RADIO NEWS

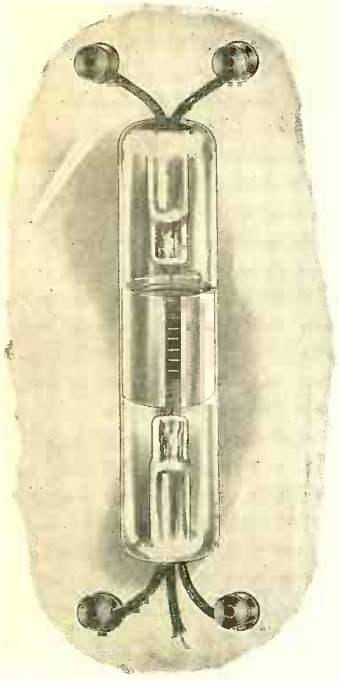
REG. U.S. PAT. OFF.

20 Cents
September
1920
Over 100 Illustrations
Edited by H. GERNSBACK

"THE 100% WIRELESS MAGAZINE"

AUDIOTRON

The Original Tubular Vacuum Detector, Amplifier, Oscillator



NOW FREE FROM ALL RESTRICTIONS

Dealers and Amateurs!

AUDIOTRONS, recognized as the most sensitive detectors ever produced, are now licensed under Fleming Patent No. 803684 to be used only for amateur and experimental uses in radio communication. They are no longer limited to audio frequency and can now be used as detectors and oscillators as well as amplifiers.

All patent questions also have been definitely settled. Vacuum tube patents are basic and have been sustained by the Federal Courts.

Be sure to get genuine AUDIOTRONS. They outclass any other form of detector and are absolutely free from all legal restrictions or difficulties. These new uses make it even more necessary to insist on the genuine. You can always tell a real AUDIOTRON by the name stamped plainly on the glass.

Insist on the name AUDIOTRON on every tube you purchase. Fully guaranteed by the AUDIOTRON Mfg. Co. *(Read the guaranty below).*

AUDIOTRON the only tube satisfactory enough to stand a guarantee!

Your last chance for an AUDIOTRON *double filament* DETECTOR

Manufacturing reasons make it impossible to continue the present hand-made AUDIOTRON.

This type has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40.

The few thousand that will still be produced, however, will be of the same standard of excellence that has characterized every AUDIOTRON.

Already recognized as the most sensitive detector on the market, these few that still remain, with all restrictions on amateur use lifted, are undoubtedly the greatest opportunity ever offered to amateur radio operators.

See your dealer at once or order direct. Be sure to benefit by this last opportunity to secure a hand-made super-sensitive, double filament AUDIOTRON Detector, Amplifier, Oscillator.

$6.00 each

(No increase in price)

The AUDIOTRON Exclusive Guaranty: Each and every AUDIOTRON is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AUDIOTRON MFG. COMPANY

(Successors to the AUDIOTRON Sales Co.)

Dept. A Lick Bldg. San Francisco, California

Dealers—

Get in touch with the AUDIOTRON Mfg. Co. at once. We will give you full information about settlement of all patent difficulties. *You will also be interested in our new proposition for wide awake dealers.* After the present supply is exhausted, new types of AUDIOTRON, manufactured entirely by machinery, will be offered for sale. Our extensive advertising during the Fall will establish definitely the superiority of the AUDIOTRON and will create new sales for you. Be sure to take advantage of our full co-operation at once. Prepare to cash in on the AUDIOTRON reputation, established since 1915. *Write us today for full details.*

CONNECTICUT RADIO

Strong Signals

Signal strength and selectivity are outstanding advantages of the CONNECTICUT Variable Condenser, because of the low effective resistance of this Condenser.

Laboratory tests have shown the efficient resistance of the CONNECTICUT Condenser to be only a few tenths of an ohm, as against from two to fifteen ohms resistance in the ordinary commercial Condenser (rotary type).

This difference would result in a signal strength from the CONNECTICUT Condenser fully ten times as strong as from the ordinary types.

These and many other advantages of the instrument, are described fully in our new booklet. Send for a copy.

Mention your Dealer's Name

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

RADIO NEWS

CONTENTS

VOL. 2 FOR SEPTEMBER NO. 3

RADIO NEWS is publisht on the 25th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.00 a year in U. S. and possessions. Canada and foreign countries, $2.50 a year. U. S. coin as well as U. S. Stamps accepted (no foreign coins or stamps). Single copies, 20 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you should change your address notify us promptly, in order that copies be not miscarried or lost. No copies sent after expiration.

All communications and contributions to this journal should be addrest to: Editor, RADIO NEWS, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

RADIO NEWS. Monthly. Entered as second-class matter June 6th, 1919, at the Post Office at New York, N. Y., under the Act of March 3, 1897. Title registered U. S. Patent Office.

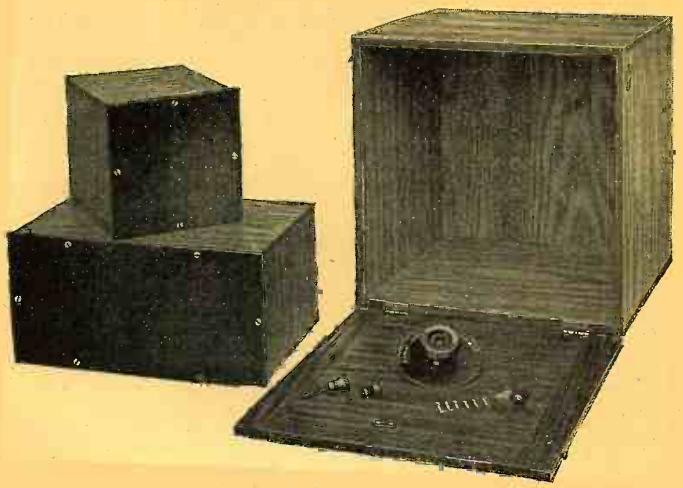
RADIO NEWS is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. For Great Britain; Goeffry Parker & Gregg, 62 & 8A, The Mall, Ealing, London.

Publisht by EXPERIMENTER PUBLISHING CO., INC. 233 Fulton Street, New York City

H. GERNSBACK, President S. GERNSBACK, Treasurer R. W. DE MOTT, Secretary

AMRAD

The Recognized Symbol of Superior Performance



THE new line of cabinets are of particular interest to operators who build their own apparatus. Beginning with two or three simple units, one may from time to time add other units, preserving the neatness and uniform appearance of the entire set and avoiding special construction work.

Among the three types of cabinets now available is a 10" x 10" x 10" size with a removable front. This construction makes the Cabinet adaptable for a complete receiver, VT amplifier or CW transmitter units for either stationary or portable purposes. This model is designed to receive the standard 10" x 10" Bakelite panel, furnished separately or two of the 10" x 5" Cabinets or four of the 5" x 5" Cabinets, which may be mounted flush or below flush as desired.

The two smaller models, both 6¼" deep are furnished complete with standard 10" x 5" or 5" x 5" panels already attached. The same panels, undrilled, are also furnished separately.

All the cabinets are rigidly constructed of first grade Chestnut and given a smooth, natural gloss finish which, in addition to the attractive appearance, insures that Cabinets purchased at different periods will exactly match. If preferred, the constructor may give the Cabinets any special finish desired without difficulty.

Further details and prices will be found in Bulletin R, sent upon request.

Radio Operators: Send your station call letters and name of nearest dealer and we will mail you our catalog now ready. Latest bulletins for insertion therein will be forwarded you monthly.

Retailers: Our new trade proposition became effective last month. A request on your letter head will bring all details and our complete trade catalog.

AMERICAN RADIO AND RESEARCH CORPORATION

15 Park Row
New York

Address all Communications
to New York Office

Factory and Laboratory
Medford Hillside, Mass.

RADIO NEWS

H. GERNSBACK — EDITOR
PIERRE H. BOUCHERON — ASSOCIATE EDITOR

Vol. 3 SEPTEMBER, 1920 No. 3

RADIO CONCERTS

ON June 15th of this year the *Daily Mail* of London inaugurated the first "world" concert, in conjunction with the famous opera star, Madame Nellie Melba, transmitting her voice over vast distances; the music in some instances was heard over a thousand miles away from the sending station. Madame Melba was performing at Chelmsford, near London, singing into the microphone of a standard radio telephone apparatus.

There was nothing radically new employed in sending out her voice, the apparatus used being well known and similar to what has been described time and again in this publication. The voice, on the other hand, was heard over a great expanse of space wherever there was a radio receiving station within range which had suitable apparatus for the interception of the concert, which, by the way, started at seven o'clock in the evening, London time. The results left nothing to be desired. As a matter of fact, the several voices came thru excellently.

First a deep voice slowly announced the program, then came the first strains from the piano, and finally the clear voice of the noted singer. Several selections were rendered by Madame Melba, and the concert terminated with the British national anthem, "God Save the King."

At Paris, the *Societé Française Radio Electrique,* on the other hand, took elaborate precautions to receive the music in a totally unlike manner than has ever been accomplisht before. This company, with its headquarters at Levallois, near Paris, erected a special booth, where by means of elaborate tuning apparatus, as well as vacuum tubes in great profusion, Madame Melba's voice was received and demonstrated to a large audience by means of a big aluminum horn. The experiments, however, did not by any means end there. The climax came—and here is where the novelty comes in—when the Societé used a special apparatus comprised of nine vacuum tubes with which to receive the music. It is interesting to note that, altho *no antenna or even a loop antenna was used,* the music not alone was received over the distance of several hundred miles, but was actually registered upon a master phonograph disc! From this master, actual phonograph discs were afterwards made, and all of them were quite clear. Here, indeed, is a worth-while novelty! While, of course, there is nothing new about "canning" radio telegraph messages, the idea of catching the voice of a great opera singer by radio on a phonographic disc seems rather novel and presents great possibilities.

The point we want to make here is that, altho America is supposed to be a country bordering close to the radio milennium, and, altho there are practically no restrictions and the law is all with the amateurs, progress, as far as radio telephony is concerned, is negligible.

In Europe, where the restrictions are very severe, and where special authorization for such an experiment as the above-described one must be had, it seems the art is thriving even more vigorously than here, where there are no such restrictions. In other words, real enterprise, as far as radio telephony and radio concerts, etc., is concerned, is rather frail and spasmodic here. Of course, there are many radiophone sets in the United States now, and these are growing all the time, but there are very few big "stunts" that come to one's notice, as, for instance, the one of Madame Melba described above.

There is nothing that popularizes radio more than a concert by a famous singer, and it is to be hoped that our amateurs, as well as professionals, shall band together and try for some original ideas. We wish to suggest here only a few:

Why cannot someone go after the Presidential candidates and invite them to make a speech via radio thru a powerful telephone apparatus in the near future? With proper advertising and with the proper enterprise behind such a scheme, it certainly should not cost a great deal to do. The people of the United States, thru the amateurs, would get a chance to listen to our candidates in a very novel manner. Another idea, which, of course, is not new, would be to transmit band concerts from famous bandmasters broadcast. Such concerts could be sent from some of the big centers, such as New York, Chicago, or perhaps Atlantic City, or some other points where the bands are staying at the time.

Of course, there are countless schemes and ideas of a similar nature, all of which make it possible to popularize radio, and that is what we are after. Now, why don't we get together and do it?

H. GERNSBACK.

"Wired Wireless" Experiments in the United States

By JOHN W. KEAN

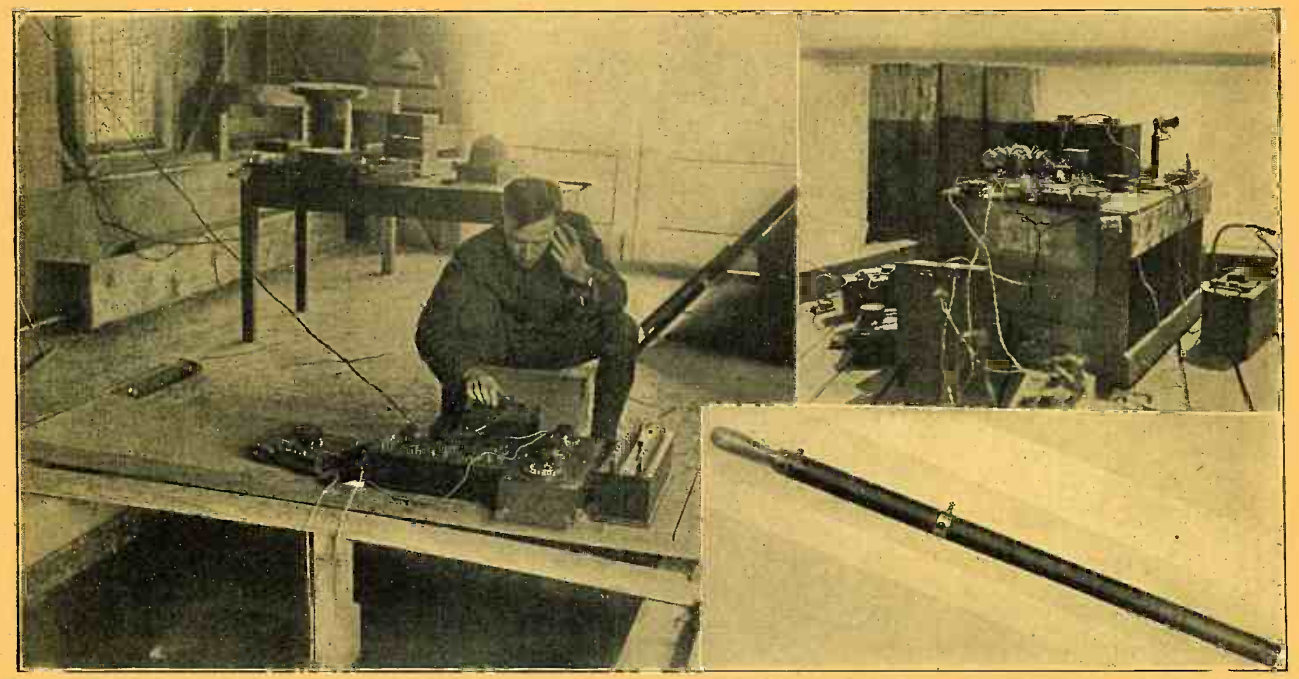
MAJOR GENERAL GEORGE O. SQUIER, Chief Signal Officer of the Army, told the members of the National Academy of Sciences at their recent meeting at Washington, D. C., the results of some very interesting experiments in multiplex telephony and telegraphy over open circuit bare wires laid under ground or under water, a fact which may shortly make possible ocean cable telephony as well as considerably improve present cable systems.

During the war, General Squier first explained, insulated telegraph and telephone wires were laid eight or ten feet under ground thru the advanced sectors of the battle area.

As radio waves past through the water, therefore, altho communication by this means was not entirely satisfactory, the Signal Corps decided to try stringing a copper wire under water, attaching radio instruments and sending messages in the usual radio manner. In other words, try a little "wired wireless."

The war ended before the experiments were completed and before the time set for Uncle Sam to begin supplying the cable. The experiments were continued, however, and Dr. Squiers told the assembled scientists the result.

The first experiment was a very simple one. A bare No. 18 phosphor bronze wire, the wire used for the Signal Corps field



The Signal Corps Man Who, By the Way, Is an M.S.E. (Master Signal Electrician), Is making Use of an Impedance Bridge in the Measurement of Submerged Wires At the Signal Corps Laboratory, Bureau of Standards. In the Upper Right Hand Picture is the Transmitter Used In Submarine "Wired Wireless" Work Between Fort Hunt, Va., and Fort Washington, Md., In April, 1920. The Bare Wire Over Which the Signals Were Sent Is Seen Going Over the Edge of the Dock to the Left of Picture. The Lower Illustration Is That of the New Resonance Wave Coil Employed in Connection with Bare-Wire Experiments.

As the war progrest the demands for lines increased and the Allied Council finally decided that Uncle Sam, beginning March 1, 1919, would have to save the day and furnish all the cable for the allied armies. It was estimated that the enormous quantity of 100,000 miles per month would be needed. It would require 14,000 ship tons per month to transport this quantity of cable from the United States.

As soon as the decision of the Council was announced the Signal Corps made a survey of our cable manufacturing facilities. It found that while we had the necessary wire, cotton thread and rubber to make the cable we only had sufficient machines to braid 8,000 miles of twisted pair insulated wire per month.

In view of this shortage of machinery, experiments were immediately begun by the Signal Corps to try and find some way of sending messages over bare wires when laid under ground. Once more it would appear that necessity is entitled to credit for mothering an invention.

The discovery had been made that it was possible to communicate by radio between submerged submarines.

antenna, was laid across the Washington Channel of the Potomac River from the War College to the opposite shore of Potomac Park. It was payed out from a small boat with sufficient slack to lay on the bottom of the river.

A standard Signal Corps radio telephone and telegraph set, SCR 76, was then directly connected to each end of the wire, one set serving as a transmitter and the other as a receiver.

At the receiving end of the line the bare wire was directly connected to the grid of the receiving set and the usual ground connection left open. A frequency of about 600,000 cycles a second was used and the line tuned at each end by the usual methods. Excellent results in telegraphy and telephony were thus obtained.

Care was observed to make this preliminary experiment as simple and basic as possible and precaution taken to see that the wire was bright and clean and entirely free from any grease or other insulating material.

Dr. Squier told the scientists that the next problem to be considered was the general efficiency of the electron or vacuum tube when used as a potentially operated instrument.

For the electron tube test, a strip of wire netting was buried in the snow outside the office of the Chief Signal Officer in Washington and a wire attached thereto leading to the second story of the building. The upper end of this wire was connected directly to the grid of an electron tube. It was necessary for maximum sensitiveness to connect it to the point of maximum potential of the antenna.

By this arrangement messages were readily received from distant points in the United States.

"These two simple experiments," the Doctor said, "demonstrated the possibility of transmitting electro-magnetic waves along bare wires submerged in water and the use of an electron tube as a potentially operated device for the reception of signals."

The Signal Corps Research Laboratories at Camp Alfred Vail, Little Silver, New Jersey, also established telegraph and telephone communications, using a bare No. 16 copper wire buried in the earth to a depth of about eight inches to connect the stations.

