu, (7ot), 7sy, (7th), 7tn, 7tq, 7zb, 7zf, 8bu, 9amb, 9amg, 9aps, 9awm, 9bed, 9bjs, 9bqq, 9bwi, 9cns, 9pi.

Spk: 5zp, 6abc, 6abk, 6acr, 6ala, 6alx, 6amk, 6ark, 6atq, 6bcw, 6bjc, 6biq, 6bmd, 6bua, 6al, 6aq, 6cc, 6cv, 6dp, 6fr, 6gr, 6lu, 6po, 6rd, 6to, 6tv, 6uw, 7abs, 7bb, 7fn, 7ge, 7jc, 7jf, 7jw, 7mf, 7mu, 7qf, 7rc, 7vf, 7wp, 7yw, 7zg, 7zk, 7zu, 9bd (Can.), 9ge, 9uu.

Fone: kfz, kfck, kfcd, kyz, kfg, klc, kfdc, klt, kmo, klp, kzn, kdyl, chcq, kfbk, kbb, cfch, kdzf, kfam, kdys, kzz, kzv, kdzi, and many others.

By 7SN, Seaside, Ore.

C. W.: 5za, 5xad, 5di, 5ek, 5px, 5nk, 5sk, 5qi, 5ae, 5fv, 6sg, 6ak, 6cc, 6gy, 6lv, 6zz, 6rm, 6pi 6rd 6gd, 6en, 6wr, 6ec, 6zx, 6lk, 6vf, 6nx, 6eo, 6lh, 6xh, 6bh, 6cu, 6oo, 6uw, 6gf, 6cp, 6bz, 6gr, 6abx, 6alu, 6ajh, 6zae, 6bcj, 6bqg, 6aor, 6beg, 6bpf, 6bqz, 6bcd, 6aat, 6bqd, 6awt, 6bcr, 6bum, 6bmd, 6ahq, 6bql, 6asj, 6avv, 6aqw, 6atq, 6zac, 6bdw, 6bmx, 6atj, 6btb, 6anp, 6brf, 6aod, 6abr, 6bdb, 6avn, 6bic, 6xas, 6blu, 6bjy, 6aiy, 6bnt, 6xad, 6atc, 6auu, 6bin, 6bud, 6aoi, 6aae, 7ng, 7iz, 7ru, 7nn, 7sy, 7dx, 7tq, 7zb, 7aw, 7sc, 7dp, 7bj, 7wm, 7to, 7pf, 7th, 7lw, 7ad, 7bk, 7jw, 7hm, 7ot, 7rn, 7ri, 7aft, 7adf, 7aem, 7afw, 7yaf, 8zk, 8dx, 8asv, 8cmi, 8aim, 9gk, 9yu, 9yf, 9zaf, 9bed, 9zaa, 9xaq, 9dky, 9awm, 9ami, 9arz, 9xam, 9yaj, 9cns, 9dsm, 9aqm, 9bhd, 9zag. Can.—4oq, 4bv, 5bq, 5ct.

Spk: 6qr, 6dd, 6oh, 6ex, 6gr, 6ec, 6ic, 6vx, 6lu, 6bua, 6ark, 6abw, 6acr, 6amk, 6akt, 6alv, 6agt, 6bak, 6zae, 6ala, 6bin, 6amw, 6bip, 7of, 7wg, 7tw, 7nn, 7jf, 7oh, 7ba, 7ge, 7ne, 7zu, 7po, 7acn.

Continued on page 64

$13.60—That's All for a Willard "A" Battery

It's Made in 3 Sizes!

This new battery—the Willard FW—is of the 6-volt type and made in three sizes, 40, 80 and 110 ampere hour capacity. They are priced as follows: 40 a. h., $13.60; 80 a. h., $17.50; 100 a. h., $22.00. A slight addition to these prices is made in the extreme South and West of the Mississippi.

Here's a Christmas present that will go big, you can be sure—with yourself or anyone else who has a radio set.

It's a genuine Willard "A" Radio Storage Battery at the lowest price for which a Willard Radio "A" Battery has ever been sold.

And when we say genuine Willard we mean just that, for this new battery is fit in every detail to bear the name. We are no less proud of having been able to produce such a good battery to sell at such a low price than of being the makers of the popular Willard All-Rubber Radio Batteries, the last word in radio battery construction.

Why This is a Real Willard

It is made in the same plant and by the same men who make the higher-priced Willard batteries for both radio and automobile service, and they bring to it the same care, skill and experience.

It has Willard quality plates, selected wood separators, tested rubber jars, acid-proofed container.

It includes such features as special terminals to insure easily-made and tight connections, special marking for positive terminal; patented rubber gaskets to prevent leakage; a convenient durable roller-type handle, and other advantages.

All Willard Radio Batteries, too, are shipped from the factory dry and fully charged, so that you always get a brand new battery and one that is ready for use just as soon as the acid solution is poured into it.

Go to the nearest Willard Service Station or your dealer's today and see this new Willard Battery.

WILLARD STORAGE BATTERY CO., Cleveland, Ohio

Made in Canada by the
Willard Storage Battery Company of Canada, Limited, Toronto, Ontario

Willard STORAGE BATTERY

CHRISTMAS PHANTOMS

Continued from page 23

Captain Hamish was oiling the control on his engine-room telegraph. He grinned sociably as Norris came in. He was a pleasant-faced man of forty, with the skin that goes with sailoring and a pair of quizzical blue eyes. It was their first cruise together and he liked the unconventional off-handedness of the new operator.

"Well?" he asked.

"You're wanted on the phone," said Norris dryly, with just a hint of a smile. The Captain's eyes narrowed.

"Huh! What's that?"

Norris shrugged.

"Some ass on a radiophone just called you up," he explained. "Refused to give a sine. Got nasty when I asked him for one. Insisted on having you in a hurry." He waited.

The Captain stared at him with open mouth. Then he chuckled.

"Feel all right Bob?" he asked.

Norris flushed.

"Go on," he said. "Rub it in. That's the way I felt when I heard it . . . . a voice, two hundred miles off the Mexican coast. He comes in like a hammer . . . . not far away . . ."

Something flickered back in the Captain's eyes—something that made Norris wonder. He straightened up.

"All right," he said. "Let's see what this bird has to say."

He led the way down to the operating room. At the door he paused and swept the horizon with keen eyes. There was the yellow haze, the copper rim of the sinking sun, and limitless distance. Nothing more. He stepped inside.

Norris plugged in an extra pair of telephones so that the captain could listen with him. Then he set his generator to humming.

"O-K . . . G.-A . . . go ahead . . . WWMQ," he spelled into the placid air. Instantly came the hollow drone of the carrier wave.

"Captain Hamish there?" demanded the voice.

"Yes," Norris answered, on the key.

"All right," ordered the voice, "give him the phones and stay off the air yourself."

Norris swung in his chair. Captain Hamish's face was a study in conflicting emotions, but he nodded and indicated that Norris remove his headpieces. Norris complied, tapping a brief "I-I" on the key. He was game to see it through.

The Captain stood motionless—listening intently. Norris could hear the voice issuing from the receivers on the table but could not make out the words. The tones were quick and incisive and seemed to be giving orders. Hamish

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had grown suddenly white. His eyes were staring.

Suddenly with a cry he threw down the receivers and dashed from the operating room. Norris stared at his retreating back in amazement. Then he grabbed up the head-set. All was silent. Save for the crack of the static there was no sound.

Down below, the ship's telegraph jangled suddenly . . . The *Susan Reynolds* began to veer around, heading inland at twelve knots an hour. Hamish on the bridge . . . . !

A shadow flitted over the deck, and a black smudge laid down beside the ship. The operator opened his door and glanced upward. Great billows of smoke were rolling from the short stacks, as the vessel, under forced draught, gathered her heels under her. He caught the change of direction, and the rapid movements of the crew.

Hamish and his stricken face kept coming up . . . .

He turned back to his instrument, and calibrated the adjustment for future reference, logging the circumstance among his records. What did it all mean? Whence came this mysterious voice that tore the soul out of a man like Hamish, and sent a tanker veering about on a strange course?

It is no part of a radio operator's job to question a captain. Yet some radio operators possess privileges. Norris, pacing the deck in indecision, suddenly took the bit in his teeth . . . .

Captain Hamish was absorbed in a chart, spread out on the table before him. Measuring distances with a pair of calipers, he did not look up as Norris entered. The latter could see that he was still gripped by fear, by a feverish anxiety to get to some place . . . . The face of the first officer stopped his tongue. The man was staring at Hamish with a curious, puzzled expression.

Norris closed the door softly and stepped back to the deck. Whatever lay behind, the captain had not talked . . .

The sun was dead astern now!

Only that noon, Hamish had said "all hell" wouldn't keep him from making Callao by the fifth. Now he was going almost dead away from it. Wherefore, reasoned Norris, the voice out of the ether, had represented "hell" or worse. He went back to the radio room.

The second officer dropped in presently, an over-casualness in his manner. Had heard the radio working. Any news? Any excitement? His hands were unsteady as he rolled a cigarette. Norris shook his head.

"No—just testing to see if the old set was working after the blow . . . . never know when you'll need it."

Continued on page 50

Bradleystat Tests Amaze Radio Engineers

Startling Effects Revealed by Laboratory Tests

Following are extracts from the unbiased report of the Amorc Laboratories, New York and San Francisco—

> *"Tested Bradleystat after 32 hours of continuous burning of tube. Battery voltage dropped from 6.88 to 6.01, but current varied only 2 points, which was unimportant.*
>
> *"We discovered a very important point thereby. As voltage dropped, your device automatically adjusted itself through temperature of discs and thereby* **maintained better adjustment than any other rheostat.**
>
> *"You have rendered radio a great service with your device."* (Signed) H. Spencer Lewis.

Are you getting the benefit of our twenty years of experience with graphite rheostats? Order your Bradleystat, today, for better radio.

Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Ave., Milwaukee, Wis.
Member of the National Radio Chamber of Commerce

Retail Price
$1.85
P. P. 10c Extra

Ask for the Checkered Box at leading radio dealers. If your dealer cannot supply you, please send us his name and we will arrange with him to demonstrate the Bradleystat.

Bradleystat

REGISTERED U. S. PAT. OFF.

PERFECT FILAMENT CONTROL

Continued from page 48

Fencing. Nothing gained. The second officer left after a bit, plainly knowing nothing.

Down in the engine-room, oilers and tenders watched the gages, making swift calculations. They shook their heads. If this continued . . .

Six o'clock. The sun down behind the haze. The black smudge flattening on the water. The boilers straining . . .

Hamish came into the radio room suddenly, coatless. His face haggard.

"Have we any code for work with Fuente?" he demanded, harshly.

Norris shook his head.

"Standard ABC," he said. "Nothing private."

The captain turned away with a gesture of despair. Norris was beside him in an instant, his hand on the other's elbow.

"Anything . . . I can do?"

The Captain lifted a face wrenched with mental pain.

"I'm afraid not, Bob," he grated.

The door slammed between them.

Nothing there. What then . . . ?

The cargo? Oil—direct from the Associated pipes at Richmond. Clearance all according to Hoyle. Nothing contraband. Norris checked back in his mind . . . he had watched the supplies come aboard. Bacon, cased stuff . . . . no bootleg. Nothing there. What then . . . ?

The radio offered a possible solution. He cut in on the carrier adjustment again, taking care that his tubes did not betray his position by oscillating . . . turned low, an amplifier in to make up the difference . . . a war trick. Distance stuff . . . static—lots of it . . . miles to the southwest, the crackling smash of cloud-banks.

Nine o'clock. The carrier wave . . . . and the voice!

"*Susan Reynolds* . . . . are you in?"

Norris' hand went out. Then he pulled it back, smiling grimly. The cards were his now. Waiting! The call came several times, then . . .

"The damned operator's gone off . . ." Not spoken to him, or to the transmitter, but in the operating room, to someone else . . . voices, persons talking . . . But where? Silence, as the carrier again went off.

Captain Hamish came in a moment later.

"Anything?" He asked.

"No." Norris lied convincingly. He wanted to be in, must be in. With the *Susan Reynolds* off course, forced draught, and the Voice loitering in the background . . .

"Let me know . . . . if he . . . comes in again."

Hamish went out after this. Norris turned on his tubes.

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". . . . . eynolds, are you in, are you in . . ?" Over and over monotonously.

It was a Federal violation not to answer if one heard. So Norris turned over to the navy length, taking weather from Loma, and logging it against official investigation. There are tricks in every line . . . . For the present, he could only wait. Sometime Hamish must break . . . . no man can grow fear of his kind and carry it. Norris was waiting for that. He heard the watch changing.

Hamish came in—suddenly. He had been drinking. He clung to the door, reeling in the swinging light. Norris flipped on a switchboard light with a green shade. It had a calming effect. Hamish sank into a chair and buried his face in his hands. Norris passed over the cigarettes but the captain shook his head.

"Not yet," he said.

Norris waited. The other's eyes were bleared when he raised his head.

"Bob . . . . I've got to talk . . . to tell . . . somebody. A man can keep bottled just so long, and then the yeast starts working . ."

The operator nodded. At last!

"I know," he said. "A friend . . . . you know where I stand."

The Captain's hand shot out. Their fingers gripped.

"Has it . . . . have they . . . . ?" He gestured toward the instrument. Norris nodded.

"Three hours . . . constantly. I cut 'em out!" He waited for the explosion. Instead . . .

"I thought so. Somehow, I had a feeling that you were standing between . . ."

His shoulders squared. Norris saw him take a resolve . . . read it silently . .

"Bob!" The Captain spoke with difficulty. "I'm a dog . . ."

"We all are." Norris' tone was equally quiet.

"Yes . . . but—this is different. I'm not fit to wear this uniform." He spread out his hands.

"Quit talking riddles.— Speak your piece," Norris spoke shortly. The other reacted decisively.

"Bob—I've sold out."

"How? Why?"

Hamish jumped to his feet and began pacing the narrow cabin. The swinging light annoyed him and he turned it out. There was only the reflection from the green glass globe.

"I've been driving for Reynolds ten years, Bob. You know the game—low pay, little thanks. Yet I stuck. You ask why? Damn fool I guess. Took a pride in the record I had rolled up. Wireless operators are the same. They'll stick and stick . . . There's no answer save in your own soul. Ten years . . .

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and I banked it against my needs, against a doctor's bill . . ."

He paused and Norris waited—tense.

"I've got a little home on San Francisco Bay, Bob . . . paid for . . . two kids . . . wife. She's ill—fighting for life. It's been a long battle . . . . hospitals, specialists. It's taken money. It's going to take more . . .if she wins. The Prentiss line wanted me, but I turned 'em down. I grew up with Reynolds and I felt he would do the right thing. He didn't. The old man might, but the young un's in the saddle now—an efficiency hound. Sees nothing but figures. I couldn't speak anything but sentiment . . . He didn't get me, that's all."

"Who did you sell out to?" Norris' voice was cool, even.

"The Consolidated. They've got big contracts down here. They want every gallon . . . got to have it. Big money. Reynolds refused 'em flat. They tried the underground then. Heard about me—someway. One of their agents met me just after I left Reynolds . ."

"Well—go on."

Hamish steadied his voice.

"I was sore . . . I listened. Two thousand flat for throwing the cargo sounded pretty big. I could do a lot with two thousand . . . for her. ."

"What was the plan?"

"I was to snag the *Susan Reynolds* inshore off Fuente. They were to handle it, from then on. As you know, it's all in barrels . . . . they'll float . . ."

He buried his face again. Norris sat silent. The whole dastardly plan was plain now. Hamish was to have wrecked his boat where the Consolidated crowd could salvage.

"Did you see Reynolds . . . personally?" he asked apropos of nothing.

Hamish shook his head miserably.

"Some underling . . . that's what made me sore. I sent in word it was urgent. Came back and said Reynolds was too busy. That's when I blew up. But, dammit man, it doesn't make the facts any less easy to face now . . ."

Norris cleared his throat. His face was stern.

"You—you could go one . . . . to . . . Calleo, yet . . ."

For a moment his meaning didn't reach the other. Then Hamish stood up.

"That voice . . . the radiophone . . . they're trailing me in the *Clytie* . . . the Consolidated yacht. I don't dare . . ."

"You mean . . . ?"

"She's an ex-sub chaser. She carries a torpedo tube . . ."

Norris' face hardened.

"You don't mean . . . . they'd try that?"

Hamish nodded.

"That's what they said. They'd do

Continued on page 56

*De Forest D-7 Reflex Radiophone**

Listen to Half the Continent This Christmas!

HERE'S the latest De Forest triumph, the D-7 Reflex Radiophone* Receiver. It's the newest and most sensitive set of them all, with a thousand mile range on a two-foot indoor aerial! That's what you've been waiting for. No outside aerial is needed. The whole set is as you see it here.

Easy to control with its single knob—small, compact, super-efficient—and an ornament to any library table!

Economical to operate, too, because you get five stages of amplification on three tubes, and correspondingly longer life for your storage batteries.

If you want to bring into your home the news, the music, the lectures of half the American Continent—with no trouble—clearly, without interfering noises—this is the set for you. Remember it's a Radio Christmas—and here's one set that is all you ever hoped a receiver could be. Ask your De Forest dealer about D-7 and the other De Forest sets—today.