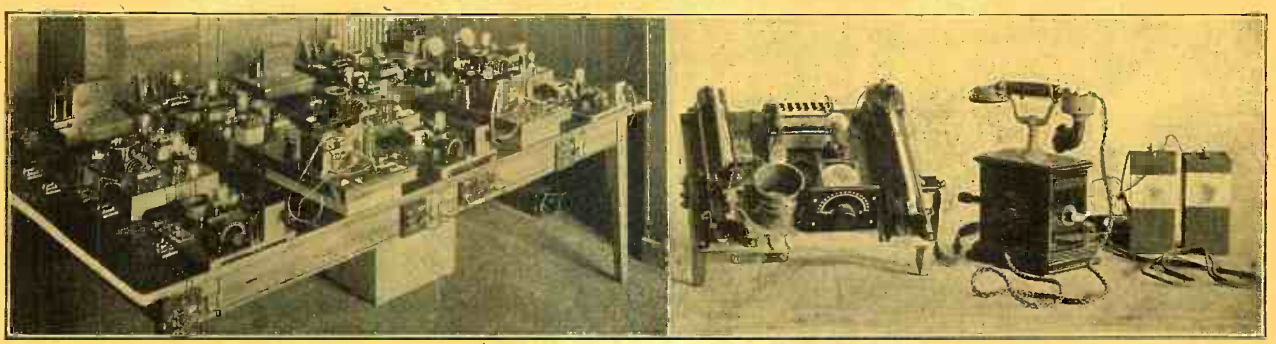
The distance between the two stations was half a mile. Frequencies as high as one million cycles were used. Similar communication was also carried on over a bare wire one and three-quarter miles long laid on the surface of moist earth. The current at the transmitting station in these installations was about 100 milliamperes. It was found that a bare wire buried in moist earth with the distant end open can be tuned at the transmitting end and at the receiving end.

(*Continued on page* 162)

"Wired Wireless" Experiments in Germany

The Fassbender-Habann High Frequency Multiple Telephony and Telegraphy

By Dr. ALFRED GRADENWITZ



The Photograph to the Left Shows the Laboratory Equipment of the Deutsche Telephonwerke. Four Morse Recorders May Be Seen As Well As a Multitude of German Vacuum Tube and Other Apparata. To the Right is Shown First the Station Equipment, Then the Subscriber's Instruments, for the System of "Wired Wireless" Telephony as used in Germany.

IN view of the scarceness of raw materials and dearth of labor prevailing in Central Europe, the telephone and telegraph service there has had to contend with serious difficulties in connection with the upkeep and extension of existing lines. Endeavors have therefore been made to employ for transmission along telephone and telegraph conductors, high frequency currents similar to those employed in wireless telegraphy and which, as is well known, act without any mutual interference when superposed upon one another.

This idea was, of course, first suggested in the United States about 10 years ago by George O. Squier, whose system is now about to be placed into actual practice. The system outlined in the following was developed in the course of the late war and tested in Berlin by Prof. Fassbender of the Charlottenburg Technical High School, in co-operation with Mr. Erich Habann.

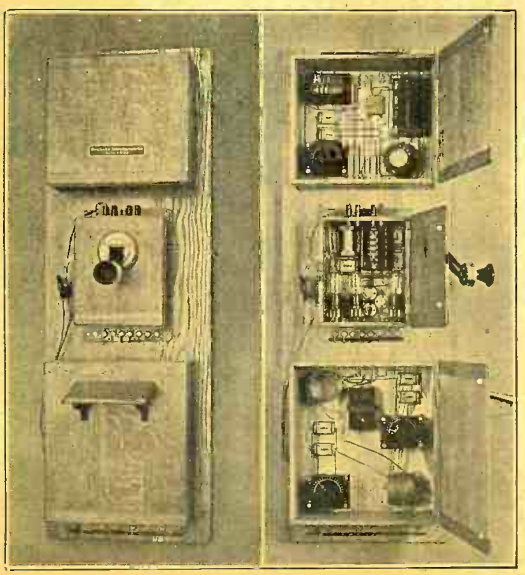
Fig. 1 is a diagram of connections illustrating the general principle of the system as applied to multiple telephony, there being a variety of possible alterations to suit the special use it is intended for.

Low frequency currents similar to those used in ordinary telephony are employed for communication between subscribers and the telephone exchange, high frequency being limited to mutual communication between the various exchange offices. This, of course, complies with actual needs; the lines between the exchanges being the only ones requiring any relief, whereas the line between the subscriber and the exchange, as a rule, can only be used for a single connection. If, on the other hand, the subscriber has several trunk lines, or even an exchange of his own, this, of course, is accounted for as a special exchange as regards multiple telephony. In the place of a considerable number of lines connecting two given exchange offices, there are only one or two lines used, each being capable of receiving multiple traffic.

The high frequency apparatus in this case is confined to the exchanges themselves, the subscriber taking no part in their superintendence. The activities of the exchange, on the other hand, are limited to connecting subscribers with a high frequency apparatus which happens to be disengaged. The exchange, of course, also has to tend the high frequency apparatus, but this can be done by a mechanic, simultaneously with quite a number of other apparatus. Details of the arrangement of connections are inferred from Fig. 2. An additional advantage of this scheme is that there are only two conductors leading from the subscriber to the exchange. Other features of the system are summarized in the following:

Use of amplifiers at the transmitter end by which the microphone currents are intensified, before reaching the grid of the transmitting tube. The starting of high frequency currents by the microphone currents themselves, thus preventing any undamped currents from passing through the conductors and setting up interference currents. The transmission of the ringing currents by high frequency, the latter principle being in many (tho not all) cases of paramount importance for the practical use of high frequency telephony. One process employed in this connection consists of applying a buzzer current to the transmitter tube grid and thus transmitting the buzzer sound, which, by means of amplifiers and loud-speaking telephones, can be intensified at the receiving station sufficiently to be distinctly audible at a considerable distance from the telephone. An alternative scheme consists of actuating, by means of relays, the subscribers' call bell, thus enabling the usual type of low frequency telephone apparatus to be employed with the same call bell in connection with high frequency currents as well.

An important point to be considered in this connection is the question as to the amount of transmitting energy, and degree of sensitiveness in the receiver to be adopted. In the case of radio telephony there are, of course, considerable amounts of energy required for bridging great distances. For this reason the transmitter has to be installed at a considerable distance away from the receiver plant, to guard against interference in reception from one's own transmitter. But in the case of "wired" wireless the losses are incomparably smaller than in connection with radio-telephony. Yet they are bound to become fairly considerable with very large distances. Still, the experimenters do not yield to the temptation of using in such cases extremely high energies, which would entail the necessity of providing two separate lines or even separate sets of poles for each line, to guard against interference from neighboring lines, strung over the same set of poles. Rather than resort to very high energies, Fassbender and Habann prefer increasing the range by means of high frequency intermediary amplifiers.



Two Excellent Views of a Typical "Wired Wireless" Telephone Set. To the Left the Set is Shown Closed and Ready for Use, While to the Right the Three Units are Shown Opened for Inspection.

High frequency *telegraphy* was at an early stage of these tests developed side by side with high frequency *telephony*, special types of apparatus being designed with a view to ensuring the same ease of operation as in the case of the ordinary low frequency Morse apparatus. Means had therefore to be provided to enable the direction of telegraphing to be inverted at any time without any alteration of connections or inquiry at the other end. One of the stations simply gives out an error signal, after which the other station ceases sending and, without any commutation, immediately receives any messages the opposite station may have to send. This is especially important for the sake of private messages concerning the service.

Distances up to 100 kilometers were

(*Continued on page* 164)

New Radio Apparatus

An Interesting "Buzzer" Radiophone*

THE unique and outstanding feature of this efficient and compact radiophone unit is that it operates on two six-volt storage batteries and no "B" battery or *external* source of high potential is required, the necessary high potential being obtained by the use of two small induction coils. Their primaries are excited by one of the storage batteries and their combined stept-up secondary potentials rectified by means of the two rectifying tubes shown on the panel.

This distinction opens up an entirely new field for the radiophone, as it may be used on automobiles, small motor boats, sail boats, camping outfits, surveying and exploration parties, forest patrol, or ranches, between farms, etc. The entire outfit can be easily transported on horseback, or motorcycle. The complete transmitter weighs about 60 pounds, including two six-volt storage batteries.

The unit operates with any suitable type of receiver and audion detector, with or without an audion amplifier, depending on the range to be covered and the loudness of reception desired.

In order to place the set in operation one of the six-volt storage batteries is connected across the two binding posts marked "RECT" (rectifier) with polarity as shown. The load on this battery will be about 1.8 amperes. Then the second storage battery is connected across the two posts marked "OSC" (oscillator). The current drawn from this battery will be about five amperes. It is customary to employ a 60 ampere hour battery for this service, and a 30 or 40 ampere hour battery for the other.

The audion detector or amplifier may be connected to the "OSC" battery only. No other instrument nor any external wires should be connected to the "RECT" battery while same is in use with the Buzzer Phone.

No rheostats are included in this panel. It is necessary that the two storage batteries are kept properly charged. The instrument will not operate properly if either of these batteries is run down. The post marked RA is connected to the antenna binding post on a regular radio receiver, which is thus connected to the antenna when Transfer Switch is thrown up to "LISTEN." Then the antenna is also connected to post marked "ANT" and a good earth connection to post marked "GND."

If the experimenter finds himself in the woods an excellent earth connection may be obtained by driving a large spike (preferably tinned, galvanized, or coppered) into the trunk of a live tree, near its root.

This set is designed to operate with an antennae whose capacity to earth varies from .002 m.f. to .0007 m.f., altho it may be used on even smaller antennae.

The wavelength range depends to some extent on the antennae capacity. The set radiates well on wavelengths from 700 meters to 2,500 meters, or an antenna of .0007 m.f. capacity. It radiates more energy on the longer wavelengths, however.

Three de Forest-Moorhead "VT" *hard* transmitting tubes are inserted in the three receptacles. Soft bulbs and those recommended for amplifier purposes will *not* answer. Only the very *hardest* tubes obtainable are to be employed with this set.

The Distinctive Feature of This Radiophone Unit Is That It Does Not Require an External Source of Plate Potential. This Solves One of the Great Problems of Low Power Radio Telephony and Thereby Opens a Wide Field of Utility for the Instrument.

When the above described connections are all properly made, the little transfer switch handle is thrown to position marked "Talk." The buzzer in rear of panel should then start vibrating. If it does not, the two contact screws on buzzer are slowly adjusted forward or backward until a regular quiet action is obtained, one which will automatically start up thereafter whenever the switch is thrown to "Talk." A very high pitch is *not* necessary. And if the two contact screws are screwed in far so as to produce a high-frequency make-and-break, the buzzer is certain to stop vibrating unexpectedly. When properly adjusted the buzzer will operate regularly and reliably indefinitely and requires no attention.

Inductance adjustments are made upon this instrument by connecting one movable clip to the contact point near the right hand end of the helix in order to give larger inductance. The grid condenser is set at the division marked 90, after which the antenna condenser is varied to give the maximum reading on the small hot wire ammeter.

After this, the grid condenser capacity is reduced to a point where articulation will sound clearest as heard in a suitable wavemeter set close to the instrument and carefully tuned to the wavelength being employed. Incidentally, this will also inform the operator as to what wavelength is being used. If no wavemeter or receiver is at hand, one must naturally resort to reports sent in by listening operators. The grid condenser or "modulation" adjustment is rather critical in order to secure best articulation, tho not necessarily the loudest voice.

A written record of all settings used is made as well as the number of the contacts on helix, setting of antenna condenser and setting of grid condenser for each given wavelength. After this the helix lead is shifted to another contact point which gives a shorter wavelength and the two condensers are adjusted.

This process is continued over the entire range of wavelength on which the radiophone set will oscillate. When the inductance in the circuit is reduced to such a point that the set will not oscillate, the hot wire ammeter will not register. The various settings for wavelength are tabulated in such a manner that it will be possible for the operator to quickly refer to them when it is desired to change wavelengths. The set, however, is probably more reliable when adjustments are kept at a fixt wavelength such as might be employed for reliable connection between two points.

If the antenna capacity is large, that is to say in the neighborhood of .001 to .002 mfd., it is then advisable to shunt the hot wire ammeter in order to avoid injury to it. This may easily be effected by connecting a small length of resistance wire across the two binding posts in the rear of the meter, altho for small aerials this shunt is not necessary.

Taken in all this effective little buzzer radiophone set should prove a very desirable and inexpensive instrument for many amateurs as well as for many commercial and private individuals who would like to establish an effective means of communication whether it be on water or on land.

Altho the manufacturers claim a practical working range of from ten to fifteen miles, additional distances up to fifty miles have readily been secured, and as a matter of fact in one instance a space of 200 miles was effectively bridged by the human voice.

Its use is particularly recommended in sections of the country where power circuits are not available. It may also be said that even where it is not possible to charge storage batteries one can resort to primary cells or to the use of a larger number of dry batteries connected in series-parallel, as in this instance one does not have to worry about securing the external high plate potentials necessary with many of the present day radiophone systems.

* *Photograph by courtesy of De Forest Tel. & Tel. Co.*

Radiophone Station of Morton W. Stearns

Dancing via An Amateur Radio Set

Front View of This Interesting and Compact Set. The Cabinet is Piano Finisht Mahogany Wood. The Various Operating Controls Are Well Arranged on Panel.

AMATEUR radio operators in the vicinity of New York were recently treated to a concert of dance music, lasting several hours. This music was transmitted by radio telephone from station "2AB" operated by Mr. Morton W. Sterns, located in the upper part of New York City, for the benefit of the Radio Club of Brooklyn which was holding a dance in the heart of Brooklyn, some 15 miles away. The music was received at the hall in which the dance was held, on an indoor (loop) antenna in connection with an amplifying device and a loud speaking telephone. The music, received at the hall, was heard by everyone present loud enough to dance by. In fact, it was reported that the music was just as distinct as that played by the orchestra at the hall.

If was later discovered that simultaneously with this dance, people were dancing in the nearby towns of Paterson, N. J., and New Rochelle, N. Y.

Owing to the success of this initial experiment, Mr. Sterns has arranged to hold weekly concerts, namely at 8 P. M. Friday evenings and 11.30 A. M. Sunday mornings.

The station is equipt with the radiophone, shown in accompanying illustrations, rated at approximately 15 watts, and music is played on a brand new development of the phonographic art, namely the Crippen *interpretone*. Due to the unexcelled clearness and fullness of tone of the interpretone it lends itself readily to the peculiar requirements of the transmission of music by radio. As is well known the transmission of speech by radio is very much clearer than by the ordinary telephone with which we are all familiar; and any scratch or rasp in the phonograph will be considerably exaggerated at the receiving station. Anyone having heard this music, transmitted by radio station "2AB", on the interpretone will readily appreciate the clarity of the music.

During the two weeks at which the Atlantic fleet was anchored in the Hudson River, numerous messages were received from the sailors and officers aboard, asking us to play music for their dances on deck, which was done much to their enjoyment.

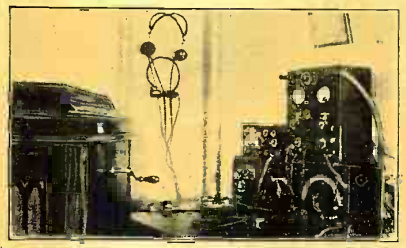
It may be of interest to the amateur fraternity to give a brief description of radio station "2AB". The transmitter consists of a Sterns radiophone, consisting of three small tubes, and rated at approximately 15 watts. The transmitter cabinet measures 8½ x 11 x 5 inches, making a very compact unit.

During the past winter, several reports have been received from distances in excess of 1300 *miles*. The operator on board the SS. Rayo reports having heard speech, and modulated buzzer signals, while 150 miles southeast of Key West, Fla. The modulated buzzer and continuous waves have also been heard by an amateur in Minneapolis. Minn. Reports, covering practically the entire territory east of the Mississippi River, and from the Canadian border to Gulf of Mexico, have been received, stating that station "2AB" had been heard.

Distances in excess of a thousand miles, on imputs not exceeding 15 watts, establishes a new long distance amateur record, for radio transmission on short wave lengths.

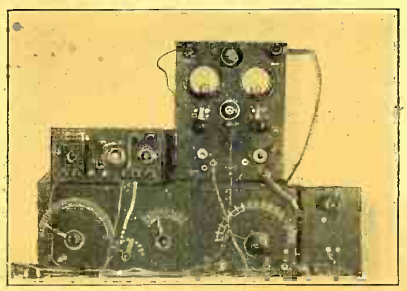
Mr. Sterns will be very glad to hear from any amateurs, located over a hundred miles away, who intercept his music on Friday evenings or Sunday mornings.

As the *interpretone* arrived after the winter period of long distance transmission had

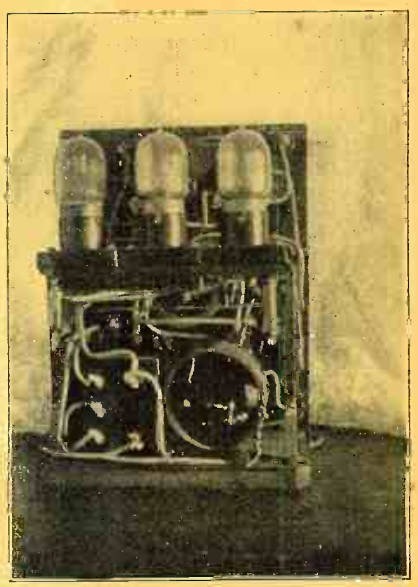


Another View of the Sterns Station Showing the New Phonograph Which Is Equipt With the Crippen Interpretone, a New Device Permitting of Excellent Results in Transmitting Music via the Radiophone.

past, it is rather unlikely that our music will be heard at any distance until the good radio weather in the fall returns, but it is encouraging to note that during the three weeks the music has been transmitted, that stations in Connecticut have reported having picked up the signals good and clear.



The Lower Unit to the Left of This Illustration is a Home-made "Paragon" Receiving Set, While to the Right is Shown the Aerial Change-over Switch. Above and to the Left is Placed the Audion Control Panel, and to the Right the Radiophone Transmitter Unit, of Which Two Larger Pictures Are Illustrated Above.



Rear View of the Sterns Radiophone Set, Showing the Three Oscillator Tubes. No Modulator Tube Is Employed Here.

ANOTHER PHONE PROPHESY.

"HELLO, this you, Hubby? Well, I'm half way to China by this time and I was wondering if you've fed the canary."

This, by radiophone installed on ships sailing out of Seattle, will be possible soon, says W. F. McAuliffe, local manager of the Radio Corporation at Seattle, Wash. In a short time, he says, the company will begin installing the instruments on the ships of the Admiral Line sailing to California, China, Japan, the Philippines, Honolulu and Alaska.

"Have you sprinkled the window boxes? "Where were you last night? I tried and tried to find you but you weren't at home and you weren't at the club. Where were you?

These are only a few of the sorts of questions that Friend Hubby will be called on to answer daily, when radiophones have been established on ocean-going vessels. And Wifey will keep her hand on the pilot wheel of the home even if she is half way across the Pacific.