De Forest Radio Tel. & Tel. Co.
Jersey City, N. J.

DE FOREST

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What is the Finest Receiving Set Made?

To be worthy of this distinction, the set must have three characteristics—

World-wide receiving range—
Reception in all wave lengths—
Reception without distortion.

RadioCraft D-6 Regenerative Radiophone* (by permission of De Forest Radio Tel. & Tel. Co.) will receive even European stations, and of course all those on this continent.

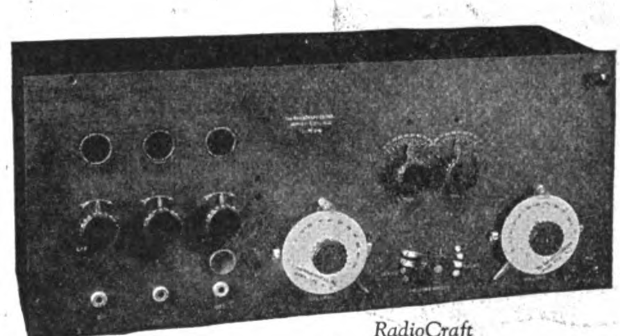
It receives on all amateur, broadcasting, and transatlantic wave lengths.

In clearness and avoidance of distortion, it must be heard to be adequately described.

D-6 uses outside aerial only, and head sets or loud speaker.

It claims to be the finest receiving set now manufactured and any authorized De Forest dealer (who also carries the RadioCraft line) will be glad to prove this to you by actual demonstration.

RadioCraft Regenerative Radiophones* (by permission of De Forest Radio Tel. & Tel. Co.)



RadioCraft
Regenerative Receiver
Type D-6

range from the simplest to the most elaborate.

It is unnecessary to add that this entire line of De Luxe radio equipment is most exquisitely finished in every detail.

The RadioCraft Co., Inc.
139 Franklin St., Jersey City, N. J.

RADIOCRAFT

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Continued from page 54

anything . . . . for oil. They're a bad gang, Bob . . . . ."

"But if you ran for it . . ." Norris persisted.

Hamish swung on him savagely.

"It's not that I'm afraid—not for myself," he shot out.

"What then?"

"It's . . . . it's her, Bob. It would kill her, if anything happened . . . ."

The operator studied him through half-closed lids.

"Know what the date is?" he asked quietly.

The captain stared, puzzled. Then his eye sought the calendar.

"The twenty-fourth?"

"Christmas Eve!"

"God . . . !"

"Hamish . . . ." He dropped the title. "Wouldn't . . . she rather have you dead . . . than live with that two thousand?"

It was brutal. He meant it to be. The Captain groaned.

"Don't Bob," he begged. He fumbled for a justification. It's her life on the one side, against . . . ."

"Against phantoms . . . . your honor . . . . facts . . . which would she rather have?"

Acute agony shot through the other. His hands, where he gripped the table, whitened. For an instant he stood backed against the door . . . . The sound of his feet running along the deck, came to Norris sitting alone beside the operating table.

Below, the ship's telegraph jangled suddenly, and the *Susan Reynolds* wallowed over on her beam ends . . .

Norris picked up his receivers.

". . . . Hamish to the fone . . . *Susan Reynolds*, are you there . ?"

Smiling, Norris turned out his detector lamp and lighted a cigarette.

Christmas Eve!

Grey dawn, with the rocking swells astern off the northeast . . .

Captain Hamish staggered in, white, drawn . . . He seemed older.

"We lost only six hours . . . . off the schedule."

Norris forced him down in a chair and poured out a drink.

"Throw it down," he said. "You need it . . . . . I'm glad."

Hamish picked up the drink. Norris turned to his drawer and scribbled on a bit of paper with a fountain pen. Then he turned and held out . . . a check.

"It's worth two thousand," he said, "to meet a man . . . "

Captain Hamish stared at him with stricken face, breathing heavily . . .

"In God's name . . . who . . . ?"

But Norris held up his hand.

"I'm Reynolds," he said. "Robert Norris Reynolds . . . . "

He went out and closed the door. It is not pleasant to see one of your commanders crying over a bit of paper . . .

INDUCTANCE DESIGN

Continued from page 26

F'' from the curve. Knowing this, it is a simple matter to calculate the inductance of your coil from either equation (1) or (2).

The accuracy of this universal formula for all closely wound coils has been compared with the various precision formulas such as Stefan's, Kirchoff's and others, and the variation found to be very small, less than 3% in most cases, and in many cases the deviation was 1%. It is therefore evident that for all practical engineering purposes the Brook's formula is satisfactory. This accuracy holds even the extreme case of the inductance of a single turn.

The shape factors F' F'' have a physical significance. A given length of wire has a definite constant resistance (at normal temperature) regardless of how it is wound. However, it has a different inductance for each different shape into which it may be wound. There is one shape which will yield the maximum inductance for the given length of wire. This shape will naturally be the most efficient design for this inductance, since the L/R ratio is a maximum. Every other shape of coil will yield an inductance less than this maximum, but a definite percentage of the maximum depending upon the shape. The first part of the Brook's universal formula, namely

$$\frac{Cm^2}{b+c+R}$$

gives the maximum inductance obtainable with a given length of wire when wound in the most efficient shape. The second part of the formula, namely the shape factors F' F'', represent the deviation from this maximum due to winding in other than the most efficient shape. The shape factor then gives the percentage of the maximum inductance obtainable with a given length of wire when wound in any shape other than the most efficient.

Numerous curves have been prepared giving for different lengths of different sizes of wire the maximum inductance which can be secured with these lengths when wound in the best shape. One such curve is given in Fig. 4. By the use of these curves and the shape factor chart of Fig. 2 and 3 the inductance of any closely wound coil may be easily obtained with hardly any calculation. Thus by knowing the number of turns and diameter of coil we know the length of wire used. From Fig. 4 or a corresponding figure we find the maximum inductance which can be obtained with this length and size of wire. From the coil dimensions a, b and c we obtain from the shape factor charts, Fig. 2 and 3, the shape factor of the coil, which, when multiplied by the maximum inductance, gives the actual inductance of the coil.

PROFESSIONAL RADIO OPERATOR

Continued from page 14

are conducted, to give the applicant a searching oral examination; he was likely to be escorted into the radio shop and asked to pick out a compound-wound generator from among a flock of shunt-wound machines, or perhaps would find himself introduced to a "jimmied up" quenched-spark transmitter, with a request by the examining officer to "make it work."

Before being given the technical examination, the candidate must successfully pass the Continental code tests, first receiving and then sending. The receiving test for the license here considered consists of one hundred words sent on an automatic transmitter at a speed of twenty words a minute, the signals being received in a pair of ordinary telephone receivers shunted across a high-frequency buzzer and provided with an audibility coil whereby the strength of the signals may be varied at will. The applicant must copy not less than twenty consecutive words without a break or an error; and since one hundred words are transmitted in the test, he has virtually five chances to do this. The candidate usually is not allowed to make corrections in his copy after the transmission of the test words.

The transmitting test is similar to the receiving in that one hundred consecutive characters, that is, twenty words, must be sent without a break from a text totalling five hundred letters and figures (five letters are counted as one word). The sending is required on an ordinary small Morse key, which the applicant may adjust to suit himself; and the signals are produced not only audibly on a buzzer, but also visually on a strip of paper tape in an electrical recorder, which leaves the candidate no opportunity to deny his errors. Many who pass the receiving tests fail in the transmitting.

As a result of exaggerated stories circulated by unsuccessful applicants for commercial operators' licenses, there seems to have come to be a wide-spread belief among the amateurs that the radio inspector's automatic transmitter used in giving the receiving tests is a villainous sort of contraption which sends a terrific scramble of tangled text in a rattling, snapping style that only a code wizard can hope to read.

While the automatic transmitter may have sounded like this to some unsuccessful candidates for licenses, it was most likely owing to their huge agitation at the radio inspector's test-table, rather than to anything wrong with the sending machine.

The youthful adventurer hailing from the country, especially he who is bur-

Continued on page 62

RHAMSTINE★
PRODUCTS

Detecting and Amplifying Cabinet $50

Famed for their performance and reliability, Rhamstine* Products bring to the radio public, at a moderate cost, apparatus of the highest standard.

It is essential that you use correct and efficient units in your radio construction to secure the best results; and in specifying Rhamstine* Products you are assured of satisfaction. They have no superior in their field.

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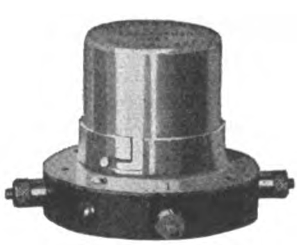
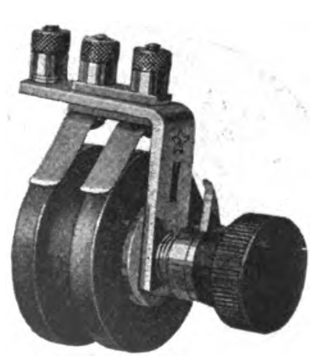
Adapt - O - Phone Without Receivers $12.00



Radio Frequency Amplifying Transformer $4.50

Audio Frequency Amplifying Transformer $4.00



Potentiometer— Type A—500 Ohms $1.75

Continued from page 60

dened with a gnawing, guilty apprehension about that big sending outfit he has been operating on unlawful waves and without a license, or who has some other equally grewsome radio-crime skeleton rattling its bones in his closet, is predisposed to become overwhelmed with secret terror in the laws-and-government chill of the radio inspector's office, and to feel about as much at ease there as if he had been thrown into a cave full of tigers and crocodiles; and when his mental state is such as this, small wonder it is if the signals of the inspector's sending machine sound in his ears like a demoniacal laugh of the King of Hades doing a fox-trot on the coals in gleeful expectation of a newcomer to his unholy domain.

The sending of the automatic transmitter, as a matter of fact, is accurate and precise, and not at all difficult to read. The transmitted text is not straight reading matter, for this would be no test, but consists of short phrases freely interspersed with numbers and punctuation marks, — something like this:

> Steamer off Cape King, girl to Baltimore: 17896 snowing north. S-O-S; fire destroyed cargo 92 abeam White Bluffs? K-O-D-Q, K-O-D-Q, K-O-D-Q de W-D-G. Gear damaged wheel,—and so forth.

The punctuation marks do not have to be written down, but the omission of anything else is counted as a break or an error. The transmitter occasionally slurs a letter when the contacting device is being shifted up or down the dials; but the applicant should not become confused or dismayed at this, because the radio inspector listens to the sending also, and does not count any break made by the machine against the candidate.

In the case of failure to pass the examination, the applicant can not reappear for another attempt until after the expiration of three months. Several cases have been known of candidates who, while unsuccessful before one radio inspector, took the examination again in a different radio district before three months had passed. Since an individual record of every applicant for a radio operator's license, whether he is successful or not, is kept at Washington, any such prohibited practice is almost immediately detected. The illegally obtained license is then revoked; and the holder of it not only is barred from reexamination for a year or more, but is liable to prosecution.

I happen to be acquainted with one ingenious amateur who, having heard many alarming stories about the radio inspector's demon sending machine and not being able financially to weather a three-months setback in case of failure

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to pass the examination, elaborately disguised himself with creole-hued theatrical pigment and a pair of blue glasses, and then went to the radio inspector's office to investigate the receiving test under a fictitious cognomen. The brown paint on his hands stuck to the license application blanks, and the affair ended rather disastrously, the adventurous amateur narrowly escaping a few months operating on a rock-pile in a striped uniform instead of at the key of a shipboard wireless set. I should not advise anybody to try the experiment.

CODE DIFFICULTIES

Continued from page 14

when mentally weary, as results are always disappointing.

(8) Don't give up and don't stop your practise! The writer does not know of a single case where these little helps here outlined did not help to some extent. They are not a universal panacea, but are intended as suggestions for some of you fellows who say "Yes, I'd like radio if I only could learn the code."

CALLS HEARD

Continued from page 44

By 6AMK, Los Gatos, Calif.

Spk: (5dx), (6cc), (6dd), (6fh), (6gt), (6ic), 6is, (6iv), (6km), 6ku, (6od), (6ol), (6qk), (6tc), (6to), (6up), 6wi, 6zi, (6aak), (6abw), (6acr), (6adl), 6ahq, (6ajh), (6ajr), (6akl), (6ala), (6ald), 6ans, (6aoh), (6ark), (6ars), (6avb), (6avh), (6avr), (6bpz), 7fr, (7ge), (7my), 7ne, (7nw), (7oj), (7ot), 7sc, (7to), (7tw), 7ve, 7vf, 7vo, (7wg), 7zg, 7zu, (7aea). Can.—(9bd).

C. W. 4bv, 4eh, 5dd, 5hr, 5la, 5px, 5za, 5zh, (6cc), (6cu), 6en, (6fh), 6gd, (6ka), (6pi), 6sa, 6zf, 6zh, (6aat), 6agp, 6ahq, 6ajh, 6apw, 6arb, 6atq, 6avd, 6xad, 6bpz, 6bum, 7bk, 7iz, (7lr), 7lu, (7mf), 7sy, 7tn, 7to, (7tq), 7wm, 7zb, 7zk, 7adf, 7aea, 7aem, 7afw, 7ahw, 8cmi, 9kk, 9pn, 9aim, 9amb, 9anf, 9aos, 9avz, 9awm, 9bbf, 9bji, 9baz, 9cni, 9dtm, 9xaq.

By 6BPL, 212 Fulton St., Palo Alto, Calif.

C. W.: 5za, 5px, 7bf, 7ny, 7pm, 7sc, 7zk, 7bk, 8yd, 8yp, 9xai, 9gk.

I. C. W.: kfay, 5xd, 5yq.

Fone: chbc (Can.), whb, woe, kxzz, kmo, kyt, ksd, 6xb, 6auu, 7xf.

Spk: 5dx, 7fq, 7gi, 7ve, 9bd (Can.).

By 6BJC, 540 St. Andrews Pl., Los Angeles, Cal.

All C. W.: 4bv (Can.?), 4eh, 5px, 5xd, 5za, 5zap, 5zh, (6ak), 6cc, 6cp, (6gr), 6gy, 6kc, (6lo), 6rd, 6uw, (6aat), (6aeh), (6ajh), (6ajf), (6atq), (6abx), (6bcd), (6bcj), -vcr, (6bjy), 6bqf, 6bql, (6bum), 7bj, 7sc, 7tq, 7lu, (7mf), 7aea (qra?), 7afw (qra?), 7ahw, 7zb, 7zo, 8asv, 9am, 9pi, 9amb, 9awt, 9awm, 9aul, 9bji, 9bju, 9bey, 9cmi, 9cmk, 9dte, 9dtm, 9xaq, 9zaf. Anyone hearing 6BJC's C. W. pse QSL by card.

By 6AUB, 3369 28th St., San Diego, Calif.

C. W.: Can.—4bv. 5nk, 5xd, 5za, (c. w. & voice), 6ak, 6av, 6cc, 6cj, 6cn, 6cp, 6cu, 6ea, 6eb, 6ec, 6en, 6eo, 6gf, 6gr, 6gx, 6ka, 6lo, 6lv, 6nx, 6pi, 6rd, 6rk, 6sz, 6tc, 6ti, 6uw, 6vf, 6aag, 6aat, 6abx, 6ahp, 6ahq, 6ajf, 6alu, 6amn, 6aoi, 6apw, 6aqw, 6arf, 6asj, 6atg, 6atq, 6auu, 6avd, 6avn, 6avr, 6awt, 6bbc, 6bdd, 6bcj, 6bcr, 6bdw, 6beq, 6bes, 6bfp, 6bic, 6bjc, 6bjj, 6bjq, 6bjr, 6bjx, 6bkb, 6bki, 6bko, 6bmd, 6bmx, 6bod, 6boo, 6bpz, 6bqc, 6bqd, 6bqg, 6bqp, 6bqz, 6brg, 6brk, 6bsa, 6btb, 6bum, 6bun, 6bvq, 6bwp, 6xr, 6xad, 6xas, 6xav, 6zf, 6zi, 6zx, 6zz, 7bb, 7bj, 7bk, 7lu, 7ny, 7ot, 7tq, 7aem, 7zo, 7zu, 8bdv, 9amb, 9bey, 9bji, 9cfy, 9zaf.

Spk: 6ex, 6ic, 6lu, 6mh, 6ol, 6qr, 6qy, 6tu, 6up, 6vx, 6aak, 6abw, 6acr, 6ahu, 6aic, 6ald, 6alv, 6ark, 6atf, 6avr, 6awh, 6baj, 6bcn, 6bic, 6bvd.

Anyone hearing 6AUB 5 watt ACCW Pse QSL.

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SHORTER WAVELENGTHS

Continued from page 29

"feed-back" instantly so as to interrupt the "run-a-ways." It is like a series of "whip cracks." Bolitho was apparently the first inventor to disclose this.

These circuits amplify at much more than the inverse square of the wavelength. The law is a doubly exponential one. Hence we see the enormous values of amplification of 5 to 10 million times possible with the arrangement using waves of 20 meters or less.