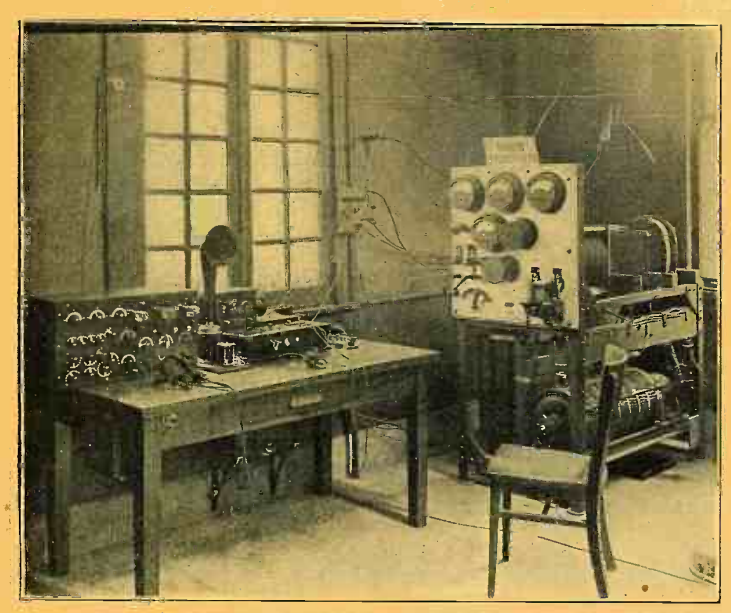
When Hubby goes on his "business" trip, and is unable to pack his golf sticks along, he will be able to telephone to the maid and ask her to send them to him, when the wireless is installed, and Wifey will be none the wiser. And for the languishing suitor who wishes to continue to press his suit even though the ocean waves separate him from his loved one, the air will be "blue" with messages to "dearie" and assurances of his undying devotion.

While just at first only business messages probably will be sent on the telephone, when it is in good working order it will be open to the use of traveling guests. At first these messages will be inconvenient, because Wifey will first have to send Hubby a wireless message telling him to be at the wireless station at a particular time, because she is going to telephone him.

But as the secret of the radiophone lies in a small glass vacuum tube three inches long, it will not be long before Hubby will have one right at his bedside, along with his drop light and cigarettes.

Time Signals by Amateur Radio

What an Illinois Watch Company is Doing as a Service to Local Amateurs



View of "9-ZS" Complete Receiving Instruments Are to the Left, Including the Loud-Speaker and the Detector and Two-Step Amplifier Box. To the Right Is Seen the 10 K.W. Transmitter of the "Rotary-Quenched Spark" Type.

HERE is some information which should prove of interest not only to radio amateurs residing in the radio-range vicinity of Springfield, Illinois, but to the radio fraternity at large. It again brings to our mind the ever-increasing and multitude of uses to which modern radio is being employed.

In this instance, the Illinois Watch Company has very kindly sent us some excellent photographs which we are pleased to present to our readers on this page. This concern is probably the first one in this country, if not in the world, to actually transmit time signals and weather reports each day to all radio amateurs as well as to any possible vessel in any of the Great Lakes who may chance to hear them and who may effectively intercept the radiated energy of a 10 K.W. transmitter.

The transmission of time signals is of course not a new thing but it is new for a watch making organization to do it. The idea is suggestive of modern business methods which includes that of giving *service*. We need not rack our brains in this case for the prime motive. A concern making a watch is naturally anxious that the watch will keep good time. If that concern is reasonably certain the finisht watch is accurate they naturally enough want them to have a likewise accurate means of comparison. The sending of daily time signals so that nearby owners of watches may have a dependable source of "checking-up" is therefore a step in the right direction and in keeping with the gospel of *service*.

We radio men are of course not particularly interested in the manufacture of time pieces so that we may be pardoned if we suggest to those who are, not only in this country but in Europe near the great watch-making plants of Switzerland, the effectiveness of using radio time signals.

No doubt it is being done to a certain extent particularly in view of the closeness of that great steel monument of French engineering, the Eiffel Tower, which has transmitted time signals to the world at large for several years past. In the United States, we have, of course the excellent radio service of the Navy.

Yes, let us return to our own shores. The upper photograph shows a good view of "9-ZS," the time-sending amateur station of the Illinois Watch Co. located at Springfield, Ill., which was installed and first operated in 1913, employing a 1 K.W. transmitter for the transmission of time signals and weather reports. In 1914, however, the power and effective sending distance was considerably increased by the installation of a Clapp-Eastham 10 K. W. transmitter of the "Rotary-Quenched Spark" type, which set has been in use ever since, except for the period of war restriction on amateur radio activity.

The actual input is 6 to 8 K.W., depending on the line voltage, which is variable, on account of the potential drop due to the load taken up by nearby factory motors during the day.

The aerial is of the L type, consisting of four wires 400 feet long and 100 feet high, spaced four feet apart.

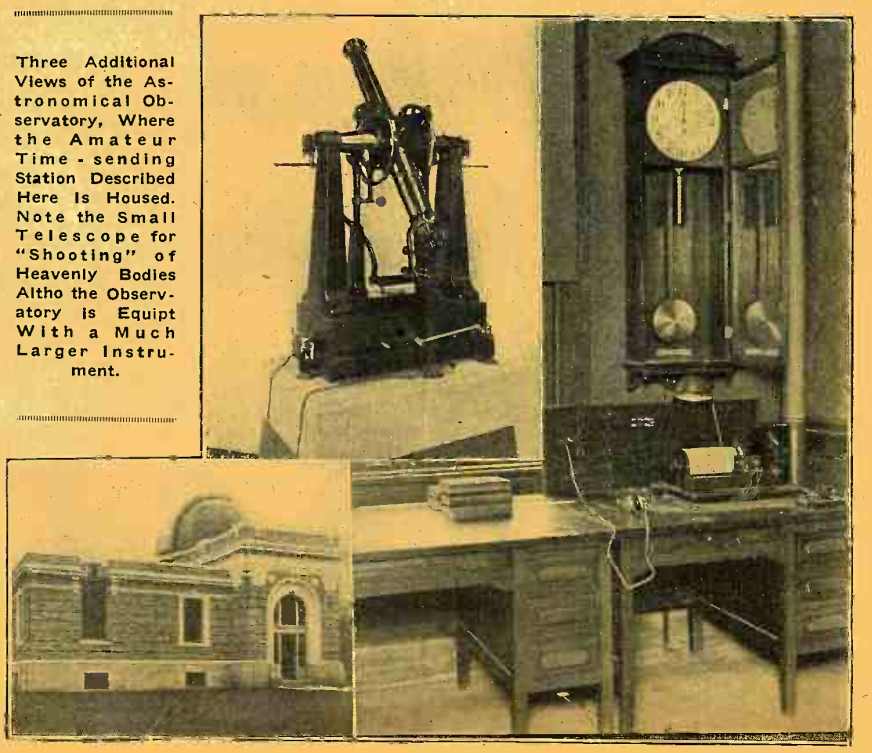
The work of the station is exclusively the transmission of time and of Illinois weather reports, the latter being supplied by the local office of the U. S. Weather Bureau. The service is much appreciated in Illinois and in neighboring states, as evidenced by the many commendatory letters received.

Incidently, the station has been headquarters for Springfield Amateurs, and during the past winter a school for radio instruction was conducted. Many operators who saw service in the Army and Navy during the War received their first incentive, and got their first code practise from "9-ZS," a fact which the men directly responsible for the maintenance and operation of the station are justly proud of, among whom is Mr. George F. Johnson, Superintendent and "Time operator" of the company.

The station is admirably housed in the Watch Company's Astronomical Observatory, three additional views of which are shown in the lower part of this page. For the benefit of those desiring to hear the station's activities and judge for themselves as to its effectiveness, time signals are sent on a wavelength of 1800 meters, at noon and at 8:00 p.m. Central Time. The time tick is immediately followed by the Illinois Weather report.

Aside from the value of the time signals, the transmission of a daily and authentic weather report is a welcomed and useful source of information to everyone in the vicinity of the station and in particular to farmers. The signals themselves reach out from 500 to 1,000 miles in all directions from Springfield, altho they have often been heard as far south as Key West, Fla.

Three Additional Views of the Astronomical Observatory, Where the Amateur Time-sending Station Described Here Is Housed. Note the Small Telescope for "Shooting" of Heavenly Bodies Altho the Observatory Is Equipt With a Much Larger Instrument.

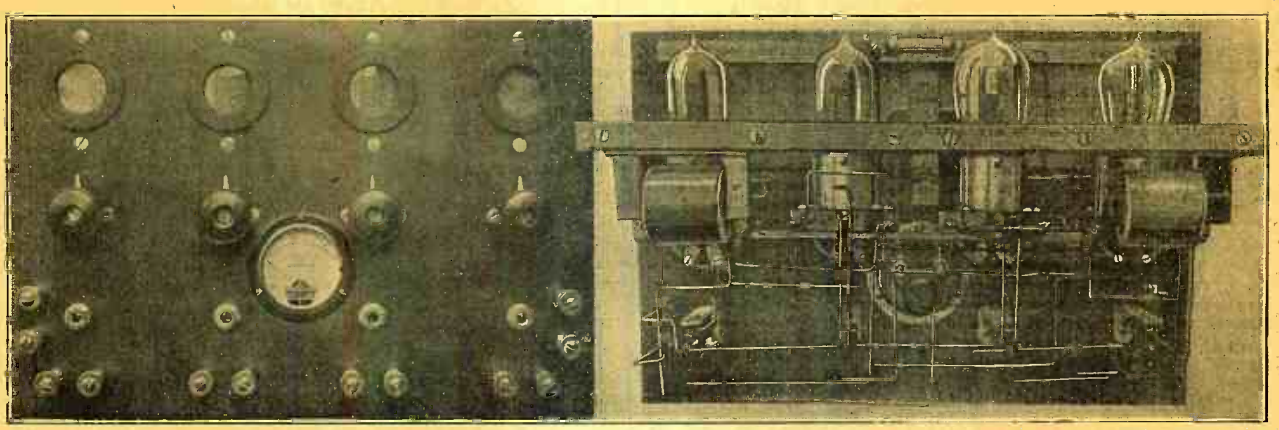


Amateur Workmanship

A Three-Stage Amplifier Built by an Amateur

Editor's Note—A young man recently breezed into our office and proudly held up for our examination the instrument illustrated herewith. This idea is not a bad one at all, and if there are any other amateurs in our immediate vicinity who would like to "show off" some of their radio handiwork, by all means let us have a look at it. If it is worthy of being displayed and described to our readers, we will photograph the instrument on the spot and gladly publish it. Not only that, but if the subject is a timely and constructive one, we will gladly pay space rate for any prepared data.

MR. MARC J. HASSID of New York City has kindly furnished us two excellent photographs of the above instrument, which he has constructed himself. He is pleased to give a brief description of the essential plans which enter into the construction for the benefit of readers who may be contemplating the building of a similar amplifier.



Here Is Proof of the Pudding, Illustrated for the Benefit of Those Who May Doubt the Fact That Any Boy, Armed with the Proper Tools and Knowledge Gained from Contemporary Radio Magazines Cannot Duplicate the Above Example of Workmanship. To the Left Is Seen the Front View of the Panel Which Has Sufficient Appliances to Operate a Detector and Three Stages of Audio Frequency Amplification. To the Left We Have the Rear View of the Instrument Which Shows How the Various Parts Were Mounted. The Center Amplifying Transformer Is at Right Angles to the Two Outside Ones. The Wiring Is Well Spaced Which, in Addition to the Rest of the Set-up, Helps Make the Set a Very Business-like One. Let Us See More Samples of Amateur Workmanship.

In constructing the set himself he has been able to lower the H. C. of radio apparatus and he does not hesitate to say that such an instrument can easily be constructed by anyone for the relatively small sum of $55, which, of course, does not include the builder's time. In this case it meant a week of fairly constant application. The cost of the instrument, you will admit, is certainly reasonable, considering the excellent workmanship and remarkable efficiency of this instrument.

As may be seen from the accompanying illustrations, the set consists primarily of a detector and three stages of amplification at audio frequencies. The four rheostats in this case are of the Paragon type, with a maximum resistance of four ohms. In the case of the amplifiers, a connection is soldered at a point of the resistance frame which will give a negative resistance of .5 ohms, which has been found by experiment to be sufficient for proper grid potential. The ammeter is of the Westinghouse type and has an effective reading scale of from zero to five amperes. When all four tubes are functioning properly this reading scale just covers the resultant current consumption. As for the V. T. sockets, these are of the General Radio manufacture and are so designed that should it be necessary, oscillating or power tubes may be used instead of detector or amplifying bulbs. This is accomplished in a very simple manner by the loosening of the two set screws, fastening the bayonet holder to the frame of the socket itself, and by simply turning the socket 45 degrees to a point where the socket has also been tapped to admit two 8/32 screws.

Three amplifying transformers, as may be seen, are arranged on the brass extension frame, so that the center one will be at right angles to the two outside ones, thereby eliminating any possible undesirable mutual effects between each transformer. These transformers are of the Acme type; each one having an amplification power of 10 to 16 times.

The four jacks furnish a ready means of plugging into the detector circuit, as well as to the first, second and third stage of amplification, respectively.

A grid leak of the Marconi type, having a resistance of ½ megohms (500,000 ohms), is employed, one leg of which is connected direct to the grid and the other to the secondary and loose coupler—in other words, to the binding post leading to that instrument, which is, of course, not shown in the illustration. The grid condenser is of the .0005-mfd. type. The general hook-up of this amplifier circuit is a standard one which most amateurs are familiar with.

The base is 9½ by 14 and ¼ inches in diameter and is of rough finish Bakelite, which presents a very businesslike and effective appearance.

The twelve binding posts shown are of a very sturdy type, permitting of secure connections to external apparatus, such as the A and B batteries as well as the secondary of any loose coupler. The screen which permits the observation of filament burning is made of a 12-by-3-inch brass mesh which has been nickel plated. All wiring connections have been effectively soldered in their respective positions and coated with black enamel.

Mr. Hassid has secured excellent results with this set, having frequently intercepted many amateurs in practically all of the districts of the United States. He uses a four-wire antenna, erected upon a roof 100 feet from the ground, 100 feet long—a standard amateur aerial. By saying that he receives these stations with great ease he means he does not simply occasionally hear them, but can intercept them at any time he wishes. Not only that, but he experiences absolutely no trouble in the matter of howling or any other undesirable noises. In considering that an amateur has been able to build a set capable of such remarkable amplifying efficiency the fact must be taken into account that the builder has paid considerable attention to building details as well as having employed the best construction practice thruout the instrument.

Should any amateurs desire to communicate with the builder for further information on the apparatus and construction details, inquiries may be addrest to him in care of RADIO NEWS.

One of the factors which most directly retards the advancement of amateur radio art is that of not exchanging mutual ideas. There is very little new under the sun, according to an old saying. That is the reason why John Smith of Heckers Corners, Iowa, seeing what Henry Jones of Laredo, Texas, has done, will suddenly conceive of a most effective way of improving upon Jones' scheme for doing a certain thing. Result, another patent application on its way to Washington.

Let us therefore have a little more exchanging of views, ideas and examples of workmanship. We do not mean, of course, that commercial, money-making ideas should be blissfully handed out to any one for the mere asking. By all means hold on to these and consult competent counsel in order to ascertain their practical and monetary value. What we refer to concerns the many little hints and helps which can be of mutual benefit to all members of the great radio fraternity but which have little or no dollars and cents value. Money is not everything. A true desire to serve and help make radio interesting, instructive and fascinating; that is the idea.

P. H. B.

GOSPEL BY RADIO.

When Melba sang by radiophone to an audience 100 miles away, most folks who read about it were thrilled at the alluring idea. Why can't all the world listen in, at a future time, when a great diva pours forth her golden notes?

One man, meanwhile is not waiting for such a development of radio wonders. He is the Rev. Clayton B. Wells, pastor of Fairmont Congregational Church, Wichita, Kans. With the cooperation of one of his parishioners, C. A. Stanley, Dr. Wells preaches every Sunday to 1,000 radio operators, amateur and otherwise, who happen to be within a radius of 500 miles from Wichita.

Radio Frequency Amplification

By A. S. BLATTERMAN*

Discussion of the Method of Radio Frequency Amplification Using Super-Audible Beats as Proposed By Major E. H. Armstrong

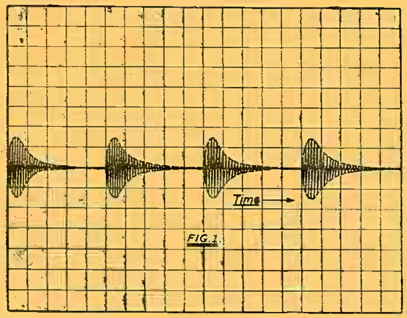


Fig. 1—Illustrating Trains of Dampt Voltage Oscillations Produced at the Detector of a Receiving Circuit By a Spark Transmitter.

UP to the present time it has been found very difficult to amplify radio signals having oscillation frequencies of the order of 1,000,000 cycles and practically impossible to do so when the frequency reaches 3,000,000 cycles or greater. The difficulties are attributable chiefly to capacity effects in the vacuum tubes as well as in the wiring, and also because it is a fairly difficult problem to build a really satisfactory coupling impedance or transformer to connect up the output of one tube with the input side of the tube next in the series when the frequency is very high. Movements of the hands of the operator or of his body near the apparatus in such cases cause extremely minute changes in capacity which are, nevertheless, sufficient to cause changes in tuning that seriously reduce the received signals.

Moreover, it is seldom, if ever, that a radio receiver can be designed for a single frequency. Both at the extremely high frequencies just mentioned as well as for the lower frequencies corresponding to long wave lengths, it is practically always necessary to arrange for reception over a more or less limited range of wave lengths and this requirement has also been a very serious factor in the design of all radio frequency amplifiers up to the present time. At radio frequencies it is possible, convenient and desirable to use tuned transformers for the couplings between successive stages; but because of the necessity for making the amplifier responsive over a large number of wave lengths the tuning of the transformers must be relatively broad. This involves the arbitrary introduction of resistance into the circuits and the loss in efficiency that results seriously reduces the overall amplification.

Major Armstrong has met the above difficulties in the way of radio frequency amplification by a method which in principle is as simple as it is highly ingenious, and, at least for the amplification of excessively short wave lengths, appears to be a satisfactory solution of the problem in hand. The principle can, as is stated by Major Armstrong, be applied to dampt wave and continuous wave telegraphy and to telephony. For receiving continuous waves a second heterodyne, either self or separate, must be brought to act on the second detector or else some form of chopper must be used. For very short waves of the order of 50 meters, it is possible to make a self-heterodyne of the first tube and thus avoid the extra adjustments and apparatus required by a separate local oscillator. In this case it is advisable to use as low a beat frequency as possible in order not to necessitate too much mistuning, and to design the amplifier circuits accordingly. The question, however, of selecting the proper super-audible beat frequency and the actions involved in the performance of these circuits are not as simple perhaps as Major Armstrong may have led some of us to believe. Upon closer inspection it is found that certain limitations must be imposed upon the design, especially in application to the reception of spark and telephone signals, and it appears likely that the system cannot be used to advantage at *all* radio frequencies.