The fact that longer "quenching" intervals i.e. lower frequency without apparent limit, on the other hand, *increases* the sensitiveness instead of decreasing it, indicates that a true "run-a-way" set of oscillations is produced and not mere amplification. These quenching circuits do not seem to interfere with each other even when a number are used in the same neighborhood, quite in contrast to other circuits. The above circuits may be approached by an observer without disturbance due to external capacity even when using very short waves. For users of the usual regenerative circuit this new method gives a notable improvement, as the short wave amplification is tremendously greater.

When using measuring apparatus, etc., near these quenching "whip-crack" circuits, the reaction of the former must be kept vanishingly small or the latter will be kept in continuous irregular oscillation.

Short waves have no disadvantages in the super-regenerative circuits. In ordinary circuits they can not be easily amplified or "feed-back" actions controlled. The observer's body distorts the effects sought.

The re-radiation of energy from a short wave receiver when oscillating is greater in proportion to the fourth power of the frequency. At 150 meters it sends out 16 times the energy emitted at 300 meters under the same conditions. If, however, sets are used which cannot oscillate but merely regenerate the short wave comes into its own kingdom of usefulness.

SPECIFIC ADVANTAGES OF SHORT WAVES

A—A better design for a loop is possible. There is less stray capacitance between wires, and sharper tuning for this reason. There is a stiffer circuit possible if a very small tuning condenser is used. The last two factors partially neutralize each other, but there is a net gain if the loop is correctly designed.

B—The "following" of the voice or music wave by change of amplitude in broadcasting is accomplished more quickly than with a longer wave; since it generally takes a definite number of oscillations to change from the steady value to a larger or smaller one in order to "out-

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line" the modulation wave. It may be possible to get along on a 30,000 meter carrier wave, but most of the fine "shading" in the orchestrial color tone is lost. The average ear supplies the defect unconsciously; just as it does in using the wire phone, which transmits only 30% of the impressed voice oscillations.

C.—The greatest side tone of a voice —i.e. a note of 2000 cycles—is only .04 per cent "off tune" with 360 meters. At 6000 meters it is 4 per cent off tune and very much reduced in amplitude relatively to the carrier wave.

D—The sharpness of the band of broadcasting frequencies allows the highest harmonics to be transmitted through filters for static or interference without distortion of the sounds in the receiving phones, when very short waves are used.

E—Short waves radiate more efficiently and allow smaller aerials proportionately to cover a given range. They afford communication at an expenditure in plain loop transmitters of less than 1/20 watt per mile over land during the day time.

F—The condenser microphone becomes very efficient at high frequencies or short wavelengths. Anything which permits the use of this transmitter raises the efficiency of the modulator; as it is giving the best results to date at "KDKA" and other stations.

G—There are 10 times as many broadcasting stations possible between 20 and 30 meters as between 200 and 300 meters. This allows a margin for tuning out and for side frequencies, due to the modulation band of frequencies.

H—The ideal loop is one-half wavelength long and short waves approach this condition. The directional selectivity of short waves is evident when we are able to mistune short waves from different directions and combine them so that a signal from East to West would register, while a signal in the contrary sense would not. Another variation is to have both register on different instruments; it being understood, of course, that all signals are sent on one wavelength.

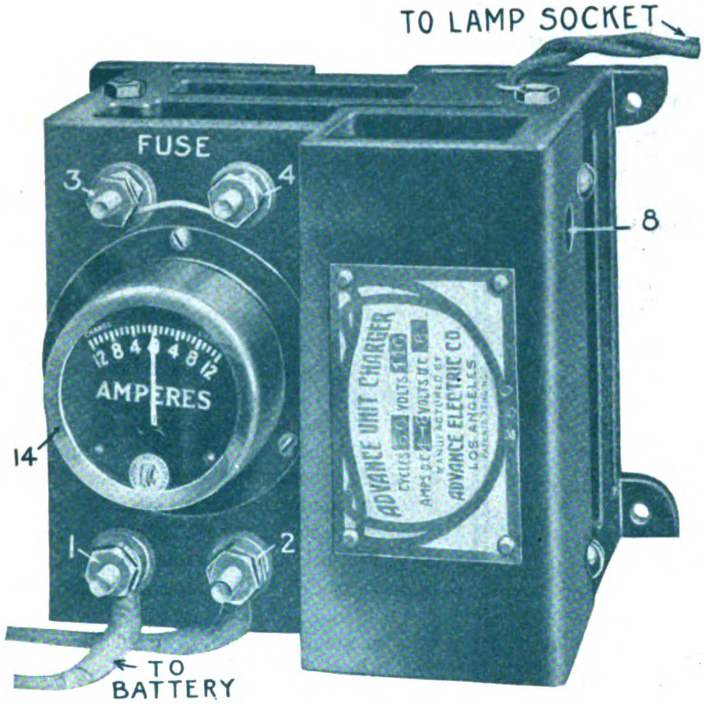
I—Short waves are better for use on Beverage antennae or with Major General Squier's line-radio. They allow smaller structures to be used.

J—By using 2-meter waves with continuous oscillations and 100 times the power available to Stone, Marconi has cast a beam of radiation 98 miles. The effects in the rear of the transmitter or projector were .5 per cent of those in front of it. Reflection was secured by distributing parallel oscillators or rods—in the form of a cylinder with parabolic cross section, having the oscillator which was a split rod at the focus.

In such experiments, the smaller the apparatus the more limited the range,

Continued on page 70

A Few Good Reasons Why You Should Buy The Advance Unit Charger



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Another Advance Product--A Precision Condenser Made in Vernier and Plain That Has Met With the Approval of Those Who Demand the Finest

Beautiful in appearance. All trimmings polished nickel.
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Stop 9 full length of rotor.
Nickeled acorn nuts 5 which insure strength.
Rotor spacers 11—5/8 inch diam., machine turned.
All spacers aluminum to .001 inch insuring perfect alignment of plates.
Stator spacers 12—3/8 inch diameter.
Spring 13 perfect contact and friction for vernier plate.
Rotor tube 2—1/4 inch diam., brass nickeled.
End collar 3 Adjustable for alignment.
Mounting posts 4—5/16 inch round 6/32 so spaced to accommodate any diameter dial.
Brass nickeled spacers 6—3/8 inch diam. accurately machined.
This condenser must be seen to be appreciated.

Vernier	Price	Plain	Price
		3 plate	$1.90
		5 "	2.25
		9 "	2.75
11 plate	$ 5.65	11 "	3.00
13 "	5.80	13 "	3.15
23 "	6.00	23 "	3.40
31 "	7.00	31 "	4.15
43 "	8.00	43 "	4.60
63 "	10.00	63 "	6.85

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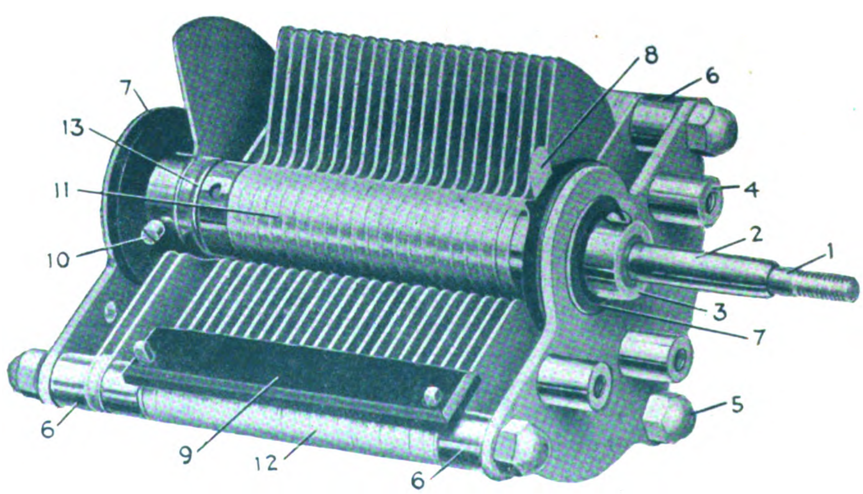


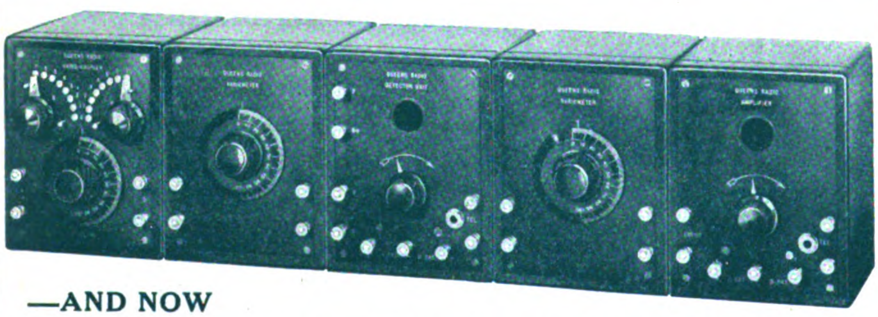
Continued from page 68

although the absorption, which is greater with short waves, is counteracted by the concentration of energy flow along the "beam." "Mirrors" of 2 to 5 meters are perfectly practical and by their use multiplex working for local broadcasting may be soon developed.

In view of all the above considerations the amateur should apply, through the medium of organized experimenters' societies or radio clubs, for licenses to try out ultra-short waves. Radio schools should do so to stimulate widespread research and comparison of data. Experienced men should direct this work; as they must be able to convince the government representative in their own field.

One is sometimes asked if there is anything to "undulate" where heat, light or electric waves pass in "empty" space. It may be said that opinion is divided. Radiation is no longer deemed a continuous process, but carries "atoms" of energy according to Plank, Einstein, Evellin and others, in spite of the dilemma imposed by the fact of interference in radiations.

The general question as to the reality of "ether" or "ether waves" is of no importance to anyone. One may swallow "whole," Einstein's postulate that "empty" space has physical properties in itself, like wood, steel or water and is so changed by the presence of a gravitational field as to be able to store energy and slow down time. Again one may reject it—as some physicists have done, at least in part—and ignore the whole question of an ether. There is wave motion of "something" and that's all anyone knows about it, including "the eleven" who Einstein says have digested Relativity.



EXIT "KUSD"

Continued from page 10

At 7:20 with daylight full on, KPH snapped a query across the intervening space:

"Is the fire any worse?

"About the same," retorted Bell nonchalantly.

By 8:00 the whole coast knew what was happening out in mid-ocean. Here and there distant boats had started a call, only to be shut up by KPH, NPG or some other station or boat, aware of the desperate struggle that the *City of Honolulu* was making. Gradually the facts became known. Ashore, marine agencies, shipping interests, hundreds of radio operators—amateur and professional—were at their instruments, listening, listening . . .

Sharply at 8:30 a.m. there came the little three-letter call from KUSD that sent a shiver up the spine of every man that heard it:

"SOS! SOS! SOS!"

It was followed by a direct call to "WMN" and a repeated position enumeration, "WMN"—the *Enterprise* answered immediately, the operator having been waiting momentarily for that very thing.

"Come to our aid!" came Chief Operator Bell's imperative command from the distant, burning *City of Honolulu.*

"Coming!" replied the *Enterprise* laconically.

The listening world knew the fire was bad then—visualized the situation, heard the answer. Into every brain crept a picture of that pillar of flame, licking avidly around the helpless human freight, and the *Enterprise,* swinging about in its course and racing to the assistance of the doomed liner, with forced draught and "full speed ahead" on its engine-room dial.

And a desperate time indeed was being experienced aboard the *City of Honolulu.* With the vessel tilted away over on its side and the ship itself threatening every minute to turn turtle, the work of launching the life-boats had begun. One by one, they were loaded up and swung clear—down into a sea that was mercifully calm, and reasonably smooth. There was no mishap—a tribute to the efficiency and training of the crew and the coolness of the ship's officers. Afterwards, when all the facts came out, it was learned that there had been no panic.

Again, later, on the air, came the flash from the burning vessel:

"Enterprise—are you coming?"

"Yes—how is it?"

"Lowering boats now —v ery bad fire . . ."

Excitement sprang to a fever heat in all directions. Practically all radio business on the coast suspended. Would

Continued on page 74

Sensational Xmas Offer

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Name..................... Address......................

Name..................... Address......................

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Send Premium to..

Continued from page 72

the *Enterprise* reach the scene in time? Would the race be of any avail whatever? Was another grim tragedy of the sea being enacted, out of reach of human help? These questions flitted through the heads of more than one radio operator, and no answer came out of the ether in reply.

Three minutes after 9 o'clock came another radio laconic from the *City of Honolulu*—from the unshakable operator on duty sitting unconcernedly above a seething furnace:

"Leaving ship any minute now . . . ."

Bell's hand was steady, despite the angle at which he was working and the orderly excitement all around him. His assistants no longer relaying with the bridge, were helping with the work of loading the life-boats. The radio was his alone . . .

At ten minutes to 10 o'clock he sent the *Enterprise* a message that will live long on the Pacific Coast—a message that tells better than the ethical dissertations of a radio instructor the correct perspective of a wireless operator's job:

"All left but the captain, chief officer, chief engineer and myself . . . !

On the heels of this, a shore station offered him a message addressed to Captain Lester. Bell accepted it, with his operating table pointed toward Neptune's locker. A moment later, his spark was again on the air to KPH—the answer trotting steadily out of the smoke billows that lay like a pall around his ship. And then . . .

"Leaving ship now, GB, ... - . -"

The most dramatic farewell ever recorded in the history of Pacific wireless! Terse, simple—he "kissed off" a fine deed of loyal service, with a casual "sine," as though departing from burning ships was a matter of daily routine. That final tag on the end of that last message from the *City of Honolulu* will remain long in the memories of those who heard it.

The rest of the story is marine history—the floating of the lifeboats on the silent sea, awaiting the arrival of succor, the message that turned the freighter *West Farallone* about, to pick up the little colony of twenty boats at 4 o'clock that afternoon, and their transfer to the more commodious *Thomas* at dawn the next day, and safe landing a few hours later at Los Angeles.

Out of the episode two paramount features stand forth—the remarkable record of the radio, through whose efficiency the entire ship's personnel and its passengers were saved with much of their personal property, due to the rapidity and efficiency of the Radio Corporation's invisible network of wireless protection, and the sterling per-

Continued on page 76

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3.25	Fesco 11 plate variable......	2.40
4.00	Fesco 21 plate variable......	3.00
4.75	Fesco 43 plate variable.......	4.00
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.35	RTL Grid Fixed .005........	.25
.35	RTL Grid Fixed .00025.......	.25
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Continued from page 74

formance of the radio operators through whose coolness and loyal service, given without regard to personal danger, another grim tragedy of the sea was averted.

But above these two circumstances, is one other factor which should be of interest to every radio fan who reads this, namely, that the men who carved this little record of radio history were amateurs—students of radio, the so-called "tinkerers" and experimenters of the barn and woodshed, who grew up with the "game," learned it in their kid days, graduated into professionals, and faced grave responsibility and possible death, remained faithful to the ideals of the craft.

The burning of the *City of Honolulu* is ranked as a marine loss. But it is an epical gain—for the cause of amateur radio—a justification for all the hours, time and money spent in its pursuit and development. For to the perfected faith of three amateurs, two hundred and sixty-two persons owe their most ultimate debt—their lives!

NEW LAND WIRELESS SYSTEM IN JAPAN

Application for government sanction to establish a wireless telephone system has been made by the Daido Electric Power Company, of Nagoya, Japan, according to advices received by the Department of Commerce. The company proposes to operate this wireless system primarily for its own convenience in connecting the various stations with its electric light and power system, but its use may be extended eventually to the general public if sufficient demand should arise.

RADIO TUNING DEVICES

Continued from page 12

crease the damping of the oscillations in the antenna circuit. So far as damping is concerned, then, an increase in coupling between the primary and the secondary circuits, by the inclusion of more turns common to both circuits, is equivalent to the insertion of resistance in the antenna circuit.

We learned in the last assignment and in this one also that the insertion of resistance in the antenna circuit of the receiver, with a consequent increase in damping in the antenna current, broadens the tuning of the receiver or makes it less selective. That is to say, if we increase the damping of the current in the antenna circuit of the receiver by increasing the coupling between the primary (antenna) and secondary circuits, we tend to decrease the sharpness of tuning in both circuits. This is a decided disadvantage in attempting to eliminate interference, since the receiver will respond to waves of more than one frequency for any particular tuning adjustment.

The advantage of the two-slide tuner, therefore, is not that we can tune both circuits to resonance, since this can as easily be accomplished by the single-slide tuner with variable condenser shown in Fig. 28, but that we can vary the coupling between both circuits and hence can increase or decrease the sharpness of tuning of the receiver at will.

In practice, then, we should first adjust the slider controlling the tuning of the primary circuit, slider *1*, until the signals are loudest. The secondary should then be adjusted by means of slider *2*, with the variable condenser set a low value of capacity, until the signal strength is at a maximum. If the tuning is broad, i.e., if the setting of the slider is not critical, slider *2* should be moved toward the antenna end of the tuning coil. This reduction of the secondary portion of the inductance from the resonant value will decrease the signal strength but the latter may be increased to its maximum value by increasing the capacity of the variable condenser. Slider *1* in the antenna circuit may now require slight readjustment. Then the tuning will be much more sharp or critical and interference from stations operating on other wavelengths will be greatly reduced, if not eliminated.