The following paragraphs may be of particular interest in connection with the opinion held by some that the present amplifier will tend toward returning spark radio systems to the favor accorded them before the advantage of continuous waves, were as fully appreciated and utilized.

GENERAL THEORETICAL CONSIDERATIONS.

In the reception of *continuous waves* by the method under consideration the actions involved are relatively simple. The interference of the incoming signal oscillation with that produced locally results in a beat frequency which is almost truly sinusoidal and makes the design of the coupling transformers a very satisfactory proposition with the possibility of securing maximum amplification through sharp tuning and accurate resonance adjustments. In this case also, it is quite immaterial, as far as the operation of the amplifier is concerned, whether the super-audible beat frequency used is adjusted to something of the order of 100,000 or 200,000 cycles or whether it is set at a low value of say 15,000 cycles.

For receiving spark signals, however, and for telephony the situation is somewhat different. Special precautions must be taken in order to avoid distortion effects, and the selection of proper value of the super-audible beat frequency is important.

Fig. 1 is meant to represent trains of dampt voltage oscillations such as are produced at the detector of a receiving circuit by a spark transmitter. The successive groups of oscillations recur at *tonal* frequencies, each group being the result of a discharge at the spark gap of the transmitter. The mathematical expression for such a train of oscillations may be written as follows:

$$[V+V_1 \text{ Sin } (pt+\phi_1)+V_2 \text{ Sin } (2pt+\phi_2)+V_3 \text{ Sin } (3pt+\phi_3)+ \ldots\ldots V_n \text{ Sin } (npt+\phi_n)] \text{ Sin } w_1t \ldots . (1)$$

wherein the bracketed expression is the equation of the envelope curve bounding the amplitude of the radio frequency oscillations, exprest in the form of a Fourier's series, and the last term, Sin w_1t, refers to the radio frequency oscillation of periodicity w_1 which is to be considered as an oscillation modulated at audible frequency according to the envelope curve just mentioned. The envelope contains a fundamental frequency corresponding to p and all the harmonics 2p, 3p, 4p....np characteristic of the spark frequency and of the decrements of the transmitter and receiver. Thus, ordinarily the periodicity p would correspond to a 500- or 1000-cycle spark and the harmonics may run to the 10th or 20th before their amplitudes are small enough to make them negligible. V_1, V_2, V_3....V_n designate respectively the amplitudes of the fundamental and the various harmonics. ϕ_1, ϕ_2,.. ϕ_n, etc., represent their phases.

The voltage produced by the local oscillation for heterodyning is

$$V' \cos (w_2t+\theta) \ldots\ldots\ldots\ldots (2)$$

The total or resultant voltage acting on the first detector at every instant is therefore given by the sum of expressions (1) and (2). This can be written in the following form

$$V_1\left[\cos\frac{(w_1-w_2-p)t+(\phi_1-\theta)}{2}\times\cos\frac{(w_1+w_2-p)t+(\phi_1+\theta)}{2} - \text{Sin}\frac{(w_1-w_2+p)t+(\phi_1-\theta)}{2}\times\text{Sin}\frac{(w_1+w_2+p)t+(\phi_1+\theta)}{2}\right]$$

$$+V_2\left[\cos\frac{(w_1-w_2-2p)t+(\phi_2-\theta)}{2}\times\cos\frac{(w_1+w_2-2p)t+(\phi_2+\theta)}{2} - \text{Sin}\frac{(w_1-w_2+2p)t+(\phi_2-\theta)}{2}\times\text{Sin}\frac{(w_1+w_2+2p)t+(\phi_2+\theta)}{2}\right]$$

$$+V_3\left[\cos\frac{(w_1-w_2-3p)t+(\phi_3-\theta)}{2}\times\cos\frac{(w_1+w_2-3p)t+(\phi_2+\theta)}{2} - \text{Sin}\frac{(w_1-w_2+3p)t+(\phi_3-\theta)}{2}\times\text{Sin}\frac{(w_1+w_2+3p)t+(\phi_3+\theta)}{2}\right]$$

$$+ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$+V_n\left[\cos\frac{(w_1-w_2-np)t+(\phi_n-\theta)}{2}\times\cos\frac{(w_1+w_2-np)t+(\phi_n+\theta)}{2}\right]$$

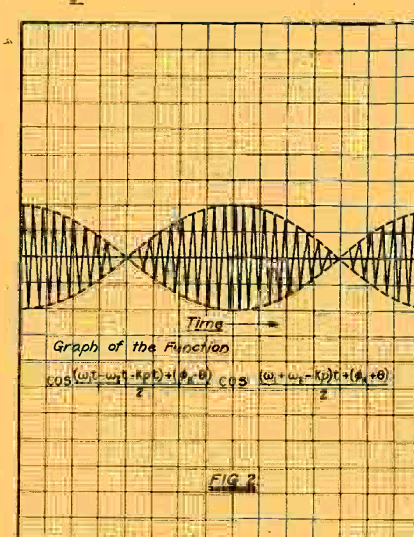


Fig. 2—The Waveform and Trigonometric Product of a Certain Radio Frequency Voltage in Short Wave Reception.

* *Radio Engineer, Camp Alfred Vail.*

$$\left[\text{Sin}\frac{(w_1-w_2+np)t+(\phi_n-\theta)}{2}\times\text{Sin}\frac{(w_1+w_2+np)t+(\phi_n+\theta)}{2}\right]+V\,\text{Sin}\,w_1t \quad \ldots\ldots(3)$$

In each of the bracketed terms four different frequencies appear, namely,

$$\frac{w_1-w_2-kp}{4\pi}$$

$$\frac{w_1-w_2+kp}{4\pi}$$

$$\frac{w_1+w_2-kp}{4\pi}$$

$$\frac{w_1+w_2+kp}{4\pi}$$

k having the different values 1, 2, 3, 4,....n corresponding to the 1st, 2nd, 3rd, 4th or nth bracket involving the 1st, 2nd, 3rd or nth harmonic.

The explicit values of these frequencies depend principally upon the values w_1 and w_2 of the incoming and local radio frequencies and also to an increasing extent upon the periodicities kp, of the audio harmonic spark frequencies, for the higher harmonics. Relatively the four frequencies concerned may be of the same or very different orders of magnitude, and the two cases presented hereby involve important practical considerations in the design and use of the amplifier. The two different conditions may be treated separately under the headings (1) Short Wave Reception and (2) Long Wave Reception.

SHORT WAVE RECEPTION.

The wave lengths to be considered here are of the order of 50 or 100 meters, or shorter. In this case w_1 and w_2 are both very large and of the four frequencies mentioned above the two involving the differences w_1-w_2 are considerably smaller than the two comprising the sums w_1+w_2. Thus, the two trigonometric products which appear in each of the bracket terms of (3) indicate a radio frequency voltage of frequency

$$\frac{w_1+w_2\pm kp}{4\pi}$$

modulated by a considerably lower, though still super-audible, frequency, in the present amplifier, of value

$$\frac{w_1-w_2\pm kp}{4\pi}$$

The form of such a voltage wave for one of the trigonometric products is shown in Fig. 2.

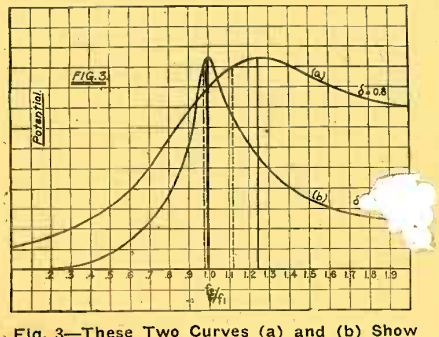
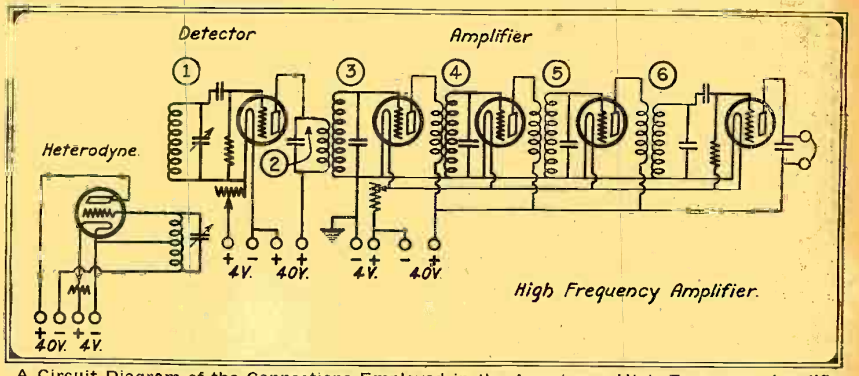


Fig. 3—These Two Curves (a) and (b) Show the Variations of Secondary Transformer Potential Under Two Given Conditions.

After rectification at the first detector tube the above frequencies are still essentially present and are imprest upon the amplifier proper. The frequencies $(w_1-w_2 \pm kp)/4\pi$ are the heterodyne beat frequencies produced by interference of the local and signal voltages. The transformers of the amplifier are designed for frequencies of their order of magnitude and are not, therefore, affected by the radio frequencies $(w_1+w_2\pm kp)/4\pi$. No energy of these latter frequencies passes thru the amplifier. Neither does energy of the incoming signalling (radio) frequency w_1 represented by the last term of (3), particularly if the transformers between stages of the amplifier are not broadly tuned. This is the normal way in which the amplifier works and is that described by Major Armstrong.



A Circuit Diagram of the Connections Employed in the Armstrong High Frequency Amplifier System.

It is only the beat or difference frequencies

$$\frac{w_1-w_2-kp}{4\pi} \text{ and } \frac{w_1-w_2+kp}{4\pi}$$

that have to be considered in designing the transformers and circuits. All of these frequencies lie in the neighborhood of the value

$$\frac{w_1-w_2}{4\pi}$$

which is the fundamental or basic beat frequency produced by the signal and local oscillations. They are greater and less than this value by the amounts

$$\frac{\pm p}{4\pi}, \frac{\pm 2p}{4\pi}, \frac{\pm 3p}{4\pi}, \ldots\ldots, \frac{\pm np}{4\pi}$$

The transformers are fundamentally designed for the basic or mean frequency $(w_1-w_2)/4\pi$. This can be adjusted by regulating the local oscillation *but its proper value is by no means immaterial.* It is limited in the lower ranges by the fact that it must be above audibility, and thus about 20,000 cycles is as low as is permissible. The limitations in the other direction are those usually encountered in amplification of extremely high frequencies and a value of 5×10^5 cycles is about as high as can be used effectively.

The transformers should be as sharply tuned as possible to permit the building up of high voltages and avoid losses in resistance. A second requirement is that there shall be no distortion in the tonal quality of the received signal as it passes thru the transformers. This means that essentially all of the harmonics contained in the envelope curve of the arriving modulated oscillations must appear in the telephone current of the last detector. Thus, it is necessary to transmit equally thru the coupling transformers of the amplifier all of the frequencies.

$$\frac{w_1-w_2+kp}{4\pi} \text{ and } \frac{w_1-w_2-kp}{4\pi}$$

and while designing the transformers for the basic frequency $(w_1-w_2)/4\pi$ the tuning must be broad enough so that the response is practically uniform over all the frequencies up to $np/4\pi$ on either side of this basic value. A spark signal may contain appreciable harmonics up to the 10th or 20th which in a 500-cycle transmission of the usual type would mean that the amplifier transformers at the receiver would have to pass side frequencies up to 10,000 or 20,000 cycles above and below the basic frequency on which the design is based.

Laboratory experience has shown that it is difficult to build high frequency transformers tuned flatly enough to pass frequencies more than about 40% above and below their best frequency. Even this value is accompanied by a marked loss of overall efficiency because of the resistance effect that must be introduced to broaden the tuning. It is obviously impracticable, therefore, to use transformers designed for a heterodyne frequency of 20,000 or 30,000 cycles because a great many of the harmonic side frequencies that have to be transmitted to preserve the quality would be lost, and in order to get even a few of them the flat tuning required and the resistance inserted to secure it would mean low efficiency. It is much better in this case to work at a beat frequency of 100,000 cycles. The 10th harmonic in the spark signal under consideration, that is, 10,000 cycles, is then only off tune by 10% which allows fairly good efficiency to be realized in the transformers. A beat frequency of 200,000 cycles would be even better.

There is another circumstance which favors the use of high beat frequencies, at least for the reception of short wave lengths, and that is that small changes in either the signal or the local oscillator frequencies such as might be caused by movements of the operator's hand or body in the neighborhood of one of the circuits, cause a much smaller percentage change in the beat frequency when this is high than when it is low, and the apparatus thereby becomes more nearly immune to such variations. At longer wave lengths, however, conditions are altered somewhat and there is an upper limit to the usable beat frequency.

The beat frequency can be produced with the local frequency w_2 either less or greater than the incoming frequency w_1. It is usually best, with short waves, to make w_2 less than w_1, because it is then more easily controlled and freer from variations of the type just mentioned.

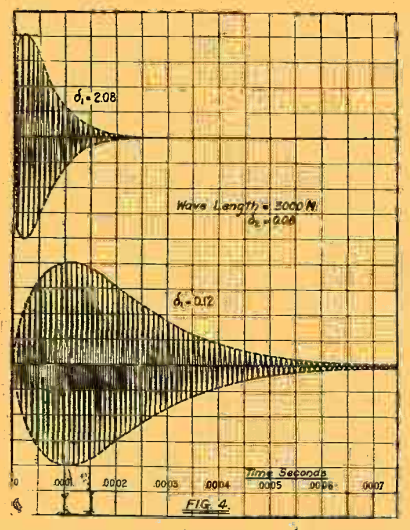


Fig. 4—The Upper Graph (a) Approximates a Static Disturbance of High Decrement While the Lower Graph (b) Is That Produced in a Receiving Circuit By a Given Spark Transmitter of Low Decrement.

LONG WAVE RECEPTION.

In the reception of long wave lengths a condition arises in which the incoming signal frequency is of the same order of magnitude as the heterodyne frequency for which the transformers are designed. Such is the case, for instance, when receiving a wave length of 3,000 meters with an amplifier tuned to the beat frequency of 100,000 cycles. When this condition exists, the incoming frequency, $w_1/2\pi$, represented by the last term of (3), passes thru the amplifier together with all the heterodyne frequencies

$$\frac{w_1-w_2-kp}{4\pi} \quad \text{and} \quad \frac{w_1-w_2+kp}{4\pi}$$

and interfering with all of them in their different amplitudes and phases produces a conglomeration of resultants which will be heard in the telephones, after rectification at the last detector, as a badly distorted, mushy signal like that usually heard when receiving spark signals on an ordinary oscillating receiver. This will always happen if the incoming signal frequency passes thru the amplifier. In order to avoid the effect, therefore, it is necessary to design the amplifier for heterodyne frequencies that lie wholly outside the range of wave lengths to be received. It is easy to accomplish this, as will readily be seen, when short wave lengths are involved but when waves of one or several thousand meters are to be handled the proper selection of the value of the heterodyne frequency requires careful consideration.

As an example, consider the case of a receiver to function on all wave lengths from 1,000 meters to 5,000 meters; that is, 300,000 cycles to 60,000 cycles. In order to avoid distortion of the kind just mentioned on certain wave lengths this whole band of frequencies is at once eliminated from use as heterodyne frequencies in the amplifier, and the range ought to be extended at least 10,000 cycles beyond this at both ends because the spark signal may contain appreciable harmonics up to this value and certain of the side frequencies of the incoming oscillation might therefore get directly thru the amplifier and produce distortion. In the case under consideration, therefore, the amplifier ought to be designed for a frequency either less than 50,000 cycles or greater than 310,000 cycles.

The disadvantages in using low heterodyne frequencies (on the 50,000-cycle end in this case) have been pointed out above in discussing the reception of short waves. Broad transformer tuning with comparatively low efficiency is required to avoid the other kind of distortion due to elimination or at least the reduction of the higher harmonics. But in addition to this there must be considered the fact that static is always more pronounced at long wave lengths and an amplifier designed for low frequencies might therefore be expected to be more affected by these disturbances than one using higher frequencies.

For these reasons it appears very desirable to design the amplifier transformers for a beat frequency of the order of 350,000 or 400,000 cycles; that is, about 750 meters in the case under consideration.

If spark or telephone signals were to be received on extremely long wave lengths such, for instance, as 15,000 meters (20,000 cycles) there is another consideration that would come in to limit the upper value of heterodyne frequency that could be used. This may best be explained by reference to the formula (3) above. High heterodyne frequencies of the order of 500,000 cycles cannot be used in this case because the sum of the signal and local frequencies $w_1+w_2\pm kp$ (carrier frequencies) would come thru almost as well as the difference or desired beat frequencies, namely $(w_1-w_2\pm kp)/4\pi$ (modulating frequencies) and very bad distortion would result. To take the figures given, f, would be 20,000 cycles and f_2 520,000 cycles. Their sum would be 540,000 and their difference 500,000, a variation of less than 10% and both therefore conceivably within the working range of an amplifier transformer.

The type of distortion discust above which is caused by the passage of the incoming frequency directly thru the amplifier and which results in a mushy, harsh signal can be confined to a rather narrow range of wave lengths by making the tuning of the amplifier transformers sharp. But this cannot be carried to extremes or, as has already been explained, it will then not be possible to pass the side frequencies. These will, in telephone transmissions, probably not exceed 2,000 cycles either side of the basic frequency but in spark signals may run to 10,000 cycles or so in extreme cases.

SHARPNESS OF TRANSFORMER TUNING.

In order to get an idea of the sharpness of tuning desirable in the transformers under different conditions, the curves of Fig. 3 are given, showing the variation of secondary transformer potential as function of the ratio f_2/f_1; that is, the ratio of the frequency to which the transformer secondary is tuned to the varying imprest frequency. Curve "a" is for a broadly tuned transformer of decrement 0.8; curve "b" represents sharper tuning with a decrement of 0.2. It will be seen that in the first case a frequency change of 10% from the best value will cause a reduction in signal of about 5%. In the second case a difference in frequency from the best value of only 2% causes the same change in signal.