Obviously, you should not attempt to use too few turns in the secondary, since there will not be enough turns intercepted by the primary flux to induce a sufficient potential across them. If too many turns are used in the secondary, the tuning will be very broad. Experi-

Continued on page 81

:: *Read the RADIOADS on Page 111* ::

What's in the Name Cotoco?

TRADE MARK REG. U. S. PAT. OFF.

Radio Supplies Made for Better Results

Designed by an organization of Electrical and Mechanical Experts. Made to supply the needs of those amateurs and professionals in radio who know and demand the best. You will find Cotoco Products displayed by those wiser dealers who are building permanent business on radio supplies that give maximum results and by keeping abreast of the latest developments in radio—namely, radio frequency and loop aerials.

We were the first makers of coils of this type. Here is your compact, economical inductance. Mounts on fixed or trunnion brackets.

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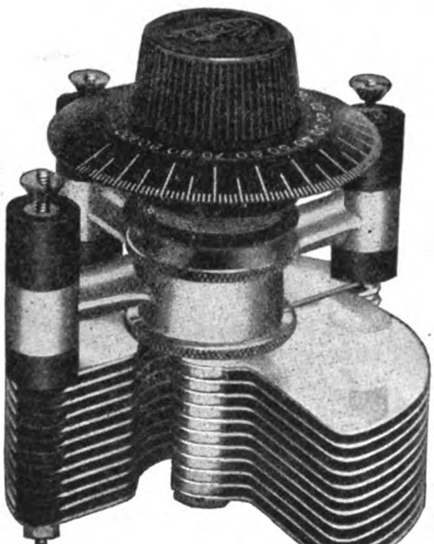
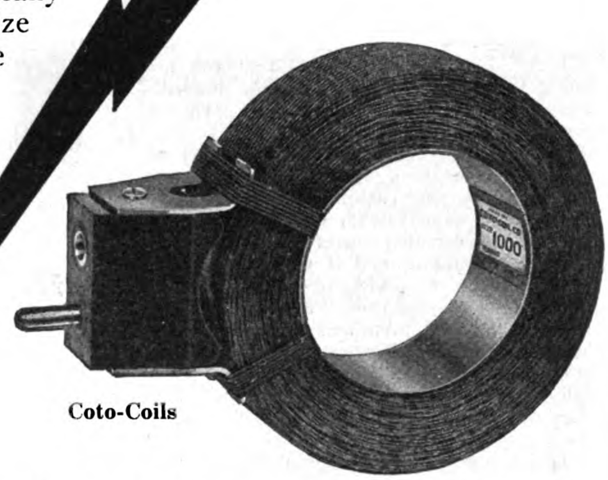


Cotoco Variable Air Condensers are scientifically correct to minimize electrical losses. We have tested many condensers, but have never found their equal.

Works just as smoothly as a fine watch, because it's made as well.



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You can tell by its looks alone that it is a precise instrument

Static and Distortion Banished Loop Aerials Available to All

Beyond our most sanguine expectations, we have succeeded in overcoming Static and securing great range with Loop Aerials. Distortion in headphones or loud speaker is practically unknown with a Cotoco built set. Write for connection diagram.

If Your Dealer Cannot Supply You

Write us his name and address. We will see that you are supplied with FREE **Connection Diagrams for Loop Aerial Sets** using either two or three stages of Radio Frequency Amplification.

Coto-Coil Co.
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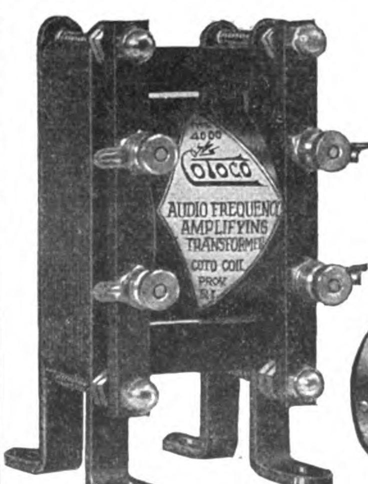
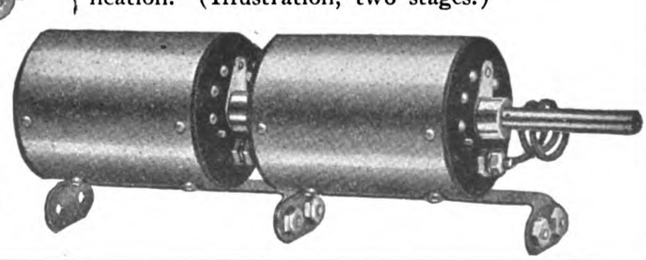


Amplifying Transformer for Audio Frequency
An excellent transformer for all kinds of amateur and professional work. Practically constant audibility with little or no distortion.

Amplifying Transformer for Radio Frequency
Tapped type. Extra selective. So most static is excluded. The key to Loop Aerial efficiency. Mount for one, two or three stages of amplification. (Illustration, two stages.)



free Xmas gifts

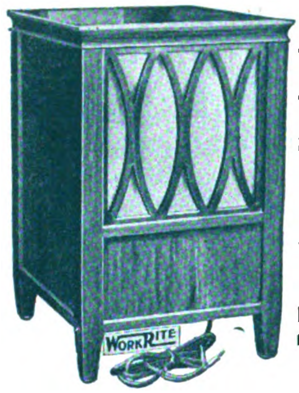
free!

Whenever somebody tells you that you are going to get something *"free"* you immediately form the opinion that *"what you get for nothing amounts to nothing."*

The publishers of "RADIO" are going to give you something for nothing—and our reputation is your assurance that you are going to get exactly what we offer you. We want to increase our direct mail circulation by many thousands and if you will help us in so doing we will reward you with genuine radio apparatus—*free.*

Several thousand premiums were mailed to our readers this year alone. Our big Xmas offer is the most liberal yet made. Carefully read the conditions of this plan and start the ball rolling in your town by rounding up subscriptions to "RADIO."

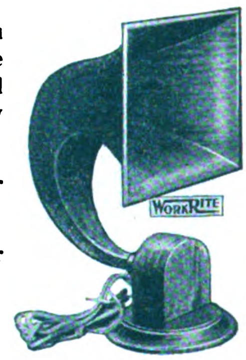
The manufacturers of the premiums and the publishers of "RADIO" stand back of every piece of apparatus that we send you. You can't go wrong. Get something for nothing. Show this issue of "RADIO" to your friends and get them to subscribe.



LET us give you one of these WorkRite Loud Speakers absolutely free for Christmas.

They are ideal for concert reception.

A little effort on your part is all that is necessary to get one.



Offer No. 1—

The WorkRite Concertola, as illustrated, will be given to you absolutely free of charge for securing twelve subscriptions to "RADIO" for one year each. The Concertola retails for $24.00. It is made from the finest grade mahogany. Hand-rubbed finish. No metal used for the horn. A special 5000 ohm phone is built into the cabinet. This is a most desirable Xmas gift. Send us 12 subscriptions and we will immediately forward one of these Concertolas by express.

Offer No. 2—

The WorkRite Concertola without cabinet, as illustrated. Given free with only six subscriptions to "RADIO" for one year each. This is really a remarkable offer. The instrument is beautifully finished in mahogany. Distortionless reproduction of signals. Equipped with special 5000 ohm receiver that cannot be purchased separately. Enjoy your broadcast concerts by installing one of these Concertolas. Why not give it to your radio friend for XMAS? Radio supplies and radio magazine subscriptions are ideal holiday gifts.

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FREE WITH THREE SUBSCRIPTIONS

So great has been the demand for the popular Trutone Loud Speaker that we are going to offer an additional supply of them to our readers for Xmas gifts with subscriptions. This loud speaker is advertised in "RADIO" under the name of the Sadler Manufacturing Co. There are two types—single phone and double phone. You may have either type if you send us three subscriptions to "RADIO" for one year each. Hundreds of satisfied users have received these instruments. The price, if purchased from a dealer, is $6.50. You get it positively free for three subscriptions. Be sure to include 60c for mailing charges.

XMAS COUPON

RADIO
Pacific Bldg.,
San Francisco.

Herewith is $......... and .... cents for mailing charges. Immediately send me the apparatus described in offer .... and send "RADIO" for 1 year to the following: (Write additional names on separate sheets of paper if more than three subscriptions are sent.)

Name ....

Address ....

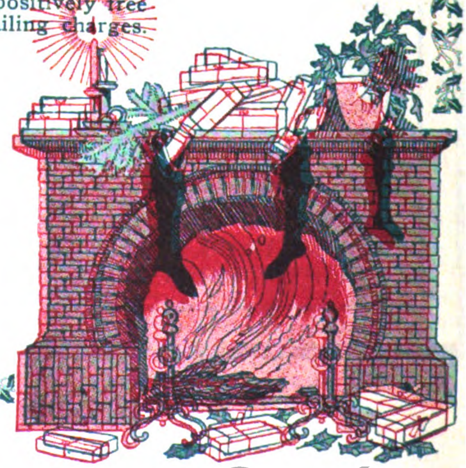
Name ....

Address ....

Name ....

Address ....

Your Order Must Reach Us By December 24th



Continued from page 78

mentation will soon show you the proper balance to have.

Fig. 30 shows a typical two-slide tuner, the only difference in its construction from that of the single-slide tuner being the addition of the second slider.

VARIABLE CONDENSERS

We have already discussed the operation and construction of the receiving variable condenser. It consists of a set of stationary plates and a set of movable aluminum plates insulated from each other by the air space between. The plates are so arranged that the movable plates may be revolved so as to interleave with the stationary ones. We have already learned that the capacity of a condenser is increased by enlarging the size of its metallic coatings and by decreasing the distance between them.

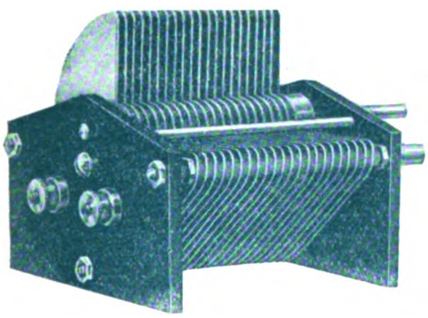


Fig. 31. Typical Variable Condenser.

When the movable plates—with respect to the stationary ones—are in the position shown in Fig. 17, the capacity of the condenser is almost zero, and would be zero if it were not for the electrostatic attraction exerted by the *ends* of the two opposing sets of plates on each other. As we revolve the movable plates within the stationary ones, we increase the capacity not because we are decreasing the distance between the plates, which is fixed, but because we are increasing the size of the plates—the size of the actively opposing areas.

Fig. 31 shows the appearance of a typical variable condenser. Since half of the movable plates are still unopposed to the stationary plates, this condenser is set at approximately half its maximum capacity.

ASSIGNMENT No. 6

LOOSE COUPLERS

In Figs. 22 and 24 were shown the schematic diagrams representing the receiving transformer or loose coupler. In the text accompanying those figures, we learned that a loose coupler consists of two coils inductively coupled to each other so that radio frequency current in one coil—the primary—can induce a potential across the terminals of the other coil—the secondary. Primarily, the function of the loose coupler is to serve as a means by which the detector can be coupled (inductively) to the antenna circuit so that its high resistance will not have to be interposed directly therein. As we have previously seen, it is of great advantage to couple the detector to the antenna, instead of directly connecting it therein as shown in Fig. 21, since the elimination of its resistance from the antenna decreases the damping of the current in the antenna circuit. By decreasing the damping of the received antenna current, we increase the sharpness of the receiver tuning which tends to reduce interference from stations operating on wavelengths other than that which we desire to receive and to which the receiver is tuned.

In the last assignment, we studied the construction and operation of one type of receiving transformer known as the auto-transformer, or tuning coil. We learned that this type of receiving transformer is conductively coupled, since

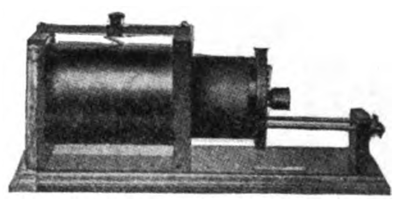


Fig. 32. Loose Coupler.

there is actual electrical connection or contact between its primary and secondary windings. The type of receiving transformer in which there is no electrical contact between the two coils or windings is called a *loose coupler.* Strictly speaking, even a two-slide tuning coil may be termed a loose coupler, since it is possible to produce loose couplings between the windings by reducing the number of turns of the inductance common to both circuits.

The method of varying the coupling between the primary and secondary of an auto-transformer, as described in the text accompanying Fig. 29, is somewhat crude, involving, as it does, a reduction in the secondary inductance for a reduction of coupling. True, the variable condenser may be used to increase the wavelength of the secondary circuit when the secondary inductance is reduced. It may happen, however, particularly in receiving the longer wavelengths, that the variable condenser may not have sufficient capacity to compensate for the reduction of the secondary inductance necessitated by a reduction in coupling.

This difficulty is obviated in the loose coupler, since, with certain minor limitations, no change in either the primary or secondary inductance is produced or required for a variation of the coupling. A loose coupler consists of two tuning coils, one—usually the secondary—being

Continued on page 84

For Xmas WORKRITE Concertolas

$12.00

CONCERTOLA JR.

A graceful, beautifully constructed instrument, harmonizing with your house furnishings.

HERE they are—the loud speakers produced by the WorkRite engineers—Concertola Sr. and Jr. Perfected until they are worthy of the name WorkRite. Hundreds of thousands of radio fans who have used WorkRite Radio Products know that "WorkRite" means perfection.

WorkeRite Concertolas accurately reproduce music or voice from the broadcasting station without the slightest distortion. On still nights they have been heard two city blocks away.

The sound chamber in both of these instruments is made from our specially developed material. Why listen to music through a "tin-panny" metal horn that loses all the beautiful tones of the artists, when you can buy WorkRite Concertola that will give you perfect reproduction of voice and music.

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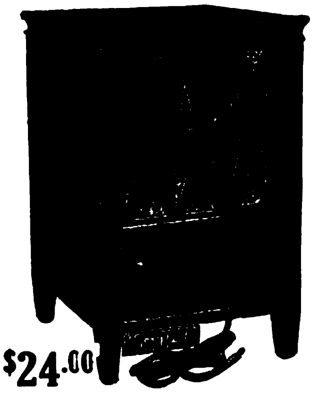

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CONCERTOLA SR.

Made from the finest grade mahogany with handsome rubbed finish.

There Is Not The Slightest Metal Used In Either The WorkRite Concertola Senior or Junior

IMPORTANT! The best sound amplifier will not get results with an ordinary head phone. Our engineering department has developed the WorkRite Concert Phone for just one purpose—to be built in the WorkRite Concertola Sr. and Jr., making a combination that is unequalled. This special phone is not sold separately from the Concertola. Phones and cord are built in each instrument.

WorkRite Concertola Jr. $12

Ideal Christmas Present Here is an instrument that can be connected to any set that has a two step amplifier and the whole family can enjoy the concerts during the holidays. Order at once so you will not be disappointed.

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Here is a real Rheostat—something entirely new and very much needed. Can be instantly changed from 6½ ohms resistance to zero by simply pushing in the knob, or you can have fifty thousand different adjustments by turning the knob. Many engineers claim the WorkRite Rheostat will double the efficiency of the set. Screws for mounting on panel furnished. The WorkRite Rheostat is really remarkable in its performance and is easily worth twice the price asked. No set should be without it. Price.....**$1.50**

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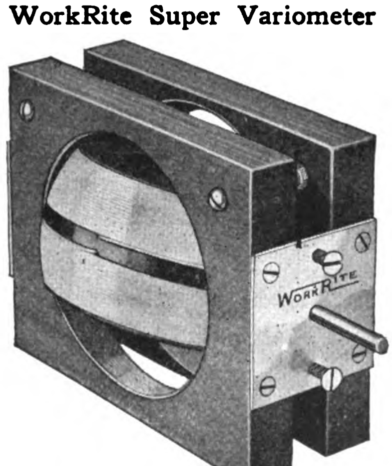
WorkRite Super Variometer



THE WORKRITE VARIOMETER is made from finest quality mahogany. All windings are perfectly made, and connections cleverly concealed. Substantially built throughout. WORKRITE VARIOMETER packed in attractive box....................$5.25
With WorkRite E-Z-Tune Dial. 6.00

WorkRite 180° Super Variocoupler

THE WORKRITE VARIOCOUPLER represents perfection in getting all dimensions and number of wire turns just right. Tunes twice as sharp as the ordinary 90-degree coupler.
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THE WORKRITE MFG. CO., 5539 Euclid Avenue, CLEVELAND, OHIO

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Continued from page 82

of the slightly smaller diameter so that it may be moved in and out of the other. See Fig. 32.

In the last assignment, we learned that the coupling between the two windings of an auto-transformer may be varied by the variation of the number of turns of inductance common to both circuits. Since the loose coupler is an inductive transformer similar to that shown in Figs. 22 and 24, there are no turns included in, or common to, both circuits. Obviously, then, some other means of varying the coupying must be employed.

The degree of coupling between the primary and secondary, whether of an auto-transformer or loose coupler, depends upon the number of turns of wire on the secondary and the strength of the

In Fig. 34 the secondary has been drawn partially out of the primary, so that only part of the secondary is threaded by the lines of force. The coupling has thus been reduced.

In Fig. 35, only a very few lines of force thread the secondary, or we may say that only a very small portion of the secondary is intersected by the lines of force. In this position, the coupling is very loose. Practically pulling the secondary 6 or 10 in. clear of the primary results in almost zero coupling between the two.

By changing the distance between the two coils, therefore, we have a simple and effective means of varying the coupling between them. By this method we accomplish an even more satisfactory variation of coupling than that which we effected by varying the number of

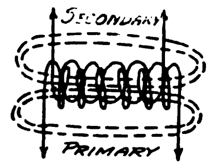

FIG 33

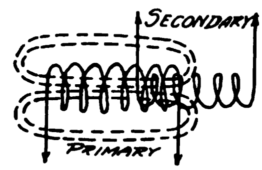

FIG 34

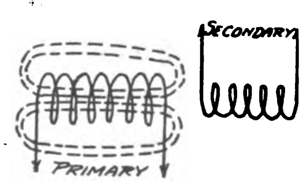

FIG 35

Fig. 33. Maximum Coupling. Fig. 34. Reduced Coupling. Fig. 35. Very Loose Coupling.

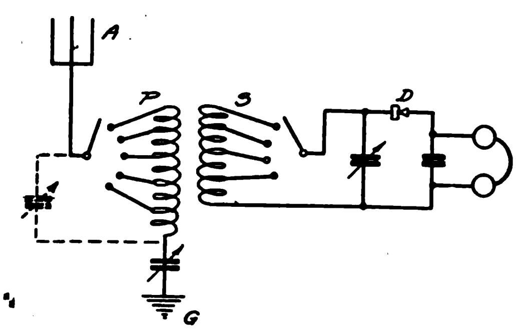

FIG 36

Fig. 36. Condenser in Primary Circuit.

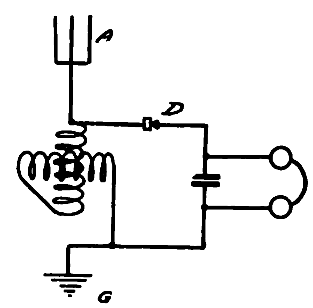

FIG 39

Fig. 39. Circuit with Variometer.

magnetic field, produced by the primary, which threads or intersects it. The strength of this magnetic field is usually spoken of as the number of *lines of—magnetic—force.* These lines of force are represented by the dotted lines of Figs. 22, 24 and 25.

Thus, for a given number of turns in the primary, there are two methods by which we may vary the coupling—either by reducing the number of turns in the secondary, as is done when using the auto-transformer, or by reducing the number of lines of force threading the secondary. This is the principle employed with the loose coupler.

In the loose coupler shown in Fig. 33, the secondary is shown as inserted completely within the primary. In this position all the lines of force generated by the primary thread the secondary and we say that there is maximum coupling between the two.

common turns with the two-slide tuning coil.

In the last assignment was mentioned the deleterious effect produced by the sliders short-circuiting adjacent turns of a tuning inductance. The same disadvantage obtains when sliders are used to vary the primary and secondary inductances of a loose coupler. To obviate this, it is customary, in modern practise, to substitute for the sliders a multi-point switch to which are brought taps from the inductance. If taps are taken off every ten or fifteen turns, some means must be provided to tune in between the wavelength values obtained when the switch is connected to adjacent taps. This is accomplished by connecting a variable condenser either in series or in parallel with the antenna inductance and in parallel with the secondary, as shown in Fig. 36. The variable con-

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denser in dotted lines represents the capacity shunted across the primary when receiving wavelengths appreciably longer than the fundamental wavelength of the antenna circuit, in which case, of course, the series condenser would not be used.

Fig. 37 illustrates the tapped type of loose coupler with two sets of taps on the primary, one set covering every ten turns, and the other set connected to ten single turns. With such an arrangement as this, it is possible to tune to a single turn of primary inductance without the use of a variable condenser, a rough adjustment being made with the first switch, and a fine regulation with the second or unit turn switch. However, the arrangement shown in Fig. 36 is in more common use.

In tuning for radiophone music, or for signals from any sharply tuned transmitter—all modern transmitters are sharply tuned—the primary condenser is first set at about one quarter of its maximum capacity. The primary inductance switch is next regulated until signals are loudest. The primary condenser is then adjusted until the signal strength is at a maximum. If too much inductance had been inserted by the primary switch, the capacity would have to be reduced and vice versa.

The secondary should be pulled about three-quarters clear of the primary. The secondary switch and condenser should now be adjusted for maximum signal strength. Next, the secondary should be drawn a little farther away from the primary. This change in the coupling will necessitate a slight readjustment of the primary and secondary condensers. The secondary should now be pulled still further clear of the primary and readjustments made of both condensers. If signals are weaker at this position of the secondary, the latter should be moved back to the second position.

Loudest signals and sharpest tuning will usually be obtained with the secondary fairly well out of the primary. This is particularly true when receiving sharply-tuned transmitters. It must be remembered in tuning that for every change in the position of the secondary, or the coupling between the two coils, a slight change in the tuning adjustments of both circuits must be made. This is because a change in the degree of coupling produces a slight change in the inductance of each circuit.

VARIOMETERS

In the last assignment and in this, we have considered the use of tuning coils and loose couplers—both of which primarily are devices for the variation of the inductance of a circuit. In addition, the loose coupler provides a means for the inductive coupling of two such variable inductances.

Continued on page 88

RADIO FREQUENCY AMPLIFICATION

MU-RAD Receiving Sets are the original product of independent experiments and experience of leading radio engineers. Five years intensive development of Radio Frequency Amplification have given Mu-Rad Sets exclusive points of difference—points that are well worth your consideration. First, unequalled **sensitivity.** Distances in excess of 1000 miles have been covered by Mu-Rad Sets using a 3-inch diameter, inside loop aerial. Second, the **selectivity** of Mu-Rad Sets which permits differentiation of stations 1% off tune, and third, the **simplicity** of **operation.** All tuning can be done with one hand. The high selectivity is retained by the use of patent circuits and Mu-Rad R F Amplifier Transformers.

SPECIFICATIONS

Cabinet: Solid mahogany, varnished piano finish.
Panel: Mirror polished black Radion.
Dials: Non-warping metal—prevent body capacity effects.
Condenser: 21 plate, permanent capacity.
Modifier: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
Rheostats: Special sector wound, smooth operation, positive contact.
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Name Plates: Extra deep reversed etched, black with satin silver high-lights.
Wiring: Tinned copper bus-wire, all interior metal white nickel finish.

The MA-12
Three stages of radio frequency amplification and detector. With 2 telephone plugs.**$128.00**

The MA-13
Three stages of radio frequency amplification, detector and two stages of audio frequency amplification. With 2 telephone plugs, **$160.00**

1000 Mile Range Guaranteed

Each MU-RAD set is sold with an attached guarantee of 1000 mile reception under average conditions using a small loop aerial.

Three Types
Type T-11 for the first stage..**$6.00**
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Type T-11B for the third stage..**7.00**

MU-RAD R F AMPLIFYING TRANSFORMERS
200-600 Meters—Air Core

The same transformer that gives to MU-RAD Receivers their extreme R F Amplification. The skill of MU-RAD Radio engineers has been concentrated on this instrument until all the objections common to most transformers were entirely eliminated. The absence of the usual iron core increases efficiency through elimination of iron losses. No metal to produce undesirable capacity effects and eddy current loss. So very accurately are MU-RAD Transformers made that their performance varies less than half of one per cent.

MU-RAD R F Amplifier Transformers as well as MU-RAD Sets can demonstrate their superiority before purchase. Ask your dealer to prove these points of difference.

MU-RAD Apparatus Sold Everywhere, Write For Literature!

MU-RAD LABORATORIES, INC.

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Continued from page 86

The trend of modern design of receiving equipment is toward panel mounting. In other words the equipment either is mounted externally on a panel of insulating material, such as bakelite (a synthetic compound of phenol and resins), or is mounted within a cabinet with the controls brought through to the front of the panel. The types of variable inductances which we have considered, however, do not lend themselves readily to cabinet mounting, since the only type of control which may be easily brought through a panel for external regulation is that requiring a rotary movement for its variation. Thus, a variable condenser may be mounted within a cabinet and the shaft, attached to the rotary plates, brought through the panel so that the movable plates may be revolved from the front of the cabinet.

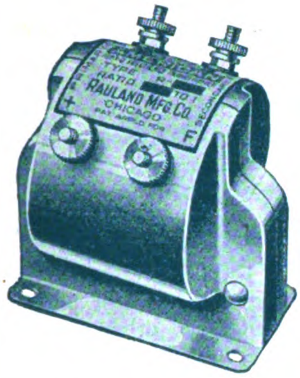
In order to provide for a rotary variation of inductance, and for other reasons which we need not dwell on here, the *receiving variometer* was evolved. In passing, it is interesting to note that the variometer was first used in transmitting sets, the German Telefunken spark transmitters of twelve years ago employing variometers in the antenna circuit.

The variometer consists of two spherically-shaped inductances, connected in series and having approximately 45 turns of wire on each inductance for reception on wavelengths from 180 to 600 meters. Fig. 38 shows a common type of unmounted variometer. The inductances are wound on some insulating material — commonly seasoned hardwood, although moulded bakelite is coming into favor.

It will be seen that one of the inductances, the *stator,* is stationary, and the other, the *rotor,* revolves within it. Since the two inductances are connected to each other in series, their respective magnetic fields oppose each other when the position of the rotor with respect to the stator is such that their windings are in opposite directions. In this position, the inductance of the variometer as a whole will be practically nil, since the resultant magnetic field of these two equal, opposing fields is zero. If a half turn, 180 degrees, is given the rotor, their windings will now be in the same direction and the current will flow in the same direction through both windings. This causes the resultant magnetic field of the variometer to be approximately twice that of either the rotor or the stator alone.

By a half turn rotation of the rotor, then, we may vary the inductance of the variometer from approximately zero to twice that of either inductance. This instrument thus furnishes a simple and convenient method for varying the inductance and hence the wavelength of

Continued on page 90



To Strengthen Weak Signals
To Bring-in Distant Stations
To Get the Full Joy of Radio

Scientific *Amplification* is the one secret of successful and satisfactory reception of Radio messages.

You will never know the full joy of Radio until you have hooked up to your set, a set of

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Our Radio-Frequency Transformer (type R-10) brings in signals of 150 to 550 meter wave-length, and *amplifies* them many-fold, clear and sharp, largely eliminating static and other disturbances.

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Send for Bulletin No. 22. It explains the technical and mechanical reasons for the splendid performance of "All-American" Amplifying Transformers. When you send for it, please give the name and address of the Radio Dealer thru whom you prefer to buy. Don't let *anybody* sell you a Radio outfit at any price, with any other than "All American" Transformers.

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Write for Bulletin No. 119-W

Federal Telephone & Telegraph Co.

Factory and General Offices—Buffalo, N. Y. Western Branch—693 Mission St., San Francisco, Cal.

Continued from page 88

radio receiving circuits and as such may be used in any circuit in place of a *single* slide tuning coil.

Fig. 39 is a duplicate of Fig. 26 with the exception that a variometer is substituted for the single slide tuner of the latter figure.

Variometers, when mounted, are fitted with a knob and graduated dial, the latter usually reading from 0 to 100, or from 0 to 180 (degrees of a circle). At the 0 position, the rotor and stator windings oppose each other so that the inductance is virtually nil. This is equivalent to setting the slider in Fig. 26 at the upper end of the tuner. As the knob and dial which carries the rotor are revolved, the rotor of the variometer is gradually shifted so that its field is changing from an opposing to an aiding one when turned through 180 degrees. This is equivalent to running the slider down to the lower end of the tuner of Fig. 26.

Fig. 38. Unmounted Variometer.

A variometer may also be used in place of the single slide tuner shown in Fig. 28, in which case it would be shunted by a variable condenser.

It will be noted that while the resistance of the tuner in Fig. 26 is increased as we tune to longer wavelengths, due to the insertion of additional turns of wire in the circuit, the resistance of the variometer is always constant, since the number of turns of wire is not changed. At short wavelengths, then, a circuit containing a variometer has a higher resistance than one employing a tuning coil.

The variometer principle, in a measure, has been applied to the loose coupler. Such a loose coupler is called a *vario-coupler,* and is shown in Fig. 40.

The primary inductance is usually tapped, leads being taken to a panel on which a multi-point switch is mounted, and the secondary, which is spherically shaped like the rotor and stator of a variometer, is generally untapped. Unlike the variometer, and similar to the loose coupler, the primary and secondary of a vario-coupler are not connected together, the magnetic lines of force of

Continued on page 92

Continued from page 90

the primary inducing a potential across the secondary or rotor.

When the secondary is turned so that its winding is parallel to that of the primary, as in Fig. 41, a maximum number of lines of force thread the secondary and maximum coupling is obtained.

When the rotor is turned so that its winding is at right angles to that of the primary, as in Fig. 42, the lines of force no longer thread the secondary parallel to its axes and hence produce no effect upon it. In this position, the inductive coupling between the primary and the secondary is virtually zero. By a right angle or 90 degree turn of the rotor, then, the coupling may be decreased from maximum to minimum.

The vario-coupler thus serves as a very convenient form of loose coupler, particularly for cabinet mounting. It is connected as shown in Fig. 43. This figure is identical with Fig. 36 except that the rotor or secondary is not tapped. In Fig. 43, the rotor is designed to have the proper number of turns for

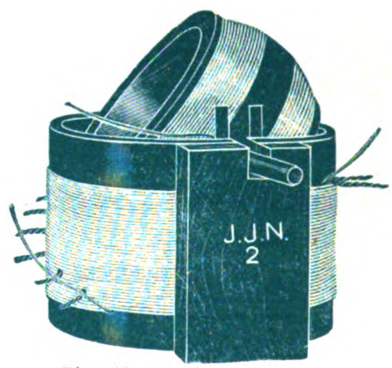

Fig. 40. Vario-Coupler.

radiophone reception so that the variable condenser alone may be used to tune the secondary circuit to the resonant wavelength.

The operations of varying the primary and secondary circuit wavelengths and the coupling are exactly as described for tuning the loose coupler, except that a rotary instead of a horizontal motion is given the secondary for variation of coupling.

HONEYCOMB COILS

In 1919 the De Forest Radio Telephone & Telegraph Company brought out a new type of tuning inductance known as the *honeycomb coil.* This is shown in Fig. 44.

When using tuning coils or tapped inductances on very short wavelengths, the amount of unused inductance would seem to play no part in the electrical action of the circuits in which they are connected. Actually, however, the usual type of inductance, particularly if it is wound in layers, is said to possess *distributed capacity.* This distributed capacity is due to the electrostatic attraction exerted between adjacent turns

Continued on page 94

Continued from page 92

or turns in close proximity to each other. The unused portion of the inductance is called the *dead-end,* and its distributed capacity is represented by the condenser in dotted lines in Fig. 45.

This distributed capacity in the dead-end thus forms a small oscillating circuit. If this parasitic circuit should happen to be in resonance with the incoming wave, as it often is, it will extract a large amount of energy from the primary and secondary circuits with a consequent decrease in signal strength.

It is highly desirable, therefore, to use only as much inductance as is necessary for proper tuning and thus to eliminate the deleterious dead-end effect.

The honeycomb coil is an inductance in which the distributed capacity, due to the peculiar form of crisscross winding, is reduced to a minimum. The coils are made in various sizes for the reception of wavelengths from 150 to 25,000 meters, and are designated by numbers to indicate the number of turns with which they are wound. Since honeycomb coils generally are not tapped they must always be used in connection with variable condensers which are connected in parallel across the secondary and in series or parallel with the primary, depending on whether long or short waves are to be received.

In combination with a primary variable condenser of 0.0015 m. f. maximum capacity and a secondary condenser of 0.001 m. f. maximum capacity, the following honeycomb coils are recommended by the De Forest Company for the usual wavelength ranges:

Type of Service	*Wavelength Range*	*Primary Coil*	*Secondary Coil*	*Condenser (Primary)*
Gen. Amateur	150-355	D.L.-50	D.L.-25	Series
Spec. Amateur and Radiophones	305-710	D.L.-75	D.L.-50	"
Commercial	460-1050	D.L.-150	D.L.-100	"
Navy Calling	835-1950	D.L.-250	D.L.-150	"
Navy Time	1760-4000	D.L.-500	D.L.-250	"
Navy Arc, Foreign and Press	3950-8450	D.L.-1000	D.L.-500	"
	6000-12500	D.L.-1500	D.L.-1000	"
	12000-20000	D.L.-1000	D.L.-1500	Shunt
	16000-25000	D.L.-1500	D.L.-1500	"

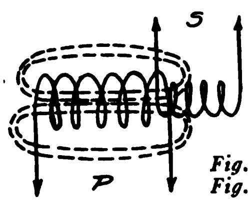

FIG 41

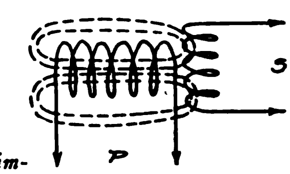

FIG 42

Fig. 41. Secondary Parallel to Primary.
Fig. 42. Secondary Perpendicular to Primary.
Fig. 43. Vario-Coupler Hook-up.
Fig. 45. Distributed Capacity from Dead-end.