If the 5% reduction in potential for the side frequencies is assumed to be as much as is allowable in order to avoid distortion, and if it is further assumed that as sharp tuning as is represented by the curve "b" with 0.2 decrement is to be usable and the harmonics or side frequencies to be past are to run to 5,000 cycles past the basic heterodyne frequency for which the transformers must be set will have to be at least 250,000 cycles, and if 10,000 cycles either side of the basic frequency are to be past the latter cannot be less than 500,000 cycles, which is about the upper practical limit. It turns out, therefore, that curve "b" corresponding to a decrement of 0.2 represents about as sharp tuning as can be used, and even then it is necessary to use the higher range of available heterodyne frequencies. It is to be noted that this tuning is by no means sharp as judged by the standard usually set for radio circuits.

With such tuning frequencies 15% greater and 30% less than that to which the transformer is tuned are only reduced in amplitude by one half, and considerable energy within these frequencies would get directly thru the amplifier and produce the distortion just mentioned with harsh signal. In figures, it may be expected if the amplifier were tuned to 3,000 meters, that mushy signals would be obtained for all waves between 3,900 meters and 2,550 meters.

If low heterodyne frequencies are to be employed, then the tuning must be broader and the resonance curve "a" applies. Here the allowable reduction of 5% in response occurs for a change of about 10% in frequency from the optimum value which means that the latter must be set for at least 50,000 cycles if a side frequency of 5,000 cycles is to get thru sufficiently to prevent distortion. With such broad tuning, however, even frequencies of half the value for which the transformers are designed get thru directly with very little loss and distortion with the mushy, harsh type of signal may be expected over a wide range of wave lengths.

For purposes of design of the transformers it is possible from the above considerations to decide on the most suitable heterodyne frequency, the sharpness of tuning and the approximate decrement and to determine roughly the constants of the transformer from the relations

$$\delta = \frac{r_2}{2fL_2}$$

$$f = \frac{1}{2\pi\sqrt{L_2C_2}}$$

Still another point is involved here. In a pair of tuned coupled circuits such as must be used in the amplifier, the secondary and primary voltages are proportional inversely to the square root of the tuning capacities in the two circuits. That is

$$V_2 = \sigma V_1\sqrt{\frac{C_1}{C_2}}$$

To get large secondary potentials, therefore, it is best to use small capacity and large inductance. Then, in order to keep the tuning or decrement to the desired value, the resistance must be increased, and these statements would hold without any qualification were the output of the vacuum tubes not definitely affected by the transformer load in their plate circuits.

When tuned, the secondary of a transformer introduces an effective resistance into the primary equal to

$$\frac{M^2w^2}{r_2}$$

(*Continued on page* 166)

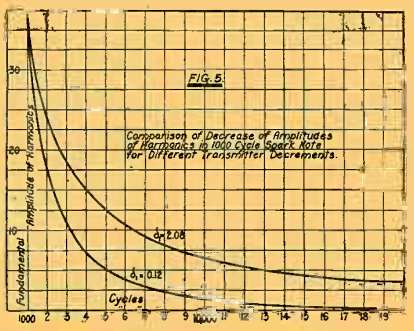


Fig. 5—In This Instance It is Seen That the Amplitudes In the Highly Dampt Signal Fall Off Less Rapidly Than the Lightly Dampt Signal.

An "Amateur" Station Operated on a Commercial Scale

By ARTHUR H. LYNCH *

DUE, perhaps, to the fact that a temporary installation was made at the New York *Times* radio tower by the Navy Department for the reception of a speech made from the deck of the U. S. S. *Pennsylvania* by Secretary Daniels, when the fleet was in New York Harbor, and carried to a loud speaking device in Times Square, the impression seems to be rampant among some radio men that an experimental station has been installed there. This impression is incorrect.

A great deal of experimentation was carried on with radio telephone receivers of various types at the time mentioned above, but the tests merely covered a few days, and the work is generally known to have resulted in the reception of the speech which was heard by the crowd assembled in Times Square.

What is really going on at the *Times* station is anything but an experiment. A continuous watch is stood for the purpose of checking up the traffic sent to the *Times* thereby making certain of absolutely correct reception, as well as permitting that paper to receive directly thru its own station messages from Germany addrest to the *Times* before they could possibly be delivered thru the regular channels. At this time of the year this is a very difficult task, and reception thru static interference, which prevails thruout the summer months, requires the greatest of concentration on the part of the operators.

Of course, all trans-oceanic reception entails a certain amount of experimentation in order to be certain of the best possible reception at all times and under the most trying conditions, and the *Times* is carrying on the usual amount of this sort of work, which is absolutely necessary.

Many facts have been discovered which prove the truth of some and the fallacy of other theories which have been advanced concerning the reception of radio signals of long wavelength over great distances. Incidentally, a general study of the static signal ratio is maintained at all times.

It may be of interest to the average amateur to know of some of the devices used and those tried and the results obtained from them. The antenna used for the set on which the regular watch is stood is of two wires 25 feet apart and running from the seventeenth floor to the top of the tower at an angle of about 60 degrees and

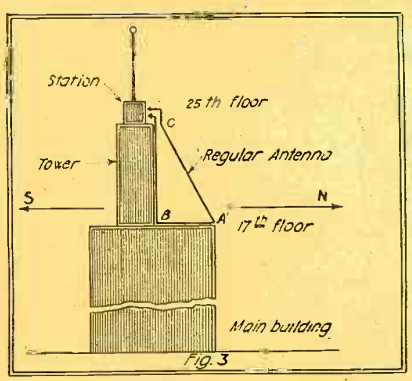


Fig. 3

An Unusual Triangular Loop Where Two Sides of the Antenna Were Formed by the Steel Structure of the Building.

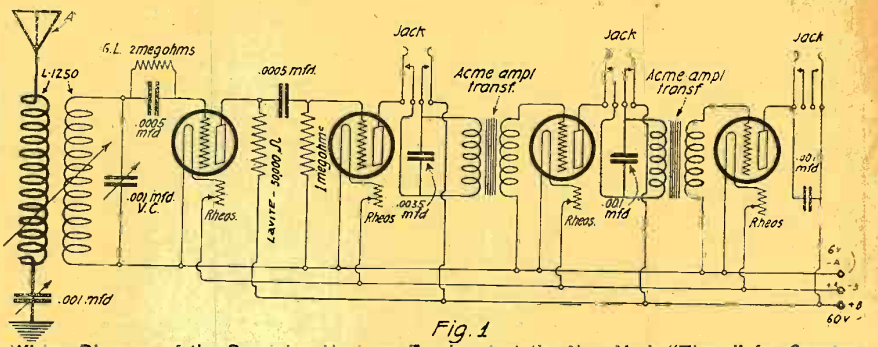


Fig. 1

Wiring Diagram of the Receiving Hook-up Employed at the New York "Times" for Copying Long Distance, High Wave, European Stations. Constants of the Instruments Are Shown Wherever Possible. A Negative Grid Potential Is Obtained by a One-Ohm Resistance Tapt Off the Filament Rheostat.

in a manner similar to that shown in Fig. 3. The radio equipment is connected at the upper end, which is also the south end, and the free end is therefore the lower and north end. No attempt has been made to make this antenna directive. Experiments using this antenna and the roof of the seventeenth floor and the steel structure of the *Times* Building for the formation of a loop similar in principle to those used on submarines, where the hull of the ship is used as part of the loop, were tried and

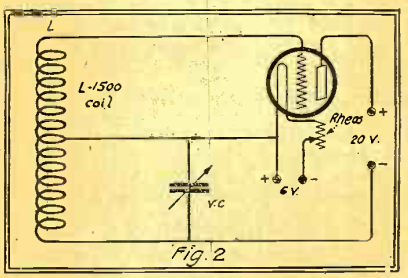


Fig. 2

Simple Heterodyne Circuit Used to Provide Necessary "Beat" Notes In Connection with the Receiver Shown in Fig. 1.

proved unsatisfactory. The ground connection is made thru the steam-heating system.

Quite contrary to popular opinion, the receiving equipment is of the most simple character, tho the results obtained are quite remarkable. Fig. 1 shows a diagram of the complete circuit, the constants being shown wherever possible. In series with the antenna there is a de Forest condenser, which, with a twelve-step General Radio inductor (Type 111-E), which has sufficient inductance to tune up to 20,000, goes to make up the primary circuit, while a General Radio inductor (Type 111-F), shunted by a similar de Forest condenser, make up the tuning elements of the secondary circuit. Four Marconi vacuum tubes are used in the receiving circuit and are under separate control, tho operated by the same high- and low-voltage batteries. The first tube is the detector, the second is used for *radio* amplification and the third and fourth are used in connection with Acme amplifying transformers for *audio*-frequency amplification. Telephone jacks are used so that any desired intensity of signal may be produced. Baldwin mica diaphragm 'phones of various types are used. In order to eliminate the possibility of the operator becoming fatigued by the constant wearing of the 'phones a loud speaker (Magnavox) has been provided. By using this apparatus when simply "listening in" the operator may keep track of what is going on, and as soon as he hears anything coming thru for the *Times* he can swing over to the 'phones. This has been found to very materially promote operating efficiency.

The proper amount of negative grid potential for the operation of the audio-frequency circuits is obtained by tapping off a portion of the filament rheostat.

A simple heterodyne provides the beat notes. The heterodyne was made by using a de Forest honeycomb coil (L-1500) and a Grebe *continuously variable balanced condenser*. Fig. 2 illustrates this circuit. Storage batteries are used for the filament current and high-voltage storage batteries furnish the plate voltage for the vacuum tubes. All types of tubes have been tried, but Marconi Class 2 tubes seem to give favorable results when the proper plate voltage is applied.

Fig. 3 is a sketch showing how the submarine type of loop, *which utilized the metal parts of the building for two of its sides,* was employed. It will be seen that the base of this loop (A-B) was made up of the steel part of the building structure on the seventeenth floor and the perpendicular section (B-C) by the steel of the tower, while the section (A-C) consisted of two wires running from the seventeenth floor to the twenty-fifth floor. The receiving set was installed at the upper floor. This system was tried out by Mr. L. J. Lesh, for-

(*Continued on page* 170)

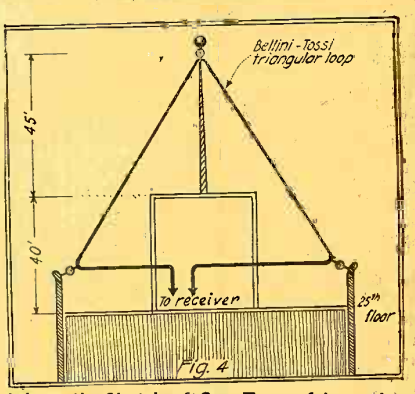
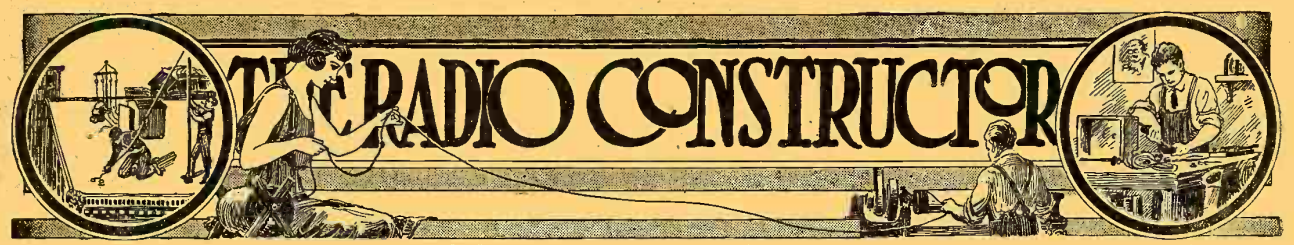


Fig. 4

Schematic Sketch of One Type of Loop Antenna Tried Out by the Navy Dept. at the "Times" Radio.

* *President of Nostat Co.*



A Trans-Oceanic Receiver

By FREDERICK J. RUMFORD

THIS is an experimental receiving cabinet designed for the reception of European and Continental messages.

It is a cabinet of my own design and has worked successfully for many months. The outfit can also be made up in a frame form; that is, having the panel mounted on a frame of wood or brass. As you will note by the photograph, I have mounted this outfit in cabinet style, which, when it is not being used, can be covered. I also have a handle on top for the purpose of carrying the outfit to wherever it is needed, or in reality making it a portable outfit.

There is a sufficient number of binding posts to make it possible to experiment with radio receiving circuits of all kinds or to be used by an amateur using his own ideas in hook-ups.

We will now pass on to the making up of this outfit:

PANEL.

The panel is 18¼ inches long, 9½ inches wide and ⅜ inch thick. The material can be either Bakelite, rubber or oak. Oak is preferable as it is within the purchasing means of the average amateur. I have used oak for the panel on the outfit pictured.

When you have your panel cut down to this size, you are then ready to measure off to drill holes for taps, binding posts, etc., as seen on drawing.

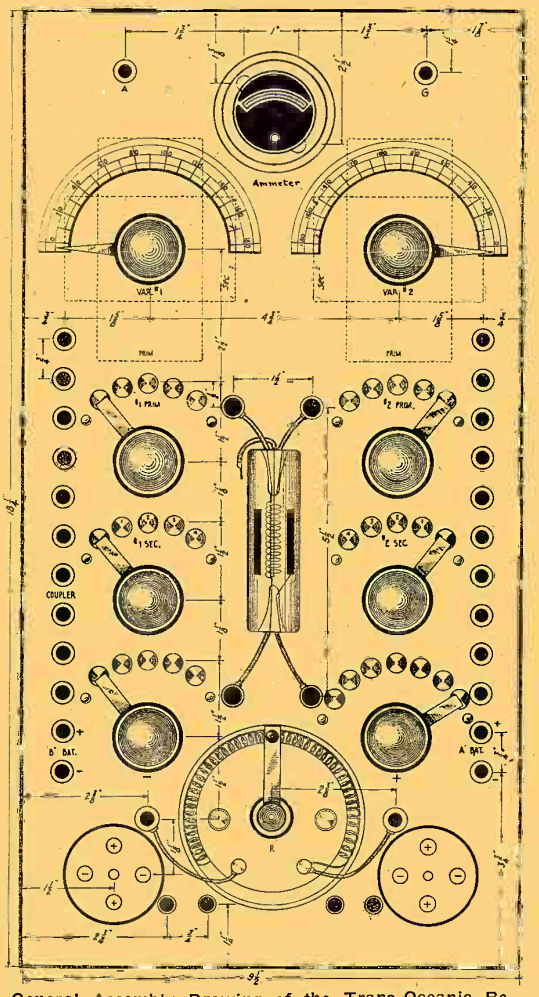
Measure down from top of panel in standing position 1⅛ inches on each side, draw a faint horizontal line across panel, and then measure in from each side 1⅞ inches; from each side make dots indicating spots for drilling Aerial (A) on left side and Ground (G) on right side binding posts.

Measure in from each side at top and bottom of panel ¾ inch and then draw a faint vertical line from point to point on each side. Then measure down on vertical line 6¼ inches on each side, which will give you your first binding post hole.

There are twelve binding posts on each side spaced ¾ of an inch apart and ¾ of an inch in from edge of panel.

Measure in from each side at top and bottom of panel 2⅜ inches, draw a faint vertical line from point to point on each side, then measure down vertical line 4½ inches on each side, which gives you the necessary holes for variometer No. 1 and No. 2 secondary revolving shafts. From this point measure down 4 inches, take the compass and draw a 3-inch circle on each side. Divide the circles into four equal spaces. Where your 3-inch circle crosses the vertical line, make a dot. On this dot place your compass for ½ inch, making two more dots on the 3-inch circle ½ inch away from where it crosses the vertical line on each side. From these two dots measure ½ inch away still on your 3-inch circle and make two more dots, one more on each side. In other words, starting at where the 3-inch circle touches the vertical line, you will have two dots on each side of this point, or five dots in all. These dots represent holes drilled to carry an 8-36 thread ⅞ inch long from tip to tip with ¼ inch head copper or brass contact.

On using switch stops, the Amateur is to use his own judgment.



General Assembly Drawing of the Trans-Oceanic Receiver. By Following Out These Construction Details You, Too, Mr. Long-Distance-Seeker, Can Secure the Same Good Results Obtained by Mr. Rumford.

There are three switches on each side, the distance from the center of each switch being 2⅝ inches. Each switch has five contacts, as outlined above, with the exception of the lower right hand switch, which has seven contacts, or one more contact on each side. The four upper switches are for the variometers and the two lower switches are for the B battery, the left hand lower switch (negative) being for the one cell unit and the right-hand lower switch (positive) being for the three cell unit.

Measure down still on same vertical lines on each side 1⅝ inches, which give you the two bottom binding posts which you connect with rheostat.

Measure in on each side at top and bottom four inches, and as before, draw a faint vertical line from point to point on each side, and again measure down on these lines 7½ inches, make a dot at each point, from there measure down 5½ inches, or 13 inches in all from top of panel, which places the four Audiotron terminals.

This is a genuine Audiotron and I have soldered five copper terminals on the leads extending from the Audiotron.

For the control of the filament in the Audiotron, I use an ordinary K & D improved rheostat and switch number 23 having a resistance of 10 ohms and continuous capacity of 2 amperes. For the lighting of the filament, I use a 6 volt 40 ampere storage battery.

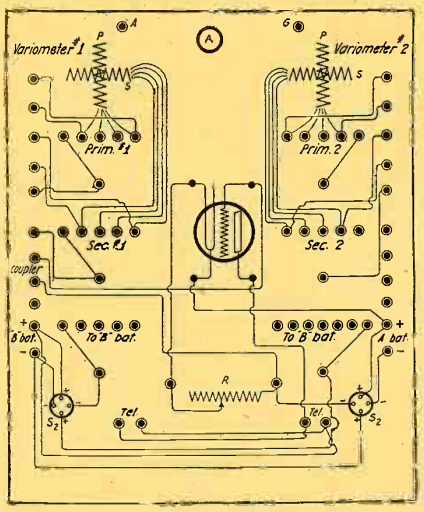
The B battery consists of 10 or 12 No. 703 Eveready 3 cell flashlight batteries, and connected in series. The wax is broken from the end of the three cell battery and taps are brought out from the positive pole of each cell to points on a four point battery switch on left of panel. Count over five, if 10 are used or seven if 12 are used, three cell batteries, and starting on your fifth or seventh a tap is taken off every three cell battery to switch on lower right hand side of panel.

A potentiometer of 400 ohms resistance, the type that is mounted on the back of panel could be used in place of the above mentioned switches. By doing that would give place on one side of panel to shunt across terminals of the B battery either a variable or fixt condenser with a value of 0.005 mfd.

The B battery is shut on and off by a Perkins 5 amp. 110 volt snap switch, which is shown in lower left hand corner of panel.

The filament battery is controlled by the same make switch, which is shown in lower right hand corner of panel.