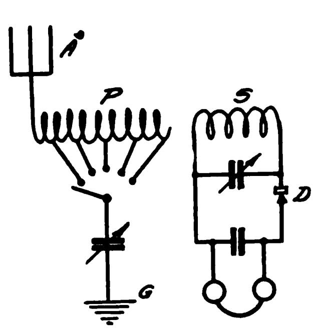

FIG. 43.

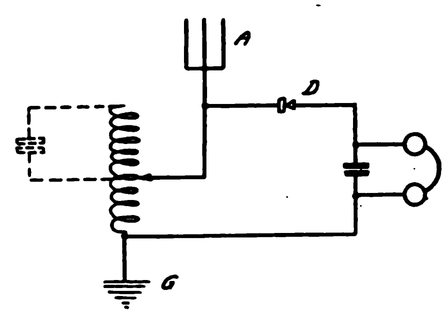

FIG 45

Honeycomb coils are used in place of the primary and secondary inductances of loose couplers. They are plugged into suitable mountings so that the distance between them — coupling — may easily be changed. When the primary and secondary honeycombs are parallel, with concentric axes, the coupling is at a maximum. When they are at right angles to each other, the coupling is practically zero. All tuning with honeycomb coils is done with primary and secondary condensers.

Because of their low resistance per unit of inductance and their very low distributed capacity, honeycomb coils are highly efficient and widely used.

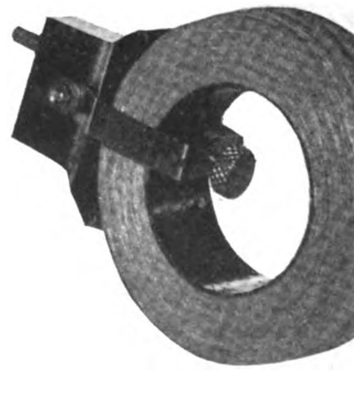

Fig. 44. Honeycomb Coil.

CALLS HEARD

Continued from page 44

By 9BJI, 3935 W. 30th Ave., Denver, Colo.

C. W.: 4eb, 4fv, 4jy, 5aj, 5aam, 5aar, 5aat, 5acf, (5aec), 5ba, 5de, 5di, 5bn, 5eg, 5ek, 5er, 5fa, 5fv, 5hk, (5im), 5ix, 5jb, 5jl, 5lb, 5my, 5nk, 5nn, 5nv, 5kp, 5pb, 5pd, (5px), (5qi), 5rh, (5sf), 5sg, 5sm, 5sk, 5sr, 5tc, (5tj), 5tp., 5tr, 5va, 5vm, 5vo, 5xa, (5xd), 5xk, 5xv, 5xy, (5za), 5zav, 5zag, 5zp, (6ang), 6abx, (6ada), (6ajh), (6ak), 6alu, (6amn), (6apw), (6aqw), (6arf), (6atg), 6auu, 6avd, 6avr, 6atq, 6bbc, (6bcr), 6bjc, 6bqc, 6bqg, 6bqz, 6bum, (6bun), 6cu, 6cc, (6ea), (6ec), 6en, 6gf, (6iv), 6lh, 6pi, 6xp, 6zaf, (6zh), 6zr, 6zz, 7bk, 7hm, (7lu), (7ot), 7pr, 7zo, 7zu, (7zv), 8ahv, 8amm, 8apy, 8asv, 8axb, 8bef, 8bfm, 8bke, 8bnj, 8bo, 8bxf, 8cf, 8cgx, 8cji, 8cmq, 8ib, 8iq, 8pd, 8qk, 8sp, 8uk, 8yd, 8zz, 9aap, (9aeq), 9afk, 9afn, 9ahh, 9ain, 9aiu, 9aiy, 9ajh, 9ajp, 9ami, 9apw, 9amq, 9anq, (9aog), 9aqm, 9arr, (9arz), (9atc), 9aua, 9aul, 9avn, 9avz, 9awm, 9awp, 9aws, 9axu, 9ayb, 9ays, (9bcf), 9bds, 9bed, 9bek, 9bey, 9bhd, (9bie), 9bik, 9biz, (9bjv), 9blt, 9bno, 9bri, 9bsz, 9btt, 9buh, 9bvl, 9bvy, 9bxb, 9bxy, 9bzi, 9bzz, (9ccs), (9ccv), 9cfi, 9cfy, 9cgk, 9chn, 9civ, (9ckm), (9cns), 9coa, 9ctr, 9cwc, 9cpy, 9dbl, 9dcr, 9dck, 9ddy, 9dge, 9dgq, (9dky), 9dpl, 9dqe, 9dqu, (9dr), (9dsm), 9dsw, 9dtj, 9dwk, 9dxd, 9ej, 9ew, 9fm, 9gk, 9ii, 9iy, 9jk, 9nu, 9pw, (9pi), 9uu, (9ve), 9yaj, 9yak, (9zaa). Can.—4bv.

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Spark: 6bop, 6btz, 6od, 6bcv, 6ff, (6aau), (6cc), (6tc), (7kj), (7my), (7vo), 7rc, 7tw, (7ge), (7oj), 7ve.

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Fone: 5za, 6bum, klp, klx, kob, kvq, kzm, kzn, kdpt, kdyl, kfad, kfaf, wgh. 6BSU will have a 50 watt tube set up in January.

Continued on page 110

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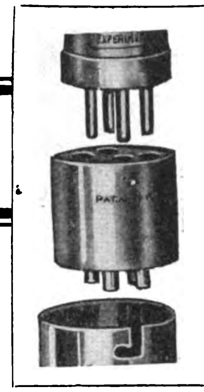

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RADIO BROADCASTING IN GREAT BRITAIN

Continued from page 21

traffic. But the largest manufacturers of radio apparatus have co-operated with the British government officials in working out plans for the proper control of broadcasting.

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Mr. Fleming, in addition to representing the Institute of Electrical Engineers of England at the Niagara Falls convention, is making a survey of radio developments in America. His survey may have considerable bearing on the regulations drawn up for government control of broadcasting in England. His technical career is interesting. After receiving his training at the Finsbury Technical College, he spent the following year at the London Electric Supply Corporation at Deptford, and after a short period with Messrs. Elliott Brothers, Instrument Makers, he crossed the Atlantic and joined the Westinghouse Electric & Manufacturing Company at East Pittsburg. Two years later he went to Trafford Park, so that he now completes a period of 20 years' service with the Metropolitan-Vickers Company.

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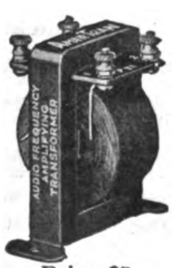

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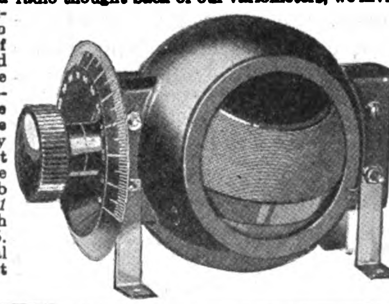

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RECENT RADIO PATENTS

Continued from page 38

varying length. The control boards *5, 6, 7* and *8* are provided whereby an operator sitting in front of any of them is capable of plugging in a receiving instrument *12* in any combination of antennae so as to get the desired directional effect, as well as to select the proper antenna lengths for tuning.

S. G. Frost, Pat. No. 1,424,294: August 1, 1922. Signaling Unit for Wireless Telegraphy.

A high frequency generator is operated by handle *10* through gearing *9*, and may be used in case of emergency to transmit a predetermined telegraphic signal. This is effected by driving a segmented switch *17* by the same mechanism as that driving the armature *8* of the high frequency generator. The segmented switch *17* may at will be placed in series with the generator.

L. DeForest, Pat. No. 1,424,805: Aug. 8, 1922. Subterranean Signaling System.

A scheme is described for sending and receiving signals by currents conducted through the earth. For this purpose wires *20* and *21* are extended to a distance considerably below the earth's surface, such as to the stratum *8*, where the conductivity of the earth is materially different from that at the surface. Tuning is resorted to, by the aid of coils *22, 23* in series with the circuit, which also includes a generator *9*. It is stated that frequencies between 500 and 25,000 may be profitably employed, and that due to the absence of atmospheric disturbances, signals may be sent farther with the same energy than in ordinary radio signaling. At the receiving station, a system of wires similar to that shown is employed, and a detector is substituted for the generator *9*.

P. I. Wold, Pat. No. 1,424,866: Aug. 8, 1922. Method and Means for Relaying Modulated Carrier Waves.

A system is described for relaying signals transmitted from station *X* through relay station *Y* to a distant station *Z*, of modulated carrier waves. In order that there be as little interference between the receiving end *8* and the sending end *17* of the relay station, the carrier waves transmitted at *17* have a frequency substantially different from that received at *8*. To obtain this result without the aid of a separate source at station Y, use is made of the property of modulator thermionic tubes to produce carrier frequencies depending upon the tuning of the modulator circuits. Thus at station *Y* the modulator *5* produces frequencies equal to $p + a$, p, and $p - a$, where p is the carrier frequency, and a the audible modulation frequency. By the aid of filter F one of the frequencies $p + a$ or $p - a$ is suppressed. At station *Y* the amplifier *A* is used to transmit the waves to a modulator *11*, so tuned that it will produce a carrier frequency $2p$. Finally amplifiers *A* at *15* are arranged to amplify this new frequency, and the signal is transmitted in this condition from *17*, and is detected at station *Z* in any appropriate manner.

J. H. Hammond, Jr., Pat.No. 1,425,523: August 15, 1922. Transmission System for Radiant Energy.

The transmitting antenna *10-11-12* may be rendered active from any one of a plurality of stations *60, 61* or *62*, and the arrangement is such that if any one station is transmitting, this may be determined from any one of the stations. The coil *40* controls the switch that closes the circuit for transmitting alterator *19*, and the circuit for this coil is controlled by any one of the switches *80, 81* or *82* located at the control stations. All of the stations are linked by telephones through inductive circuit *46, 47, 48*, so that conversa-

Continued on page 102

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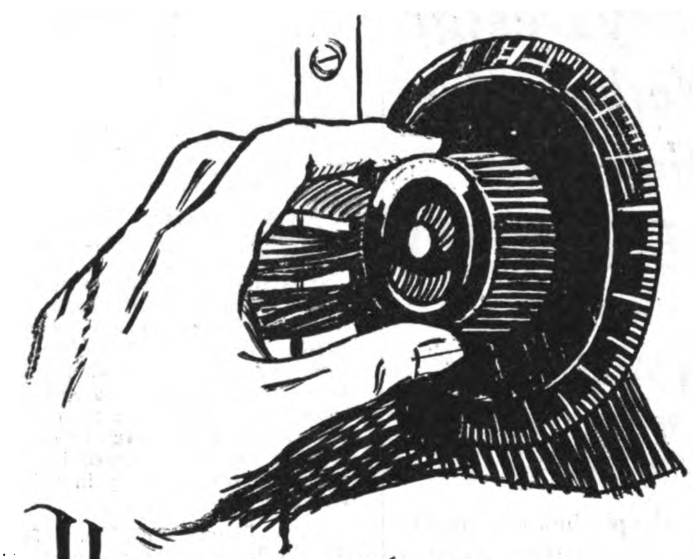

How to stop noises when you touch dials

Have you ever found, after tuning in a distant broadcasting station, that when you removed your hand from the dial there is a growling noise which makes it impossible to hear anything else!

This is usually caused by two things—too much current through your tube filament and dials made from resinous and other compounds which, being comparatively poor insulators, cause body capacity to make proper tuning an impossibility.

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Be Sure and Read the Radioads on Page 111

Continued from page 100

tion may take place between them. Further, when the transmitting circuit for the antenna is active, a buzzer *88* in a box *85* is also active, and may be heard in any of the phones *73, 74* and *75*. In this way each operator may know whether radiation is going on. There is also a metronome *86* in the box *85*, the beats of which may be used as a guide by the operators for the lengths of their dots and dashes.

R. A. Weagant, Pat. No. 1,425,154: August 8, 1922. Apparatus for Receiving Radiosignals.

It is stated that atmospheric disturbances which are so objectionable in receiving, act as if they were propagated downward in a vertical direction. Therefore to eliminate these disturbances, a grounded screen *5* may be used, consisting of a series of parallel conductors, under which the collector *10* may be situated. Electromagnetic signaling waves are but slightly hampered by the screen *5*, since they travel mainly in a horizontal direction.

E. A. Sperry, Pat. No. 1,426,337: Aug. 15, 1922. Signaling Apparatus for Detecting Submarines.

A device is described that is actuated to transmit a code signal by radio upon the entangling of a submarine in a net. All of the operative parts are associated with a submerged buoy *1* adapted to be released and to rise when the net is pulled away by the submarine, and rises to the surface. Within the buoy are a radio transmitting set *16* and a battery *15*, the set *16* including a motor driven code wheel. The buoy carries an antenna system *8, 9*, and as switching device *84* is used for causing the transmitting system to operate when the buoy rises. The entire buoy interior is carefully shut off against moisture, and to absorb any that may come in, a mass of calcium hydroxide is located in the bottom.

F. N. Waterman, Pat. No. 1,426,132: Aug. 15, 1922. Electrical Measuring Instrument.

A measuring scheme is described for the direct measurement of the decrement of damped waves in any circuit. For this purpose the measuring circuit shown is loosely coupled by the aid of coil *1* to the circuit to be measured, and the decrement of this measuring circuit is made as low as possible in order to reduce the error due to this factor. Use is made of the formula $d_1 + d_2 = \frac{C_2 + Cr}{C_2 + C_1}$ given by Bjerknes, where

d_1=decrement of circuit under test per cycle,

d_2=decrement of instrument circuit per cycle,

Cr=capacity of instrument circuit at resonance,

C_2=capacity of instrument circuit off resonance, with longer wavelength than at resonance, and

C_1=capacity of instrument circuit off resonance with shorter wavelength.

It is seen that if in this formula Cr and C_2 are maintained constant, for every value of C_1 there corresponds but one value for $d_1 + d_2$. The measuring circuit is arranged so that a change in a capacity will cause a direct change in reading for $d_1 + d_2$.

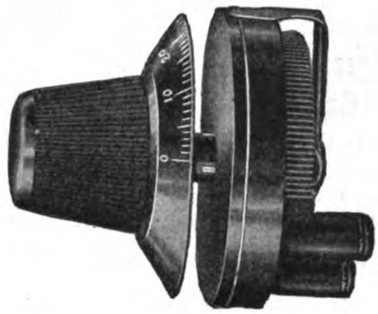
J. H. Hammond, Jr., Pat. No. 1,425,522: August 15, 1922. System for Sound Transmission.

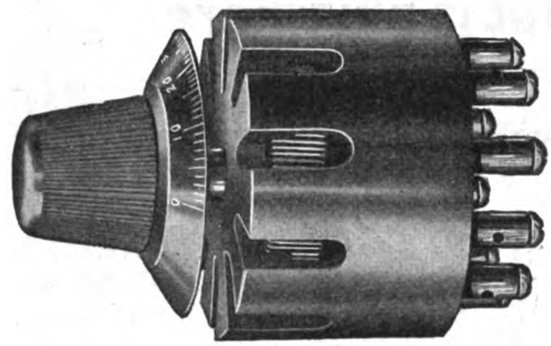
A receiving antenna *110* is arranged to cause the selective actuation of sound transmitting diaphragms *10, 11, 12*. Each of these diaphragms is arranged to vibrate at its own selected frequency by the use of appropriately driven interrupters *45, 46* and *47*. The control of these diaphragms is effected

Continued on page 104

RADIOADS ON PAGE 111

VERNIER Rheostat
Model 200





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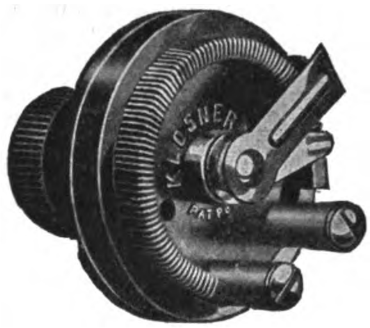

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P. O. NAMES ITS RADIO STATIONS

The Post Office Department has announced for the information of radio users the call letters of all radio stations used for air mail, post office business and broadcasting. The stations and their letters are as follows: Washington, WWX; Hazelhurst, WWU; Bellefonte, WWQ; Cleveland, NRH; Chicago, NAJ; Iowa City, KIOTS; Bryan, O., KDEL; Omaha, KDEF; North Platte, KDHM; Cheyenne, KDEG; Rock Springs, KDHN; Salt Lake City, KDEH; Elko, KDEJ; Reno, KDEK; San Francisco, NPG. Market and weather reports are broadcasted by the Post Office stations and can be received by amateurs.

Continued from page 102

by the aid of electromagnetic switches *60, 61* and *62,* so that the group frequency of waves received by the antenna *110* determines which of these switches will be energized. To secure this result the circuits for the mercury vapor relays *70, 71* and *72* are tuned respectively to the different group frequencies.

R. A. Weagant, Pat. No. 1,426,133: August 15, 1922. Apparatus for Static Interference.

Use is made of the fact that static interference waves appear to travel in a vertical direction, while signal waves appear to travel mainly in a horizontal direction. Thus loops *1* are behind one another by an appreciable distance so that signal waves do not act on them simultaneously, but static disturbances do. These loops are connected opposite to each other, and therefore the interferences are annulled. A detector *10* of any suitable type may be coupled to an inductance coil *7* in either or both loop circuits.