Measure up from bottom 1 3/16 inches from each side, draw a faint horizontal line from point to point,



Here We Have the Schematic Wiring Diagram Employed Thruout the Receiver.

then measure over on this line from each side 2¾ inches, make a dot, and from that dot, measure over ¾ inch more, this giving you the four binding post holes for your telephone receivers.

It is advisable not to shellac the coils because it creates energy losses, acting as an imperfect dielectric between the turns. However, if the Amateur wishes to shellac the coils, he should shake them dry, leaving only a thin film or layer of shellac on the coils.

VARIOMETERS No. 1 AND NO. 2.

The primary is 2 inches long, 4¼ inches diameter, and is wound with 4 layers lap winding of No. 28 D.C.C. wire, the winding starting ⅛ inch in and continuing to ⅛ inch from end. Take tap at each layer and bring down to upper switches on panel. The form that this is wound upon is non-shrinkable and non-warpable and is 1/16 inch thick, each primary contains 86'7" to a layer or a total to each primary coil of 346'8" for the four layers. Thus the two primary coils contain 693'6" in all.

The secondary is 2 inches long, 3¼ inches diameter, and is wound with four layers lap winding of No. 30 D.C.C. magnet wire, winding starting in ⅛ inch and continuing to ⅛ inch from end. Take taps at each layer and bring down to center switches on panel. The revolving of the secondary is done by having screw connected with secondary by two nuts. On front of panel there are two celluloid indicators of 180 degrees. The screw connecting the secondary is three inches long, 3/16 inch diameter, and the slot on the head of this screw has a wire soldered to it as an indicator. Each secondary contains 83'3" of wire to a layer or a total of 333'2" of wire for the four layers. Thus the two secondary coils contain in all 666 feet, 4 inches of wire.

I have experimented further since the original construction of this set and have found that by using different sized wires I have obtained better results, say No. 30 D.S.C. magnet wire for the primary and No. 36 S.S.C. magnet wire for the secondary.

For example, if using No. 30 D.S.C. wire on the primary, each coil would contain 129' to a layer or a total of 516' of wire for the entire coil consisting of four layers. This would make the total amount of wire contained in the two primary coils 1032 feet.

Using No. 36 S.S.C. magnet wire on the secondary coils, each coil would contain 192'2" of wire to a layer or a total of 768'8" of wire for the four layers. Thus the secondary coils would contain 1537'6" of wire in all.

In purchasing, the Amateur would need, using the above figures, ½ lb. of No. 28 D.C.C. magnet wire, and ¼ lb. of No. 30 D.C.C. magnet wire or ½ lb. of No. 30 D.S.C. magnet wire and ⅛ lb. of No. 36 S.S.C. magnet wire.

These coils can easily be interchanged for further experimentation along these lines.

I have covered wave-lengths from 200 meters to 20,000 meters; it all depends upon the hookups and the condensers used. I have received from Nauen (POZ), Paris (FL), and Rome (IDO) on long wavelengths, and I have also received Arlington (NAA) time signals and other American stations. I have received undampt and Amateur stations.

As to the hookups used for the reception of these messages, I would suggest the Amateur doing some experimenting himself.

OPERATING DATA.

Connecting the two primary coils in series and leaving the two secondary coils as they are, will give you a long primary and two short secondary coils or vice versa making long secondary coil and two short primary coils.

Connecting variometer No. 1 primary and secondary coils in series then connecting variometers in multiple, will give selective tuning.

These variometer coils are not connected in with the tube but they can readily be placed in that circuit by connecting wires from one binding post to the proper binding post. If these coils are connected by a jumper wire to the two binding posts marked "coupler" they are then in with the Audiotron; otherwise, they are not connected with it.

The Amateur can arrange the two variometers so that the wire may be run from one binding post to the other binding post; run them in series and multiple by the use of jumper wires whenever desired.

These coils do not carry any connections other than those to the separate binding

Actual Photograph of the Finisht Instrument. Note the Convenient Metal Handle at the Top of Case For Portable Purposes.

posts and contacts. The Amateur should use his own judgment in connecting the coils in whatever form he likes. He can connect his loose coupler onto the binding post marked "coupler" by so doing he abolishes the use of the variometers.

The two bottom switches are for the regulation of the plate voltage left hand one for the end cell, and the right hand one for the cell units.

The A and G binding posts represent aerial and ground. They are not connected into the set but the Amateur can connect his aerial and ground to the marked posts and then run a jumper wire on the front of the panel which will make it possible to connect the variometers in whatever form he wishes. All jumper wires are on the front of the panel I have left the ammeter for the Amateur's own idea of hook-up. The idea of this outfit was for the Amateur to be able to connect up any desired hookups by the use of jumper wires running from the posts where necessary on the front of the panel. In order to eliminate as much as possible of the complications of the diagram I have decided to leave out the secondary wires on the both variometers leading to the contacts.

It is advisable for the Amateur to shunt all circuits with variable condensers. The capacity to be determined by further experimentation.

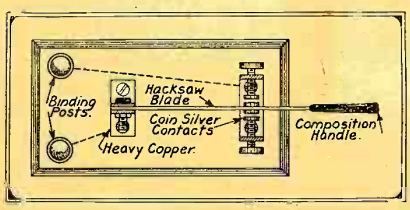
If the Amateur will follow closely the drawings and directions I believe this receiver will more than meet his expectations.

Another Double Speed Key

An article for any radio amateur to be proud of is a double speed key. This instrument can easily be made by anyone possessing a few tools and a little ingenuity.

The base may be made of wood, marble or any suitable substance the experimenter has on hand. The lever is made from a hacksaw blade with the teeth ground off. The pivot holding the lever is formed of two pieces of copper strip bent at an angle of ninety degrees. These two are screwed to the base and the lever is bolted in between these strips.

The contacts are two thumbscrews mounted in a U-shaped strip of copper.



Here You Are "Speed Kings". Build Yourself One of These Keys and Wig-wag the Old Morse Code to Your Heart's Content. This, of Course, Providing You Are Operator Enough to Receive at the Same Speed Yourself.

The contacts proper are two pieces of coin silver soldered onto the screws. Two similar pieces are mounted on the lever in the proper position.

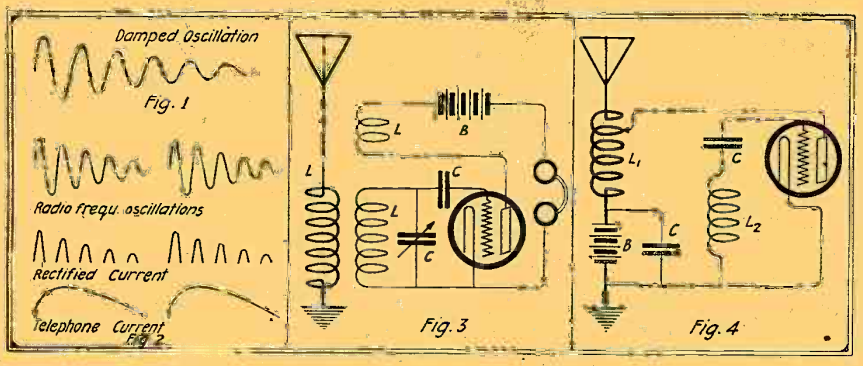
The knob is made of a composition material, and may be designed to suit the tastes of the operator.

The advantages of a key of this sort are obvious. This type of key is designed for speed and especially adapted to calling. This "bug" is easy to manipulate after one gets the "hang" of it, because the movement is sideways, rather than up and down.

Contributed by WILLIS OLDFIELD.

Radio Telephony Simplified

By H. L. BEEDENBENDER*



Figs. 1 and 2 Illustrate the Performance of a Dampt Oscillation In a Detector Circuit. Fig. 3 Shows a Simple Inductive Feed Back Circuit, While Fig. 4 Is That of a Conductive Coupling, Which Furnishes Greater Power In the Antenna Circuit.

MANY amateurs are still somewhat in the dark in regard to the construction and operation of radio telephone sets. There is nothing very unusual in the field altho there does seem to be a cloud overhanging it as far as the radio amateur is concerned. This is due, no doubt, to the fact that heretofore expensive apparatus such as high frequency-alternators, arc generators, etc., were required. The advent of the vacuum tube as a generator has opened up a new field for experimentation. It is the only method at present adaptable to small powers and other advantages such as comparatively low cost, simplicity, and stability of operation; in short it is ideal for amateur short wave transmission.

As the field of radio telephony has been practically untouched by amateurs, it is necessary to understand some of the important details underlying the theory of operation. This is a great similarity between radio telegraphy and radio telephony. One who understands the fundamentals of one field can easily pick up those of the other. There is nothing really hard to master. As a matter of fact, the receiving circuits are identically the same. In transmission, however, it is necessary to employ undampt waves instead of the dampt such as are used in spark transmission.

A dampt radio frequency wave transmission system cannot be used in the transmission of speech because such a system produces trains of discrete oscillations as shown in Figure 1. These trains arrive at the receiving system and are rectified by the detector, and give discrete impulses of current in the telephone receiver. As these impulses are within the range of audibility they cause the diaphragm to vibrate and produce a musical note. Figure 2 shows the above phenomena graphically.

Now when an undampt radio frequency wave arrives at the receiving station it is rectified by the detector. This rectified current, however, is practically constant and therefore produces a *constant* uninterrupted pull on the diaphragm of the telephone receiver. Therefore no sound is heard.

Speech waves are complex and when we consider how comparatively crude radio telegraphy is, we see the big problem of radio telephony. In the case of telegraph signals all that is necessary is to start and stop the flow of energy by means of a key. In telephony, however, we have to radiate the energy in close approximation to the complicated wave forms of the speech vibrations. When we consider how complicated these wave forms of speech vibrations are, we can readily realize that it is quite a problem. Like all other big things, once it is solved it is quite simple.

The solution is to generate an undampt radio frequency wave and *modulate* it by means of voice or *audio* frequency waves. That is to say, waves of radio frequency are sent out by antenna, the intensity of which varies with the frequency of the speech waves. Therefore, we need an undampt wave generator and a device to modulate the waves generated.

The following methods may be used to produce the undampt radio frequency wave: First, the high frequency alternator; Second: arc; Third: special spark gaps and, Fourth: vacuum tube oscillators.

As the first three methods are complicated and the cost of the equipment is above the average amateur's pocketbook, we will only devote our attention to the vacuum tube oscillators.

The V. T. is in common use as far as amateur receiving systems are concerned, but when it comes to employing them in transmission system the amateur seems to hesitate. There is nothing really complicated in the basic theory of operation. Let us consider the simple inductive feed-back receiving circuit shown in Fig. 3. While this is really a receiving connection, it is also a miniature transmitter. In the plate circuit there is oscillating energy, and if the circuit is coupled to the antenna there will be a small amount of energy radiated. The idea is to get more energy into the antenna. The power is in the B battery. Raise the voltage of this battery by adding cells or employing a DC generator. Be sure the particular tube will not break down with the increased voltage. Also, there is nothing to be gained in using inductive coupling between the plate and antenna. We can get greater power and efficiency by using the circuit shown in Fig. 4.

DATA FOR THIS EXPERIMENTAL SET.

Wavelength—150-300 meters.

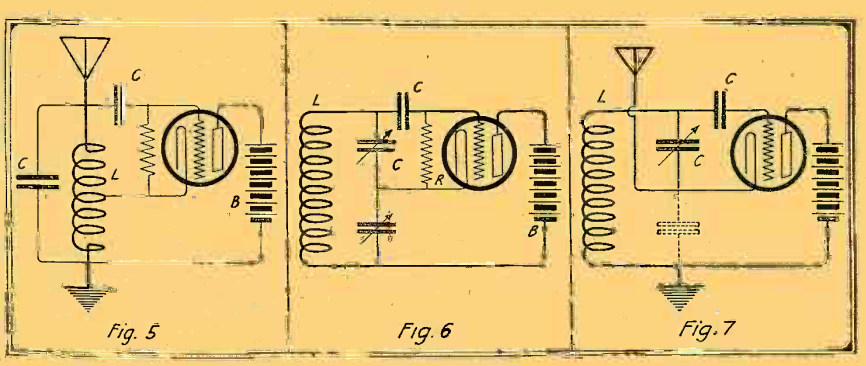
L_1 = 24 turns heavy stranded wire wound on tube 4 inches diameter. Plate connection is tapped on twelfth turn.

L_2 = 30 turns No. 18 DCC wound a SAME tube ½ inch from L_2 windings in same direction.

Fig. 5 shows another feed-back circuit.

Wavelength—130-300 meters.

L = 24 turns heavy stranded wire wound on tube 4 inches diameter. Tapped on thirteenth turn.



In Fig. 5 Is Shown Another Method of Feed Back. Fig. 6 Is the Common Capacity Feed Back, While Fig. 7 Is Similar to Fig. 6, But With Antenna In Circuit.

*Eastern Radio Laboratory.

So much for the inductive feed-back circuits.

The common capacity feed-back is shown in Fig. 6.

Substitute the antenna for C and we have the circuit shown in Fig. 7. A modification of this circuit is shown in Fig. 8. No doubt many of us remember this circuit from our experiences while in service.

Now that we have a simple means of generating undampt radio frequency waves, we come to the problem of modulation. Books may be written upon this subject, and, therefore, I will only give the simplest solution to the problem. "Simplicity means efficiency," and for low-power transmission this method is entirely satisfactory. Therefore, we will connect a sensitive telephone transmitter in series with the ground lead in order to modulate the radio frequency wave.

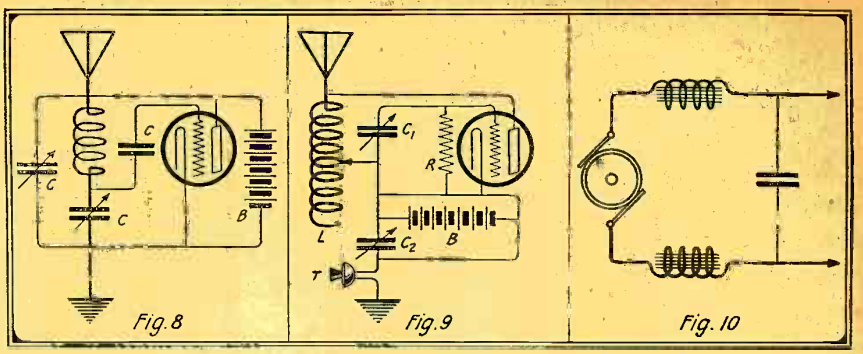


Fig. 8 Is a Modification of Fig. 7. In Fig. 9 Is Shown a Circuit Employing Capacity Feed Back Which Has Given Very Good Results. Fig. 10 Shows the Method of Connecting Iron Core Inductances on Each Side of the D. C. Supply, as Well as a Large Capacity Condenser Across the Circuit In Order to Eliminate Undesirable Ripples.

CONSTRUCTION OF A SIMPLE AND EFFICIENT SET.

Fig. 9 shows a set employing capacity feed-back which has given very good results. It may be constructed from parts found about the average laboratory or workshop.

Wavelength—150-500 meters.

L = 100 turns heavy stranded wire wound on tube 4 inches diameter and tapped every 20 turns.

C_1 = Variable condenser .0016 mfd. maximum capacity.

C_2 = Variable condenser .001 mfd. maximum capacity.

R = Grid leak.

In order to place the set in operation it is necessary to connect a hot wire ammeter in series with the antenna in order to observe maximum radiation. Adjust the inductance and capacities until the set oscillates on the desired wavelength. A wavemeter will come in handy when making these adjustments. Then speak *distinctly* into the transmitter. Adjust grid leak for modulation; that is, increase or decrease its resistance. It is a good plan to have someone listen in on a nearby receiving set to observe the modulation. *In adjusting the set remember that you have ALL of the following things to adjust: tuning inductance, tuning condenser, grid condenser, grid leak resistance, filament current and plate voltage. Failure to get the proper values for one of these may cause the set to be a failure.*

If the experimenter has the equipment, the following is an interesting experiment after the set is placed in operation:

Calculation of output and efficiency:

(1) Measure the resistance of the antenna. The method for doing this may be found in any up-to-date radio text-book.

(2) Measure the output current in amperes by means of a hot-wire ammeter.

(3) Then,

$$W = I^2 R.$$

Where W = watts output.
I = amperes output.
R = antenna resistance in ohms.

This gives the output of the set.

The input is measured as follows:

(1) Measure plate current in amperes with a milliameter.

(2) Measure the plate voltage in volts.

(3) Then,

$$W = E I$$

Where W = watts input.
E = plate voltage in volts.
I = plate current in amperes.

Therefore we get,

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}}$$

$$\text{Efficiency (per cent)} = \frac{100 \times \text{Watts output}}{\text{Watts input}}$$

Notes on general operation:

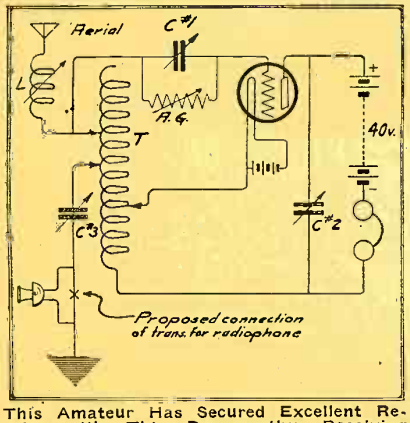
Know well the vacuum tubes you are using and their operating characteristics. The curves from most tubes in use today may be had from the respective manufacturers. If several tubes are connected in parallel, more power will be radiated. When a DC generator is used, a large capacity should be shunted across it and iron core inductances connected in series, as shown in Fig. 10. The proper values of L and C are determined by the operating characteristics of the machine. The more slots on the commutator the lower the ripples or unevenness of the voltage. Don't raise the voltage above the safety point of the particular tube you are using.

For greatest efficiency, all inductances should have a *very low high-frequency resistance.* This may be done by using heavy stranded wire or Litzendrabt. Connections must be as short as possible and soldered properly.

In conclusion we may say that there is nothing really mysterious in the use of V. T. transmitters, but good engineering practise has to be adhered to, and if the reader follows the suggestions and uses the data given in this article, success is within his reach. Patience and perseverance are big factors in experimental work. Amateur radio telephony is the coming thing. It is surprising, when we consider the advantages, why more work isn't being done with it in the amateur field today, and the sooner we take it up the better it will be for everyone in general. We are capable of accomplishing big things. Why not do it? The one big problem in radio telephony is interference. But it is no larger than those that have been solved already. With all the amateurs working with radiophone, someone is bound to hit upon the proper solution. Therefore—get busy, "O. Ms.," and let us hear your "Hello, hello; one, two, three, four."