G. M. Wright, Pat. No. 1,426,137: Aug. 15, 1922. Radiogoniometer.

In one type of radiogoniometer, use is made of two collector circuits at right angles to each other, and each connected in series to a stationary coil such as *A, B.* Within these two coils a coupled search coil is rotatable, the position of which is adjusted to give a maximum or minimum effect. The present improvement resides in making the search coil in two parts, *C* and *D,* at an acute angle with respect to each other and in series. Due to this arrangement errors arising from variations in coupling between the search coil and coils *A* and *B.* as the search coil is rotated, is minimized.

R. A. Heising, Pat. No. 1,426,733: August 22, 1922. Method and Means for Preventing Amplifiers from Oscillating.

When one or more thermionic amplifiers *A* and *A'* are used between a source *1* and a load circuit such as 4_1, L_4, there is a tendency for the tube to oscillate, due to capacitive coupling between the various electrodes of the amplifiers. It has been found possible to overcome this tendency by causing the output circuit to have a comparatively high inductance, as by the insertion of a coil L_1 therein.

W. Wilson, Pat. No. 1,426,801: Aug. 22,1922. Repeater for Undulatory Currents.

A luminous discharge repeating device is described in which there are four electrodes; a heated filamentary cathode *4,* a perforated auxiliary electrode *6,* an anode *5,* and a control electrode *8* of disc shape, placed very near to the cathode *4.* By heating filament *4* and impressing an undulatory e.m.f. upon control electrode *8,* a luminous, varying discharge is produced between electrodes *6* and anode *5.* By making electrode *6* in the form of a wall between cathode and anode, and by providing the control electrode *8,* deleterious luminous discharge between cathode *4* and the auxiliary anode *6* is prevented.

E. F. W. Alexanderson, Pat. No. 1,426,944: August 22, 1922. Radiosignaling System.

A multiplex transmitting system is described, in which a plurality of audio frequency sine waves may be simultaneously superimposed upon a radio frequency wave transmitted from antenna *1.* Thus a "magnetic amplifier" *8* is shunted across the coupling coil *7* of a transformer *3* which transmits energy to the antenna *1.* By varying the magnetic field in the amplifier legs *9* and *10* at any frequency, corresponding variations are obtained in the amplitudes of the transmitted radio waves. To produce these variations at audio frequency, alternators *19, 20* and *21* are provided, controlled by signaling keys *28, 29* and *30.* When any of these keys are depressed, audio frequency

Continued on page 108

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See Classified RADIOADS on Page 111

Continued from page 104

waves impressed upon antenna *1*, and the alternators *19, 20* and *21* are arranged to supply different audio frequencies. At the receiving station, a plurality of receiving circuits may be provided, each tuned to its own special audio frequency so as to receive signals transmitted by one of the keys *28, 29* and *30*, or else a switching arrangement may be provided to connect a single device so as to be sensitive to any one of the plurality of audio frequencies.

J. Bethenod, Pat. No. 1,427,350: Aug. 29, 1922. Radiotelegraphic Coupling.

In order to prevent circulatory currents between armature section C'. C^2 and C^3 of a high frequency alternator, they are each connected to individual transformer primary coils T', T^2 and T^3, while their secondaries are connected in any appropriate manner to the antenna *A*. Further in order to decrease the dielectric stress, the midpoint of each of the armature sections is connected to the midpoint of the corresponding transformer winding, and all these midpoints are connected to ground at *E*.

LETTERS TO THE EDITOR

Continued from page 34

to allow some wild ham with $8.16 worth of second-hand five-and-dime-store junk to put $3000 or $4000 worth of apparatus out of business. Even if the "novice" could afford to change, I doubt the results. I frequently use my Grebe CR-8, and there is the spark "frog" strong at 400 and annoying at 360. On my Westinghouse RC, the spark blankets everything for the entire range, and putting in the loading coil—1800 to 2800 meters—makes no difference, excepting that he is stronger, if anything. But, of course, sparks can't be heard above 200 meters!

As to the comparative value of the amateurs' code and the broadcasting program, only one idea can prevail. The broadcast is by far the more important of the two. The amateurs are always yelling: "Look what the amateur has done for radio!" but they seldom get down to concrete facts and say *what* he has done. And when they do, you usually find out he wasn't an amateur, anyway. As to the amateurs "handling messages, free of cost, for the public," they may —and probably do—shoot a lot of semi-useless stuff into the air which wouldn't otherwise be there, but its value is doubtful, to say the least. The spark hog who is getting every one's goat in this town isn't doing anything but jam the air. His sending is rottenly ragged, and he tries to "step on her" so fast that he is always falling over himself. No one could possibly read him. At times he spends several minutes sending his own call, and at other times he just holds his key shut for twenty to thirty seconds. It is lovely, in the middle of a violin solo or a symphony orchestra number. But, of course, as he is "handling messages for the public, free of charge," all novices—and others—must grin and bear it and say how nice it is that sparks can't be heard on the broadcast wavelengths.

So long as the amateur takes the position that the amateur is king, and that "the king can do no wrong," just so long is he going to have trouble. The letters of "A Belligerent Ham" and "A Reader" are starts in a decidedly wrong direction. The amateur should watch his step and not try to hog it all, as the tendency indicated by your correspondents seems to be, or he will find that the "novice"—who already outnumbers him twenty, or more, to one—will finally turn and rend him. And he will not find the rending pleasant. —A NOVICE
Decatur, Ill.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of RADIO, published monthly at San Francisco, California, for October 1, 1922.

State of California,
County of San Francisco, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared H. W. DICKOW, who, having been duly sworn according to law, deposes and says that he is the Business Manager of RADIO and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher, Pacific Radio Publishing Co., Inc., Pacific Bldg., San Francisco. Editor, Arthur H. Halloran, Pacific Bldg., San Francisco; Managing Editor, none. Business Manager, H. W. Dickow, Pacific Bldg., San Francisco.

2. That the owners are: Arthur H. Halloran, Pacific Bldg., San Francisco; H. W. Dickow, Pacific Bldg., San Francisco.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock bonds, or other securities than as so stated by him.

H. W. DICKOW,
Business Manager.

Sworn to and subscribed before me this 21st day of September, 1922.
(Seal) JOHN WISNOM,
Notary Public in and for the City and County of San Francisco, State of California.
My commission expires August 14, 1923.
Form 3526.—Ed. 1922

CALLS HEARD

Continued from page 96

By 8yu, Y. M. C. A., Dayton, O.

1bcg, 1bi, 1cm, 1gv, 1xm, 2awf, 2awl, 2bqd, 2ckl, 2fc, 2xl, 2xq, 3afb, 3apr, 3bhm, 3bhl, 3bpw, 3ckl, 3dh, 3do, 3go, 3gr, 3hl, 3iw, 3lr, 3nb, 3ot, 3tb, 3vw, 3zo, 3zw, 4bx, 4di, 4en, 4fg, 4id, 4gh, 5cy, 5da, 5di, 5do, 5ek, 5el, 5ew, 5fj, 5fv, 5kc, 5pf, 5pv, 5px, 5qi, 5sx, 5uo, 5xd, 5su, 6ea, 6ka, 6xa, 7cc, 8acb, 8ach, 8acw, 8afd, 8agd, 8ago, 8aim, 8aiw, 8aly, 8ame, 8an, 8anb, 8aoo, 8ard, 8apw, 8asj, 8ats, 8ave, 8avf, 8awk, 8awl,, 8awo, 8abv, 8axb, 8axc, 8azd, 8azm, 8bas, 8bbe, 8bbv, 8bcy, 8bda, 8bdu, 8bea, 8bef, 8bfm, 8bfn, 8bf, 8bie, 8bk, 8bke, 8bjs, 8bgn, 8bog, 8bpj, 8br, 8brl, 8bso, 8bss, 8btl, 8bum, 8buo, 8bvh, 8bwb, 8bwk, 8bxm, 8bx, 8byp, 8ccb, 8cbm, 8cbx, 8cdk, 8cei, 8cfp, 8cgx, 8cgm, 8cjs, 8cko, 8ckv, 8ckz, 8cmi, 8csp, 8cur, 8cwr, 8cxp, 8ej, 8dz, 8fv, 8gm, 8iq, 8hn, 8oc, 8oe, 8on, 8ox, 8qm, 8sb, 8td, 8tj, 8zz, 9aap, 9abh, 9abu, 9aep, 9ac, 9abm, 9ahy, 9agm, 9aia, 9ai, 9ajg, 9amc, 9ana, 9anq, 9apr, 9apw, 9aur, 9aux, 9aw, 9awm, 9aws, 9axc, 9axh, 9axu, 9axw, 9ays, 9ba, 9bai, 9bas, 9bds, 9bcx, 9bct, 9bft, 9bhe, 9bik, 9bj, 9bft, 9bkj, 9bkp, 9bls, 9hly, 9bmn, 9bno, 9bok, 9bop, 9bpw, 9brk, 9cba, 9cbu, 9cd, 9cdc, 9cdg, 9cgn, 9cgz, 9ch, 9cp, 9cja, 9cva, 9cwg, 9dag, 9dda, 9dgu, 9dhz, 9dky, 9dpl, 9dsd, 9dsm, 9du, 9dwk, 9dyn, 9dzy, 9fm, 9gk, 9io, 9kwe, 9lq, 9mc, 9me, 9mic, 9pd, 9pq, 9pn, 9qk, 9qx, 9sb, 9uz, 9uu, 9um, 9yah, 9ym, 9yu, 9xt, 9za, 9zx, 9zif, 9zv, 9zn. Can.—3dh.

Above stations all heard on one wire antenna between steel buildings. 8YU would like to know why amateurs don't listen in on 375 meters once in a while. 8YU's ½ K. W. 500 cycle spark is QSA vy, anywhere east of the Rockies, but no one to work while we are on that wave. Since putting our C. W. on 200 meters we find we can at least do a little work, but know our 375 meter spark would be easier copying on 375.

By 9DR, 1830 Stevens Ave., Minneapolis, Minn.

C. W.: 1xu, 1yk, 1bko, 1cmk, 2fp, 2gr, 2kl, 2nz, 2qz, 2zk, 2brb, 3bz, 3fs, 3gk, 3lp, 3lr, 3pb, 3pc, 3zo, 3zw, 3afb, 3ajd, 3auu, 3auy, 3bhm, 3bnu, 3bvc, 4bo, 4dq, 4eb, 4ft, 4jk, 5ba, 5de, 5di, 5do, 5ek, (5el), 5fb, 5he, 5je, (5kc), 5lb, 5ma, 5nc, (5nv), 5nk, 5px, 5qs, (5sf), 5sm, 5tj, 5uo, 5vm, 5xd, 5za, 5zh, 5acf, 5anu, 5cap, 5dak, 5zag, 5zaw, 5zaz, 6cp, 6cu, 6ea, 6en, (6ka), 6pv, 6abx, (6arb), 6asj, 6awt, 6bmn, (6bsa), 6cbr, (6xad), 7lu, (7sc), 7zb, 7zo, 7zu, 7afw, 7bwa, 8ab, 8an, 8ar, (8bo), 8cf, 8ft, 8ib, 8kg, 8ow, 8qi, 8qk, 8sp, 8vy, 8wa, 8xe, 8xh, 8yd, (8ze), 8zv, 8zx, 8zz, 8aer, 8afn, 8agc, 8aim, 8aio, 8aiw, 8ajp, 8ajv, 8akp, 8ame, 8anb, 8aoe, 8aqo, 8asv, 8ati, 8atu, 8awp, 8awt, 8awz, 8axp, 8azb, 8bdo, 8bdu, (8bdv), 8bed, (8bfm), 8bke, 8bnj, 8bpl, 8btl, (8bux), 8bvr, 8bwa, 8bxh, 8bxx, 8cak, 8cay, 8cbc, 8cgm, (8cgp), 8cgx, 8cjh, (8cmi), 8cpx, (8ctp), 8cur, 8cuu, 8cyt, (8zae), (9cp), (9ex), (9gk), (9ii), (9iy), (9ps), (9uu), (9zc), (9zn), (9abv), (9anq), (9aog), (9aqm), (9aqu), (9ays), (9bcf), (9bed), (9bhq), (9bji), (9bmn), (9bqw), (9bvy), (9bxt), (9ccb), (9ccs), (9cfi), (9cfw), (9cgg), (9ckm), (9dba), (9dcf), (9dhz), (9dky), (9dsm), (9dvw), (9zaf). Can.—3co, 3ji, 4bv, 9aw.

Spk: (5xac), (9abv).

By 9CIP, St. Paul, Minn.

All C. W.: 1xm, 1xu, 1ahz, 1bgf, 1bkq, 1cmk, 2gk, 2gn, 2gr, 2lo, 2ml, 2ns, 2ud, 2wb, 2xq, 2zk, 2zl, 2agc, 2apa, 2awf, 2awl, 2aws, 2ayv, 2bea, 2bfx, 2bgi, 2bgm, 2bnz, 2bqd, 2bqe, 2brb, 2ckl, 2cqz, 2xap, 3bg, 3bz, 3cc, 3cg, 3dh, 3fs, 3iw, 3jk, 3mk, 3rf, 3yh, 3zw, 3aay, 3afb, 3anz, 3apr, 3aqh, 3bij, 3bit, 3bnu, 3buv, 3bvc, 4bq, 4bv, 4by, 4dc, 4eb, 4eh, 4en, 4fg, 4gh, 4jk, 4ki, 5cy, 5da, 5di, 5eg, 5ek, 5er, 5fv, 5jl, 5kc, 5mb, 5mo, 5nk, 5nn, 5nv, 5of, 5pb, 5pf, 5pv, 5px, 5qi, 5rh, 5sk, 5sm, 5tj, 5tu, 5uk, 5un, 5uo, 5va, 5vm, 5vo, 5xa, 5xv, 5za, 5zu, 5aag, 5aam, 5aby, 5aec, 5xad, 5zas, 6ak, 6cc, 6cu, 6gr, 6ka, 6abx, 6avd, 6bcr, 6xad, 7gk, 7lu, 7zo, 7zv, 7afw, 8bk, 8bo, 8cf, 8gt, 8lt, 8ml, 8ow, 8pf, 8xg, 8yn, 8zr, 8zx, 8zz, 8aio, 8anb, 8axn, 8bdo, 8bke, 8brm, 8btd, 8bzy, 8cjz, 8cur, 8czc, 8zaf, 8zag, 9lq, 9ox, 9awh, 9bji, 9bri, 9cba, 9ccv, 9ctr, 9dcr, 9dky, 9dpl, 9xac. Can.—3co, 3dh, 3ds, 3jk, 3nb, 4bv, 5jb, 9al, 9aw, 9yu.

By 6EA, 343 So. Fremont Ave., Los Angeles, Cal.

All C. W.: (Can. 4bv), 5di, (5xd), 5xad, 5za—buzzer, (6ak), (6cc), (6cp), 6fh, 6gr, 6gx, 6lo, 6nx, (6rd), 6rm, 6vf, 6abx, 6ajf, (6ajh—voice), (6aor), 6aqw, (6arb), (6asj), (6awt), (6bcr), 6bmd, 6bnw, (6bsa), 6bum, 6xb—voice and music, (6xad), 6zf, 6zh, 6zi, 6zx, (6zac), 6zaf, 7bb, 7dp, 7jw, 7oz, 7sc, (7th), 7xi—voice, 7zb, 7zk, 7zo, 7zu, 8cf, 8rr, (9dr), (9ps), 9amb, 9awm, 9bed, (9bji), 9cns, (9dtm), 9xm, 9yaj, (9zaf—voice), klp—voice and music, kzn—voice and music, kdpu, kdpv, kfay—buzzer, kfbk—buzzer, voice and music. nrrs—buzzer, wwv and wxy. My 5 watts A. C.-C. W. was also heard by Canadian 5ej, 8czn, 8ib, 9aog, 9aps, 9aqm, 9bed, 9blg, 9bxt, 9ctr.

★ ★ RADIOADS ★ ★

A CLASSIFIED ADVERTISING SECTION READ BY BETTER BUYERS

The rate per word is five cents, net. Remittance must accompany all advertisements. Include name and address when counting words.

ADS FOR THE JANUARY ISSUE MUST REACH US BY DECEMBER FIRST

TRANSMITTING APPARATUS

500 cycle Telefunken quenched gap Transmitting set for sale. This Transmitter radiates 12 amperes on 375 meters and 11 amperes on 200 meters. Motor Generator with 1½ horse power Wagner induction motor. D. C. end of the motor generator is used for exciter and is good for 25 amperes at any voltage up to 65 for charging storage battery. The Wagner Motor is worth $90.00 alone. The following meters are included: 0-1500 watt meter, 0-250 voltmeter for 500 cycle use, 0-10 ampere 500 cycle ammeter and a frequency meter. Also necessary field rheostats and switches. Telefunken transformer, quenched gap, mica condensers, wave changer, two loading inductances, and 0-20 amp. thermo radiation meter. Will sell for $250. For further details write to F. L. Wisner, Radio 6ZQ, 1906 Chestnut St., Berkeley, Calif.