An Experimental Regenerative Receiver Circuit

By H. S. GOWAN



This Amateur Has Secured Excellent Results with This Regenerative Receiving Circuit Which He Intends to Use In Future Radiophone Tests.

THE following is a description of a new connection with which the amateur is able to use old tuners, etc., yet employ the most modern dampt-undampt receiving circuit. This circuit has been in use at station 3 D S here for some time now, in connection with a rebuilt DeForest Audion panel and class A Moorehead tube and has given surprisingly good service bringing in all kinds of 1, 2, 3, 8 and 9th district amateurs very clearly. It works especially well on the phone of 2 X J, with which it requires very critical filament adjustment to bring in loud conversation. All tuning is done with the coil sliders and condenser C2, optional condenser C No. 3 being sometimes useful in tuning in 600-meter stations, but the best work on radiophone is done with no condensers in either the primary or secondary circuits of the tuner. C No. 1 is a .0005 Mf. V. C. Ag. is an adjustable grid leak made of a piece of fiber with two holes about one inch apart, into which two battery carbon binding posts are fitted with washers, and the space on the fiber being filled with marks from a *bb* graphite pencil, the amount of lead to be deposited being found by experiment (usually to the point where as much A. C. induction is removed from the phones as possible). T is a three-slide fifteen inch tuning coil, while L is a small loading coil, such as a two-slide tuning coil. A variometer might answer better for this purpose, or, for that matter it may be dispensed with altogether, but it helps to "louden" signals when adjusted correctly. Condensers C2 and C3 are .001 Mf. each.

This set seems to work best with an aerial made of two stranded wires 600 feet long, 80 feet high in a V style, 200 feet apart at the far end, but will also work on a single No. 18 DCC wire 15 to 25 feet high, and 150 or 200 feet long. The phone is slightly louder on large aerial, however.

A peculiarity of this set is that one can nearly always hear NSS on it, by just set-

(*Continued on page* 186)

"One of the Gang"

By MISS MARIANNE C. BROWN

INSPIRED and encouraged by the approval and success which greeted the "Autobiography of a Girl Ham," I feel moved to enrich the world's literature with the following recollections of my six months in the Marconi Co. factory. But first of all, I must unburden myself of a few private grievances I hold against the fair unknown authoress of the aforementioned "Autobiography." Therefore, to her my next few words are addrest.

In the first place, dear lady, you seem to have taken elaborate precautions to keep your identity secret. Why this incog? You really are not a "deep-dyed-in-the-wool" amateur, such as you describe yourself, as long as you refuse to hob-nob with others of the same variety. Moreover, you are missing a great deal more than half the fun of the game. There isn't anything unusual in a girl enthusiast any more—all the boys I have met seem quite used to the idea. Did you know that last year the number of licensed women operators in and about New York very nearly approached one hundred? And all these women had their licenses in their own names. (Wow! What an awful slam! Excuse it, please.) Joking aside, next time you get talking to a fellow Ham, after the usual "qra", "qrk", and "can i cum over", just you say, "Sure, come on," and see if it is so terrible to have it known that your station is operated by a girl.

There is a lot more I could say on this subject, but I feel it is unfair to the reading public to keep them any longer from these momentous reminiscences. If you want to hear the rest of my opinions, just drop me a line and we will fight it out privately. Now to my subject.

In the course of the recent unpleasant row "over there," I decided to do my bit by becoming a wireless operator. So I went to school and studied hard, so hard in fact, that in three months I had absorbed enough theory and code to pull down a first-grade commercial license. On all sides I was assured, both officially and privately, that we would not have long to wait before the government would call us. So I sat calmly by and waited for the preferment to fall into my lap. Needless to say, it fell not. That meant that I would have to find my own job. I applied for a position as an operator with the Marconi Co.; I offered my services to the Naval Reserve; I even endeavored, together with four other adventurous spirits, to enlist in the Marine Corps at one of their recruiting stations. Of course I met with no success anywhere. Then I read an advertisement for workers in the Marconi factory in Aldene, N. J., applied, and was accepted. I was prepared to operate anything from a typewriter to a drill-press. What they gave me was a nice, new 1 KW Navy type panel transmitter. You see they put me in the Test Department, which was by far the most interesting place to be in the factory at that time.

To my relief, I found there was another girl in this department, altho she was there for only a couple of weeks after I came. I must say, she knew more of the theory of radio than any girl I ever met. She copied and learned every formula and specification to be found in the factory. They used to say of her that she would even calculate the impedance of her screwdriver before using it on a set. Be it said to her everlasting credit, that she preserved her dignity and good breeding all the time she was there. I tried to for a week or so, failed utterly, and then settled down to complete enjoyment of my existence as "one of the gang."

We had another interesting personality in the character of a young Mexican boy with an unpronounceable name. We called him "Jazz" because it was so much easier to say and it really wasn't unlike his name. It was one of the small routines of the department that each tester keep a record of the data of the sets he tested, together with certain helpful memoranda and diagrams, in a notebook. It was another small routine that each tester enrich Jazz's notebook with many helpful and original diagrams. A sample of these I display herewith. I do remember seeing some highly elaborate drawings in which "permittance," "synchronous impedance," and "purple electrons" figured very prominently.

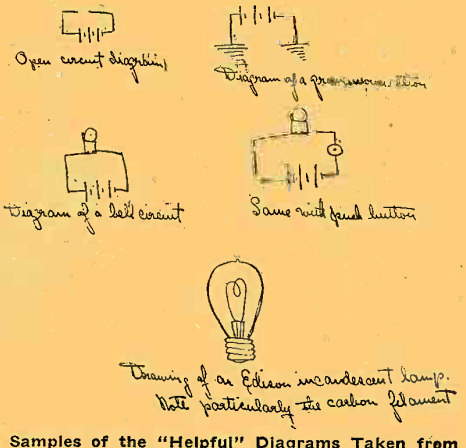
Of course, the gang had a lot of sport at my expense, and I admit I did make some glorious mistakes. One of the first things they did was to give me charge of testing all the meters. This was a particularly disagreeable job which everybody hated, and which they always gave to the newest member of the department, and incidentally made that member feel that a great honor had been conferred upon him. Let me say in passing that no one came into the department after me, so I held the enviable position of meter tester until I left. I must have tested upward of two thousand meters during my time there, —meters of every type and description from the most modern Westons to some ancient obsolete types that I declared Noah must have used in the ark. (One of the engineers here remarked, "Sure, on his arc set.) Well, I complained that the facilities for testing meters were nil, and that I could do nothing until I was supplied with some good standards and a proper place to mount them. They gave me the meters and a nice large board and told me to construct a panel. I did. The like of it was never seen before or since in the electrical world. I believe it still graces the walls of the company's test room. I mounted on the boards the four standards, in connection with which I used no fewer than six switches. In addition to these, there were two more switches and two sets of rheostats. Of course no one could operate it but myself, and occasionally I forgot how it worked. A few brave souls attempted to use it at various times, but the results were too disastrous for individual repetition of the act. In fact, whenever things began to get dull, I would throw a couple of extra switches, and the resulting fireworks were real lovely.

We were very busy up to and even a little while after the armistice. We had to test separate pieces of apparatus before the sets were assembled, and the complete sets before they were shipped to the navy. The sets I worked with were ½, 1, 2, 5, and 10 KW, and the separate parts, transformers, control panels, quenched gaps, *meters* and the like. As I say, we had all we could attend to, and the boys used to take turns working nights. That was one thing I escaped. I had so far to travel that the boss never had the heart to ask me to stay.

"Whenever Things Began to Get Dull, I Would Throw a Couple of Extra Switches, and the Resulting Fireworks Were Real Lovely."

For the day of the false armistice. By way of celebration we hitched up every transformer and gap we could find, not forgetting a goodly number of a particularly

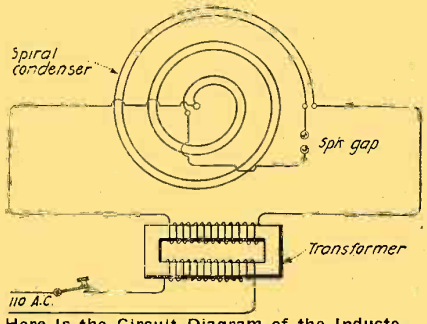
(*Continued on page* 185)



Samples of the "Helpful" Diagrams Taken from the Note Book of the Incomparable "Jazz."

Ideas—Sixth Spasm

By THOS. W. BENSON



Here Is the Circuit Diagram of the Inducto-denser. Nice Little Jigger. It Combines Capacity and Inductance.

WHEN Old Man Static starts to jam the ether it is time to get after the transmitter and see if we can't push more stuff thru, in fact we have to in order to be heard. And listen, I got the slickest ideas about transmitters that ever happened. Just doped out a method for combining the sending apparatus into two instruments. Just think of it, a transformer, rotary, condenser, O.T. an' everythin' in two instruments. Stanbi and get this string, O. M.

Instead of having a bulky O. T. and a big condenser, suppose we were to make the O. T. primary out of two wide strips of copper and space them a short distance apart, and presto, we have the condenser and O. T. in one unit! Or putting it the other way, why not make the condenser of two long strips of copper then wind it into a spiral. It's a wonder nobody ever thought of it before. Gee, this is too easy!

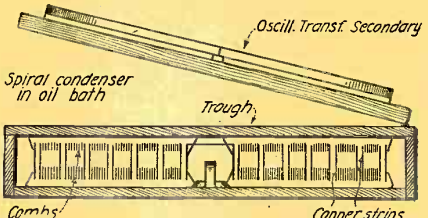
Let me tell you fellows how to build the thing. Build a trough about 16 inches square and 6 inches deep. Mount four hard rubber combs (Apologies to Mr. Whitson) in the bottom of the trough by means of small wood block. Now we take two lengths of copper strip about 4 inches wide and long enough so that when separated the width of two comb teeth they will have the proper capacity for the spark frequency and power in use. We gracefully wind these strips around the comb teeth. Separating the sheets two comb teeth, and the pairs about four or six comb teeth. Clear? Then fill the trough with Transit or Hi-Flash to make an oil dielectric between the sheets. There is your inductive capacity or capacitive inductance, whichever you wish to term it.

No, old timer, the current in the two sheets do not neutralize each other's fields, look the circuit over and you will find the current flows in the same direction in the two strips and gives a nice healthy field. So you can slip four more combs over the top edges of the strips, tack the lid on and hinge the secondary of the O. T. to the lid. This, I consider, the most radical improvement in radio apparatus in the last two hours.

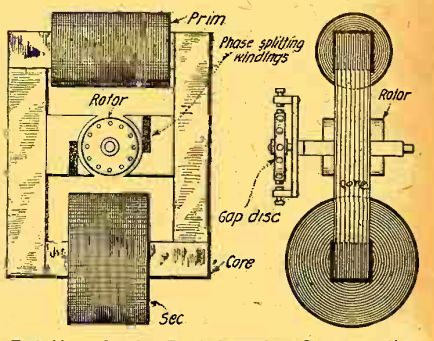
The above described Inductodenser is approached in novelty only by my new Rotarformer. The latter is an improvement on the transformer whereby it serves to drive the rotary gap, doing away with the motor used for the purpose. It precedes, I believe, a similar device built by Prof. Defule, of St. Vitus University, despite his ribald claims to the contrary.

The advantages of a magnetic leak on a transformer hardly needs mention but I decided the magnetism leaking across could be put to work. By boring out the leak to accommodate a squirrel cage rotor and supporting the rotor by bearings bolted to the transformer frame we have a motor that can be used for driving the gap. The pole pieces formed by the transformer leak are milled out to take a small winding as shown in the illustration, this winding is connected in series with the primary of the transformer. This arrangement becomes practically a split phase motor that operates while the transformer is in use. The rotary disk is to be arranged on end of the shaft of the motor and studs mounted as desired.

There's the dope. The whole transmitter in two instruments that can be readily mounted together into a compact set, another step towards that much sought efficiency of 118 per cent.



Build a Trough and Get Yourself Four Hard Rubber Combs, as Well as Some Copper Strips, Then Go to It.



But Here Is the Real Surprise, Boys, In the Shape of the Nifty Rotarformer.

Editor's Note.—At first we were inclined to think these words were the results of the hot weather, but we have changed our minds since we learnt that Mr. Benson lives in Philadelphia. It must be the reaction, you know.

A Magnetic Sending Key

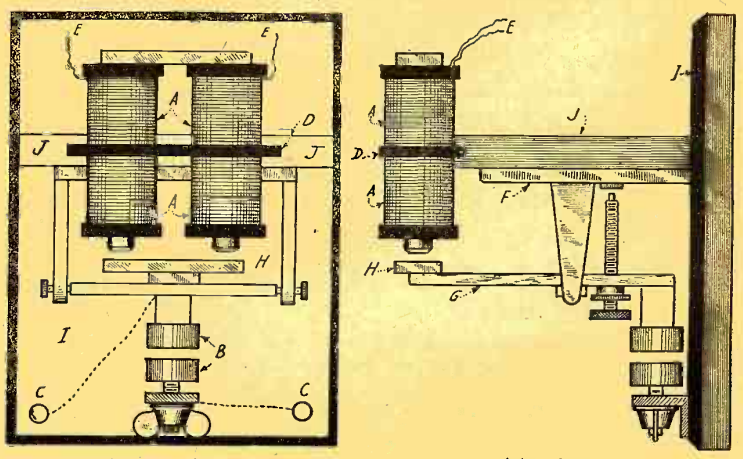
By C. C. WUTH

Here is a sketch and explanation of what I consider an original idea for a relay key for radio work. No key was handy that would hold 110 volts, so the relay was constructed from an old telegraph key, some scrap copper and a pair of bell magnets. It was operated by a regular telegraph key with a few dry cells.

A wooden base was constructed (I) and an upright piece of wood (J) was screwed down upon it. The bell magnets (AA) were fastened on the upright by the band (DD). The old telegraph key (F) was fastened to this upright by two screws and a soft iron bar (H) was soldered to the lever of the key (G). On the other end of the lever a piece of copper rod ½ inch in diameter was fastened (B) and a corresponding piece was fastened for the other contact. Zinc rod may also be used for these contact points.

The leads (E) ran to two dry cells and an ordinary key, while the binding posts (CC) were connected with the large copper contacts and directed to the I-K.V.A. transformer and to the 110-volt A. C. circuit.

It worked very satisfactorily, the contacts keeping fairly cool, considering the speedy action of the key and circuit load.



Top view Side view

General Layout and Construction Details of a Magnetic Relay Key Designed for Radio Transmission Work Which Mr. Wuth Has Used to Advantage.

"Mystic Waves"

A Radio Story based upon actual happenings

By ROBERT W. ALLEN

HOWARD GRANT removed the receivers from his ears and uttered a well-satisfied sigh as he leaned back and contemplated the apparatus before him. Truly he had spent an unusual afternoon, having succeeded in communicating direct with Denver, Colorado. All the local amateurs had obediently stopped sending when they heard Grant start with a series of messages for that city, a thousand miles from San Francisco.

Penetrating the high Sierras and Rockies, his signals were reported "rather QSA" by the operator at Denver, thus establishing a new amateur record for the Pacific Coast in daylight transmission. Being Grant's first achievement he was extremely gratified with the result. His name would appear in the newspapers as well as in the large radio publications. The high pitcht rotary spark he used would be listened for by many and he would handle innumerable messages.

The telephone rang. Howard expecting a congratulatory praise from some amateur friend, lifted the receiver enthusiastically. A feminine voice greeted him from the other end of the wire.

"I'd like to go, Vivian," he said slowly in answer to a request that he accompany the young woman to a theater that evening, "but I am sure to have many radio messages from all over the United States. You say you already have the tickets? Well, that's different. Guess I'll have to postpone my business for the evening and go anyway, besides there is a fine show on this week," he added lightly. "Meet you by 7.30 at entrance? All right, good-by." Howard's girl friend rang off.

As luck or misfortune would have it he must go out on a night when his signals might be heard in Chicago, or possibly, New York. However, it was only a matter of slight delay and to-morrow night would do as well; besides, Vivian Clark was "some" girl, after all.

Eight-thirty found them enjoying the performance immensely and Grant was not sorry he had gone. Over their ice cream after the theater, Grant told Vivian of the day's work and the new record established for the Pacific states. He added that the goal he was striving to attain was to be in direct communication with New York City.

Wishing him success in his radio work they both parted at her door and ten minutes later Howard was home. He glanced at his watch and saw it was midnight, the best time for long-distance radio work. Hurriedly he made his way to the basement. Fingering his keys for the right one he reached for the padlock. The door to his wireless room was wide open! Certainly he remembered closing and locking it as he had always done. A feeling of anguish passed over him as he reached for the electric light switch and flooded the room with a sickening glare.

Robbed! Burglars had entered the room and had taken every piece of his wonderful apparatus! His rotary gap, transformer, condensers, audion panels, regenerative receiving cabinets, everything was gone. No— They had left a variometer. It was the cheapest thing he possest.

He gazed absently at the empty space. Everything was stolen and very little chance for the arrest of the criminal. An amateur—if it was one—surely was the thief. He thought of the scores of amateurs who had visited his station. From Oakland, Berkeley, San Jose, Santa Cruz and other cities fellow-amateurs had come to see him. Anyone of them might have stolen his instruments.

Robbed! Burglars Had Entered the Room and Had Taken Every Piece of His Wonderful Apparatus!

There was nothing in the room in the way of evidence. Only burnt matches had been left on the table by the thief, or thieves. The station, being in the basement, had been easy for the burglars to enter, while picking the insignificant padlock on the door of the radio room was simpler yet. The weather had been unsettled and the ground outside was still wet from recent rain.

Many footsteps were distinguishable, among them the imprint of a shoe with hob-nails. Grant bent closer to the ground and pierced the darkness with an electric flash-light. A woman! The footprints of a woman! It was a very small foot with French heels and no one in the family wore such shoes. A woman among the burglars! It was preposterous.

Only few women had visited his station, and these had been the friends of his mother who had invited them to listen to the music by radiophone sent out from a local radio company. Certainly none of these could be accused of stealing his radio set!

There was only one woman who had recently entered his station directly. An eccentric lady of middle age who was interested in the mysteries of wireless. But it was impossible to even think that any woman had aided the robbers. Grant was in a quandary and could not account for the imprint of the woman's shoes. The only thing to do would be to call the police immediately, which he did.

After an hour of waiting, two large, red-faced Irishmen came in answer to his telephone call. They examined the lock cursorily and one said, "They opened it, didn't they?"

Grant looked at the man. "Yes," he replied, "and it wasn't much of a task, I suppose."

"What did they take?" asked the other policeman.

"My complete radio outfit," answered Grant.

"Describe it, please."