Genuine German Telefunken H. W. Ammeters with scale reading of 0-4 amps and adjustment for temperature variations. Brand new, very exact, with original seals unbroken. Diameter 2⅞ inches; regular price $8.50—special at $3.95. Add 20c parcel post charges. Send 5c in stamps for descriptive matter. E. Tiebout, 68 79th Street, Woodhaven, N. Y.

RECEIVING APPARATUS

WESTERN ELECTRIC HEADSETS, while they last, No. 10020, the $15.00 grade, prepaid for $11.25 each. A few only of the former $12.00 grade at $9.25 each. Grab this bargain as we have only fifty sets. Radio Supply Co., P. O. Box 842, Phoenix, Arizona.

All parts and accessories for radio you can buy from manufacturer cheap. Get price list. Continental Electric Co., 107 E. 129th St., New York City.

A BARGAIN—Two variable condenser .01 mfd. each. From Marconi 107A Tuner. Excellent for long waves; self shorting switch. $10.00 each, postpaid. D. Linehan, 934 Galt Ave., Chicago, Ill.

Two Step Amplifier $25.00; Honeycomb Regenerative including coils and Radiotron $45.00; Variometer Regenerative including Radiotron $45.00; Homcharger $12.00; Radiotron Detector $3.50. Box 205, Williamsport, Pa.

25 Mile Receiving Set Complete $14.00. Also Regenerative units and parts at a bargain. Write for circular. Alexander Jurek, 2642 Ballou St., Chicago, Ill.

Several A-batteries, Willard, 6 volt 90 ampere hours, new, $10.00 each. Robertson, 1680 Broadway, Alameda. Phone Alameda 1686-J.

Ten per cent discount on all standard radio goods. Prompt service. Superior two step Amplifier $25.00. QST Radio Service, Williamsport, Pa. (8t)

FOR SALE CHEAP! $100 Receiving set like CR-9, for $60.00. Also Magnavox for $85. First Class! Ralph Haynes, 1230 American Avenue, Long Beach, Calif.

MISCELLANEOUS

RADIO EXPERIMENTERS WIND YOUR OWN HONEY COMB AND SPIDER WEB INDUCTANCES with the "RA-GAR UNIVERSAL" COIL WINDER. (Patent Pending). Milling machine accuracy in wire spacing guaranteed. Makes all Standard Honey Combs 25 to 1500 turns, including coils for Armstrong Super-Regenerative Circuit, Lattice wound Variometers and Variocouplers; also Spider Web or Basket Wound Inductances. Average cost per coil, Five to Ten Cents. Simple enough for a child to operate; no experience necessary. Boys make coils for profit. Professional Model makes all of above coils, $4.50. Amateur Model for Honey Combs only $3.00—full instructions included with each winder. (Include parcel post for two pounds.) Immediate delivery. No stamps. "RA-GAR UNIVERSAL" COIL WINDER COMPANY, Dept. 5-A, 642 22nd Avenue, San Francisco, Calif.

FOR EXCHANGE—1916 Chevrolet "490" Chassis, in good running order, for Magnavox and Magnavox Power Amplifier, complete with bulbs. C. E. McCartney, 901 Chapala St., Santa Barbara, Cal.

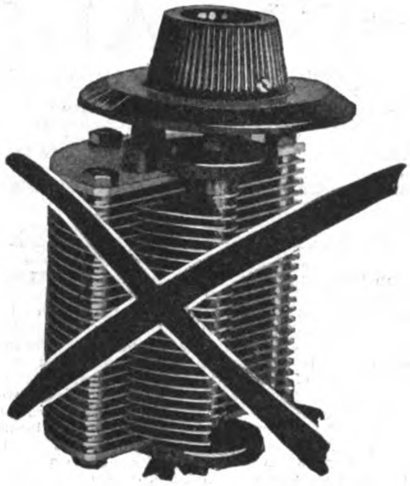
RADIO WORLD, THE GREAT NATIONAL WEEKLY—published every seven days with all the latest news, developments and pictures of the radio field. 15c a copy. $6.00 a year (52 numbers), $3.00 six months, $1.50 three months. Special to radio readers. Send $1.00 and we will send you the next eight issues of RADIO WORLD. Pub. Office, 1493 Broadway, New York. (tc)

NOTHING BETTER FOR CHRISTMAS than a subscription to "RADIO" for your friend. Magazine subscriptions are a lasting gift the whole year 'round. Send us the name and address of the person to whom you desire to send RADIO and we will advise him of your generous gift in the form of a beautiful Xmas card. His subscription will start with either the December or January issue, as stated by you. Send $2.50 today. Avoid the rush. "RADIO," Pacific Building, San Francisco.

EASY COURSE IN HOME RADIO, by General G. O. Squier; a complete volume of radio instruction in the form of seven books, containing hundreds of illustrations and diagrams. A most suitable Xmas gift. Price per set of seven books only $3.00, postpaid anywhere. "RADIO," Pacific Building, San Francisco.

TWO PAGES OF AMATEUR CALLS OF THE 6th DISTRICT will be published weekly in "BROADCAST PROGRAM," a 32-page magazine issued by the publishers of "RADIO." First issue out on November 26th. Contains all broadcast programs for Central California. Price per copy, 5 cents. By mail $1.00 for six months. "RADIO," Pacific Building, San Francisco.

Salesmen that have been or are calling on electric or radio trade, see Mr. Rice, 6811 N. Clark St., Chicago.



These two pictures compare the thickness of the standard variable air condenser and the Dubilier Variadon

The New Variadon—

No thicker than an ordinary dial

THE following are the more remarkable features of the new Dubilier Variadon, the first practical mica variable condenser:

1. It is no thicker than an ordinary dial. Yet it serves the purpose of an air-condenser with several dozen plates.
2. It can be mounted on any convenient part of a receiver case (front or rear of panel).
3. Its adjustment cannot be destroyed by ordinary shocks, falls or vibrations. Hence short-circuits are practically impossible.
4. It makes the vernier unnecessary.
5. It can be used as a grid-leak condenser, so that new tubes or different tubes can be adjusted to suit the receiving set.

Capacity .0004 or .0006 mfd. Retail price $2.50.

Capacity .001 mfd. Retail price $3.00.

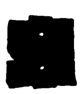
Supplied complete with dial and knob.

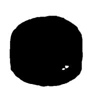
Other famous Dubilier Products:

Dubilier Micadons
Micadons are little mica condensers which reduce tube noises. Made in a wide range of capacities. Price 35 cents to $1.50 each, according to capacity.

The Ducon
Screw the Ducon in any lamp socket and thus do away with the antenna. The broadcasting station comes in loud and clear. Price $1.50.

The Du-rec
A chemical rectifier of which every spot is sensitive. No "cat-whisker" adjustment necessary. Does not oxidize with age. Price, mounted, 30 cents each.





DUBILIER Condenser & Radio Corp.

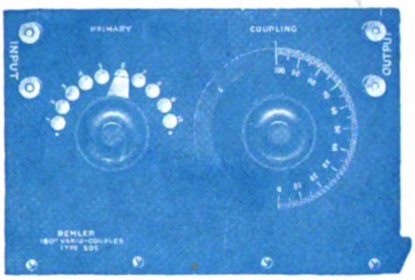
48-50 West 4th. St. N.Y.

Distributors and Branch Offices

San Francisco, Cal.	709 Mission Street
St. Louis, Mo.	Syndicate Trust Bldg.
Washington, D. C.	Munsey Building
Chicago, Ill.	33 So. Clinton St.
Atlanta, Ga.	Forsyth Building

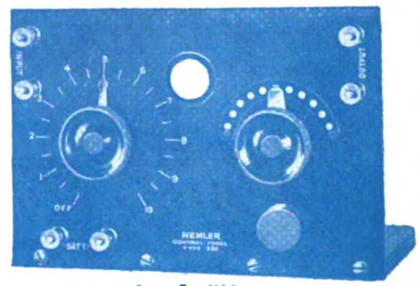
Distributed in Canada by General Electric Company, Ltd., Toronto

REMLER
Cunningham

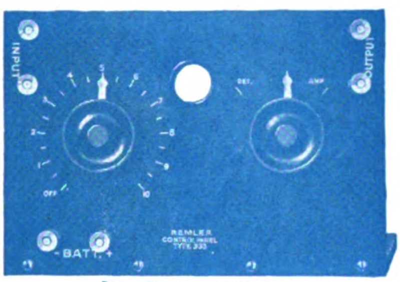


Remler Type 505 Panel Mounted Vario Coupler Price $12.00

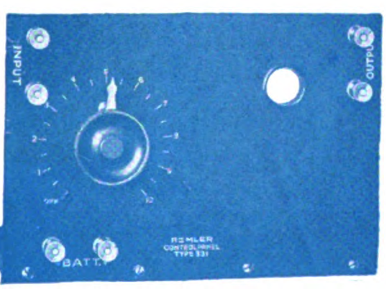
Remler Type 502 Panel Mounted Variometer Price $10.50



Remler Type 330 Detector Panel Price $8.50



Remler Type 333 Amplifier Panel less transformer Price $9.00



Remler Type 331 Amplifier Panel less transformer Price $6.00

Remler Panels Make An Ideal, Economical Receiving Set

In placing these panels on the market Remler has put a high quality receiving set within the financial reach of everyone.

When designing these Remler panel-units, Remler engineers combined every point necessary for efficiency in receiving, together with special features of construction for the convenience of the user. No process of manufacturing that would make these panels efficient in operation, beautiful and uniform in appearance has been neglected. Each panel is a complete unit mounted on a hardwood base for table use but so designed that any number of panels may be easily mounted in a single cabinet.

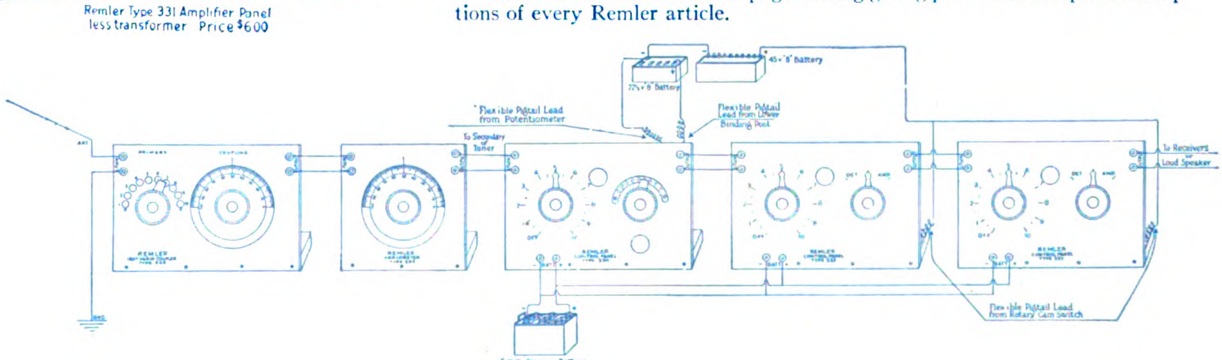
Remler standard parts are used exclusively in their assembly—hence it is possible, by using combinations of Remler panel units, to obtain a complete receiving set, using the same circuit employed in the most expensive receiving set on the market, at only a fraction of the cost.

You can Start with only three panels:

A complete and efficient receiving set for local work is obtained by connecting together Remler panels types 505-502 and 330. For long distance receptions other panels may be added one at a time to suit the convenience of the owner until the most complete and efficient circuit possible is obtained. The cost is nominal.

The diagram below shows five Remler panels connected to form a complete inductively coupled receiving set and two-stage Amplifier.

Send 10c for new Remler 40-page catalog giving prices and complete descriptions of every Remler article.



The Remler Technical Bureau is at your Service. Address your problems to Dept. R

REMLER RADIO MFG. COMPANY

FACTORY AND HOME OFFICE
248 FIRST STREET
SAN FRANCISCO, CALIF.

EASTERN SALES OFFICE
154 W. LAKE STREET
CHICAGO, ILLINOIS

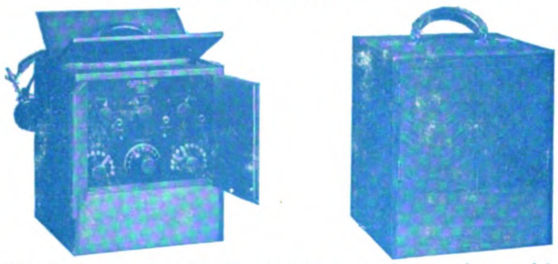
—for cottage or skyscraper!

This will be A RADIO CHRISTMAS!

—because there are now radio sets so supremely simple anyone can operate them, so compact they are adapted for use in any location from the tiniest cottage to the tallest skyscraper, so efficient that broadcasted programs may be received from stations both near and far with perfect ease and clearness.

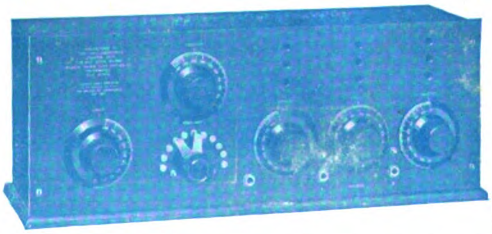
Such a set makes an ideal Christmas present, and you don't have to accept a substitute either, if you will go to the best radio dealer you know of and insist he show you the *A-P quality line*. Two remarkable sets from the *A-P line* are shown below.

The Oard Phantom Receptor



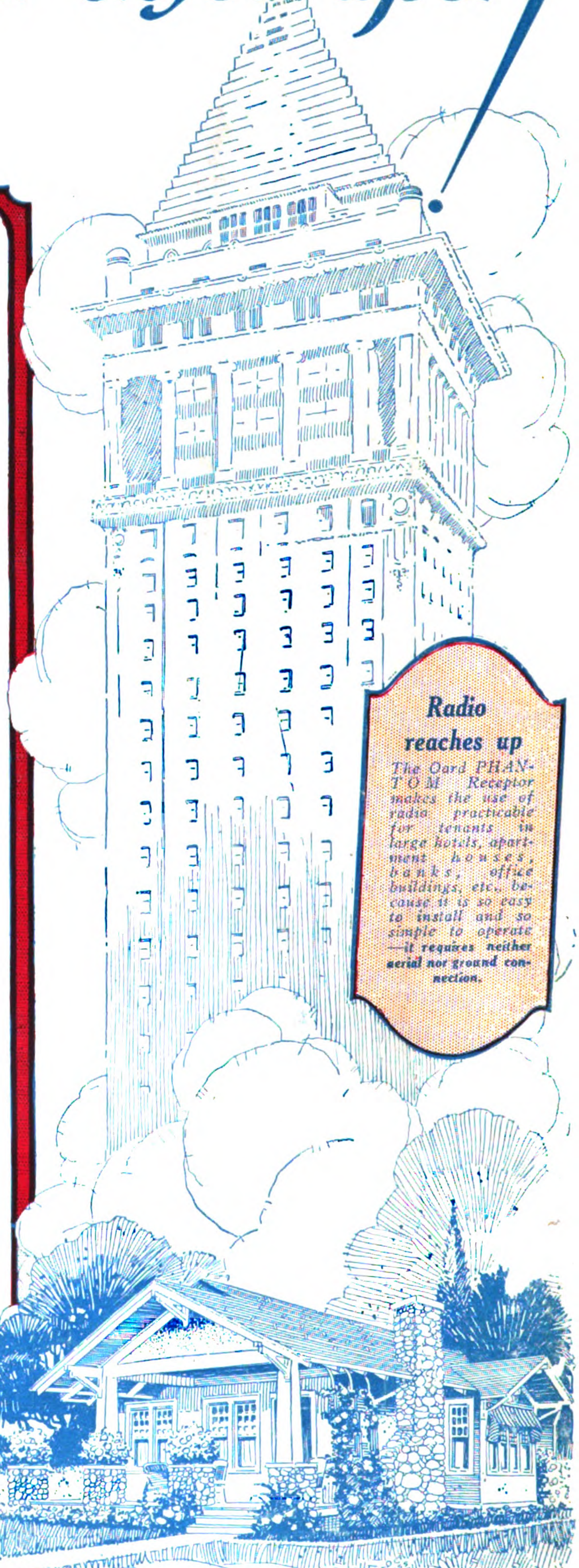
An A-P set so simple, compact, and complete within itself it can be used successfully in *any location* by *any person* who desires to receive radio programs or communications. *It requires neither aerial nor ground connection.* Efficient over both short and long distances. Highly selective.

Type AR-2 Receiver Detector and two-stage Amplifier



A beautiful regenerative set complete in a single cabinet. Combines ease of operation with marked sensitiveness and selectivity in action. Wave length 175 to 2,000 meters.

The best radio dealers handle the A-P quality line. Ask the one nearest you to demonstrate the two extraordinary sets pictured above.



Radio reaches up

The Oard PHANTOM Receptor makes the use of radio practicable for tenants in large hotels, apartment houses, banks, office buildings, etc., because it is so easy to install and so simple to operate **—it requires neither aerial nor ground connection.**

If there is no A-P dealer near you write us for Bulletin R-4. In writing be sure to include the name and address of some radio dealer, together with your own name and address.

A-P Quality Line

Atlantic-Pacific Radio Supplies Co.
646 Mission St. — San Francisco, Cal.

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