"There was an audion detector," began Howard, "three amplifiers, regenerative—"

"Hold on," interrupted the officer, "I said to describe what was taken, not how it works."

To the best of his ability, Grant described the apparatus, mentioning every tell-tale mark on it. The police officers had to be told several times before they knew what he was talking about. They knew as much about wireless instruments as Grant knew about radio stations on Mars.

At the end of an hour and a half the task of describing was completed and the policemen departed. How indifferent the men had acted. They did not seem to care whether he ever recovered his instruments or not. All they had looked at was the lock. Fingerprints, footprints, nothing did they search for in the way of evidence. Although they promised him that they would soon have track of the lost apparatus, he knew that as long as the recovery of them depended upon the police, he could expect nothing.

Sadly he went to bed. All his dreams of the day had vanished in the loss of the set. Radio instruments such as he had possest were very expensive and he could not afford to replace them. He bitterly berated his ill-luck and wondered who could have played such a trick upon him.

Two weeks past and matters were at a standstill. Nothing was heard of the stolen radio instruments, but Grant had purchased a few cheap instruments and a pair of phones and he was able to communicate around the city.

The results obtained were far from satisfactory after the feat of having talked with Denver, and the more he thought of it the harder he tried to unearth new evidence to lead to the capture of the thieves or the recovery of his set. He built up theory upon theory but he arrived at no definite result. Possibly he would recover them some day but it certainly was discouraging just then.

Grant had visited his friend Dick Brockton several times and had listened in on his instruments but found very little enthusiasm in the work.

"It surely is hard luck, Howard old boy," consoled Dick, "but you can never tell when something will turn up. Remember that eccentric lady you told me about? She was here to-day. Say, but she's a funny one."

"Why so?" asked Grant.

"The foolish questions she asked. Wanted to know if wireless waves would make cracks in the windows; if they could blow down trees and many other such questions. She certainly had me going."

Howard smiled. "Hope you enjoyed answering them, Dick; I know I didn't. Well, I must go down town now as I want to get some good galena. See you this evening."

Arriving home with the mineral, Grant tried it out and was surprised with the results he obtained with it. This caused him a little satisfaction and he decided to erect a longer aerial for the reception of commercial stations when time permitted.

"Howard!" his mother's voice was calling him from above. "Someone on the telephone asking for you, hurry up."

"Hello," said Grant. "Yes, this is he. What? You have found my apparatus in Sebastopol? You say you have some of it at the station? I will be down to identify it as soon as I can get a car."

Excitedly Grant boarded a street-car for the station. Who was it he knew in Sebas-

topol? Wesley Leonard! Why had he not suspected him before? Had he not visited him on the very day of the robbery? It was a simple case. Seeing how easy it was to enter the station, Leonard, who was noted for his dishonesty, had decided to take a chance and steal the apparatus, being that he lived some sixty miles from the city, and was in little fear of Howard dropping in on him.

At the station house he was led to a room where radio instruments had been placed on the table.

"Do you recognize them?" asked the police sergeant.

Grant hastily looked at the instruments. "They are not mine," he answered slowly. The apparatus on the table was different from his in every way.

"But they were stolen," said the officer. "Johnson confessed to having stolen them."

"Johnson!" exclaimed Howard in surprise, "confessed that he stole them from me?"

"Well, no, not quite that. Johnson said he didn't know the owner of the apparatus. He was only acting as the look-out. Then this wireless stuff isn't yours?"

"No," responded Howard absently; "it might belong to one of the other fellows who were robbed recently."

"I guess you're right about that. I'm sorry it is not yours, but we will do our best to recover it."

Grant left the station house greatly deprest in spirits. He had pictured himself again flashing out messages thru the ether to far distant stations. His sudden hopes were shattered and he sullenly returned home.

Leonard, after all, had not been the guilty person, but why should he not be? A new light suddenly dawned upon Howard. Being dishonest, what would have prevented Leonard from entering the station? He knew where everything was located and he had plenty of time to view the possibility of robbing the station while Grant was sending. Why had he not thought of it before? Leonard *must* be the thief. He would go to Sebastopol and visit him. But what would Leonard say when Grant appeared at his door and requested to see his radio set? Tomorrow would be Saturday and he would ask Brockton to accompany him. There was still a possibility that he might recover his apparatus.

Brockton readily consented to go. More, they would go in his machine, so they might bring back the instruments if they were located.

"There goes the door-bell," said Dick; "wait here and I will answer it. That woman said she might drop in this evening to see me about something."

Howard waited in the radio room while Brockton ushered his visitor into the front room.

"How do you do, Mr. Brockton," Howard heard the woman say. "I seem to smell wireless in the air."

"Yes," answered Brockton, "there generally is quite a bit of ozone about at this time of evening. Come into the parlor."

"I will," said the eccentric woman, "I have some questions to ask you."

Howard laughed to himself and pitied Dick when he tried to answer them. The questions this woman asked were extremely puzzling.

"Mr. Brockton," began the woman, "are you aware that at this moment wireless is passing through your window?"

"Certainly," responded Brockton, "wireless waves can pass through anything."

"I thought so, I can at this moment hear them. Look, see that flash which just came through the window?"

"No, I saw nothing," said Dick slowly, "and it is impossible to hear the signals without the instruments."

"Listen!" the woman stood up, "there they go again. They are talking about me, the villains. I am sure it is the amateurs."

Brockton gazed at the woman spellbound. Here was something out of the ordinary. Was the woman— Again she spoke.

"I must locate these stations, and destroy them. Will you help me?"

"With all my ability," replied Brockton, wishing he was some place else. "Do you wish to build a compass station to locate them?

"Yes, yes," said the woman greatly agitated, "anything that will lead to these wicked persons. I will pay you much for your trouble. When will you start?"

"In a very short time. I must find out something before beginning. Suppose you come— no, I will telephone to-morrow evening and let you know."

"How much will you need?" asked the woman opening her purse.

"Nothing now; later I will tell you the cost."

The mysterious woman departed, much to Brockton's relief. "I never thought she was crazy," began Dick as he entered the room where Howard was waiting. "Why, Howard, what's the matter, you look sick?"

"The woman',' said Grant with an effort, "the woman, that's her. Quick, telephone the police."

"Hold on, old man, I just dealt with one, don't make it two. What are you getting at?"

"Can't you see, Dick? This woman is the one who stole my apparatus. That is, she must have hired someone to do so. Just like she wanted you to locate those who were talking about her. She had my apparatus stolen so I would be unable to talk about her. Her upper story is quite unsettled. What do you think about it?"

"By George, Howard, you hit the nail on the head. What can we do about it? Having her arrested would do no good. She is very accurate in her statements and it would be very hard to hold anything against her. The questions she asks are foolish but the greater part of them take thought. Besides we are not sure of her."

"I have it, Dick, I shall call on her tomorrow and tell her I have something interesting to tell her and possibly I may learn something to my advantage."

"You're right, old man, and I shall be only a few steps away in case I hear you yelling for help," he added with a laugh.

The next morning found Grant at the door of the unbalanced woman. It was she who opened the door for him.

Howard told who he was and the woman immediately remembered him.

"It's too bad your apparatus was stolen," she said sympathetically, "now you can't talk over the air to your friends."

The woman certainly did not appear demented. She had spoken quite naturally to him and aroused not the slightest suspicion. She gazed at Howard from steady, clear blue eyes.

"I am sorry to disturb you," began Howard, "but knowing you are interested in the mysteries of wireless I thought you would like to hear what I have to say."

"By all means, my dear boy, I am extremely interested. What is it you have to tell me?"

Grant was undecided, as he had not expected things to run along quite so smoothly. But he could not back out at this moment.

"It is this way," Howard started to explain, as if picking his words out; "while I had my apparatus I often heard mysterious ether waves. They seemed to pass through the room and were accompanied by a flash. They spoke of a woman but didn't tell her name. If only I had my instruments I may be able to locate these fiends. Only with aid of the stolen apparatus will it be possible to destroy their plants."

The woman's expression changed as he related these facts. She eyed him with a glassy stare.

"The mystic waves," she said in a low tone, "the mystic waves, they talk of me. Can you not hear them now? See that flash? Oh, Mr. Grant, say that you will help me locate them? Your stolen apparatus, come with me, I have some like it."

She rose from her chair and made her way toward another room, Howard following. Opening a closet door, she first brought out a regenerative cabinet, then audion panels, phones, transformer, rotary spark gap, all Grant's instruments she placed upon the table.

"Take them," she said with a sob, "take them and capture the fiend who talks of me!"

"I will take them, all right," replied Howard, "in a few minutes I will come in a machine."

He was soon back with Brockton. Leaving the latter in the automobile, Howard again entered the house and removed all his instruments to the machine.

"Where in the world did you get the instruments?" asked Brockton of the woman, as they were ready to leave.

"From the villains," answered the strange woman, "and I saw that Leonard did the work well."

"He helped you?" inquired Howard.

"I saw him leave the fiend's station. He told me the villain was talking to me by means of wireless waves. He agreed to aid

(*Continued on page* 184)

"Take Them," She Said, with a Sob! "Take Them and Capture the Fiend Who Talks of Me!"

RADIO DIGEST

GUGLIELMO MARCONI.

A rather complete résumé of the life and work of this famous inventor has been accurately and concisely set forth in the July 10th number of *The Wireless World,* of London, by E. Blake, A.M.I.E.E.

Among the many interesting and historical facts given by the author is gleaned the following timely remarks:

It must not for a moment be imagined that modern wireless in all its wonderful applications is the sole work of Marconi and his assistants. During the past fifteen years an army of experimenters representing almost every country under the sun has been at work, and the five years of the Great War has advanced wireless work to a degree which it would have taken some ten years of peace to reach. Marconi's system still exists and holds its own outstanding position, but his apparatus perforce keeps pace with the knowledge and experience gained year by year. Of the other co-existing systems and appliances and their relative merits it would be inappropriate to write here; no system is perfect, or embodies the best of all the many wireless inventions now available, and the discussion as to which is the best belongs properly to the technical and commercial men. In fairness, however, to all concerned, and in order to correct the erroneous idea so largely current amongst 90 per cent of the general public, that Marconi "invented wireless," it must be pointed out that the art of aetheric communication is like a coral reef, inasmuch as it represents the work of many. Wireless was not invented, but, like Topsy, it grew.

What then is it which places Marconi amongst the immortals? By what right will he be numbered with Volta, Galvani, Faraday, Maxwell, Hertz and Kelvin? It is that he led men to conquer another domain of nature at a time when they halted. He it was who first scaled the barriers and his was the hand to make the breach thru which the rest poured.

Honors fall about him freely. He is a freeman of Rome, a Nobel prize winner and the recipient of many decorations. Yet withal he seems to stand aloof from us, a solitary figure, making contact with the heyday of things with one hand, and with the other feeling for the intangible. He is now in the prime of life and still working. Will he "dream" for the world another reality like wireless telegraphy?

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY.

The 1920 edition of this important volume has just been publisht by The Wireless Press, Ltd., of London. It contains nearly 1200 pages of very interesting and useful information on the ever increasing subjects of radio telegraphy and telephony. Incidentally there are excellent reproductions of many stations and apparatus covering a wide range of the radio art. Views of some of the world's largest plants are included.

Among some of the important subjects are the detailed records of recent Radio Development, National and International Radio Laws and Regulations, a Résumé of Radiotelegraphic Legislation, Directory of the World's Radio Stations (land and ship), International Call Letters, Vacuum Tube Amplification, Direction Finders, Particulars of Radio Patents, Radio as Applied to Aviation, General Information and Useful Tables, Various Biographies.

An important section is that devoted to the literature of radio, such as the books publisht during 1919 and a résumé of important radio articles publisht during the year.

Amateur radio is given attention in several ways by describing its purpose and place in the art. A directory of the World's Radio Societies is certainly a useful addition.

It may justly be said that the book appeals to the engineer, the operator, the commercial radio salesman and the general amateur public. It is understood that the book costs $3.50 in the U. S. and that it may be purchased from The Wireless Press, Inc., New York.

EXPERIMENTAL WIRELESS STATIONS.

By P. E. Edelman

The theory, design, construction and operation is fully treated including Wireless Telephony, Vacuum Tube and quenched spark systems. The new enlarged 1920 edition is just issued and is up to date, correct and complete. This book tells how to make apparatus to not only hear all telephoned and telegraphed radio messages, but also how to make simple equipment that works for transmission over reasonably long distances. Then there is a host of new information included. The book gives you all the recent important radio improvements, some of which have never before been publisht. This volume anticipates every need of the reader who wants the gist of the art, its principles, simplified calculations, apparatus dimensions and understandable directions for efficient operation.

Vacuum tube circuits; amplifiers; long distance sets; loop, coil and underground receivers; tables of wavelengths, capacity, inductance such are a few of the subjects presented in detail that satisfies. It is independent and one of the few that describe *all* modern systems.

It has been endorsed by many instructors for its clear accuracy, preferred by leading amateurs for its dependable designs. The new Experimental Wireless Stations are sure to be satisfactory for many purposes. 12 mo. 24 chapters. 320 pages. 167 illustrations. 1920 edition. Publisht by The Norman P. Henley Pub. Co., New York.

THE FIRST LADY RADIO OPERATORS IN GREAT BRITAIN AND IN THE UNITED STATES.

According to a British contemporary the first lady operator in Great Britain was Miss Parker, of London, while the first lady operator in Scotland was Miss Turnbull, of Innellan, Argyllshire. These two lady pioneers qualified about seven years ago.

We might as well add that we can boast of our first lady "opr" in the person of Miss (at least she was a miss then) A. G. Parker, who "beat" the above ladies to the post by about three years. Miss Parker sailed the seas as a *genuine ship operator* from November, 1910, to April, 1911, on the *S.S. Mohawk* of the American Clyde Line. Strange the ladies should both have the name of Parker, but nevertheless it would seem to be a fact.

WIRELESS TELEGRAPHY AND TELEPHONY.

By H. M. Dowsett

The object of this interesting book is rather a unique one. It is designed to act as a connecting link between the elementary textbook and the advanced treatise or specialized textbook, and in particular to meet the demand for a book of instruction which can be used in sequence to *The Handbook of Technical Instruction for Wireless Telegraphists* by J. C. Hawkhead and the present author.

The following subjects are treated: The Nature of Electricity and of the Atom; Phase Displacement Effects in Elementary Circuits; The Spark Discharge; Continuous Wave Transmitters; Thermo-Ionic Effects and Oscillation Valve Phenomena; Special Apparatus for High-Speed Transmission and Reception; Measurement of Electric Current and of E. M. F.; Measurement of Resistance; Measurement of Capacity; Measurement of Inductance; Measurement of Frequency; Measurement of Dielectric Strength; Measurement of Decrement, and finally the Measurement of the Direction; and of the Distance of Transmitting Stations, and of the Intensity of Received Signals.

Illustrations number 305 and are timely and instructive. A useful Table of Symbols has also been included. The book contains 331 pages and is well bound in heavy red cloth. The publishers are The Wireless Press, Inc., New York.

FIRST RADIO TELEPHONE EXCHANGE.

The city of Avalon, Catalina Island, is about thirty miles off the California coast. One of the earliest applications of radio telegraphy was that between Los Angeles, Cal., and Avalon. It is reported now that the Islanders are to be given telephone connection with the mainland by means of radio.

The Pacific Telephone and Telegraph Company announces that an ordinary telephone exchange is to be installed at Avalon and that conversations between subscribers' stations on Catalina Island and stations on the mainland will be carried on by radio telephony without manual relaying.—*Telegraph and Telephone Age.*

RADIO PLANTS TO BE ERECTED IN MEXICO.

A cablegram received from the American consul at Manzanillo, Mexico, states that the Minister of Public Works and Communications is considering the erection of four wireless plants, two of which are to be located at Manzanillo and Morelia. American companies interested in work of this nature should communicate directly with the minister for the construction of the plants and should furnish specifications, quotations and information as to the length of time required to do the work.

The consul also reports that plans to complete terminal works at Manzanillo have been approved and that 3,000,000 Mexican dollars (normal value 1 Mexican peso equals $0.4985) are involved. The work includes the installation of a water system, the construction of piers, and the leveling of hills.—*Telegraph and Telephone Age.*

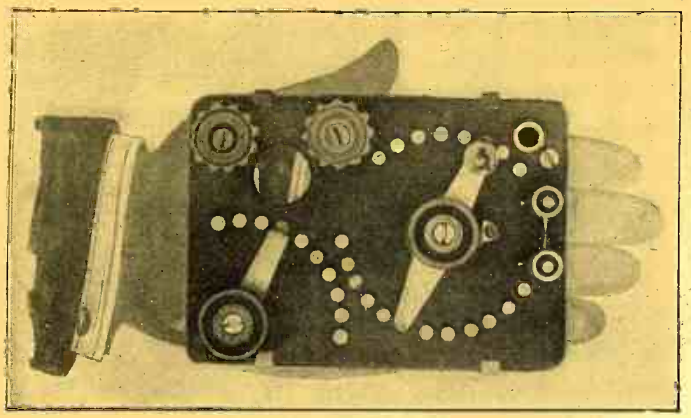
SELECTED STUDIES IN ELEMENTARY PHYSICS.

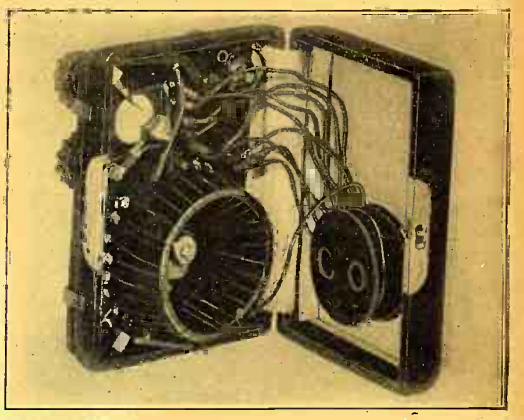
By E. Blake, A.M.I.E.E.

Here is a handbook of particular value to the radio student and amateur, and has been written for those who desire to read

(*Continued on page* 184)

Concerning Our Recent Prize Contest





Two Views of the 6 x 5" Portable Receiver Designed by Mr. J. McLaughlin.

IN our May issue we announced a $100.00 portable radio prize contest, but we are very sorry to state that of the fifteen odd entries that we received, there is not a one that would be honorably entitled to a prize in the opinion of the judges.

We wish to call particular attention to our announcement on page 627 of our May issue where we state as follows:

"In awarding prizes the judges will take into consideration *not only the smallness of the outfit, but its efficiency as well.* In other words, the first prize will not necessarily go to the amateur who builds the smallest outfit, but rather to the one who builds a small one that is efficient as well. Of course the word 'small' as used here is rather elastic. In other words, the outfit which can be slippt into the pocket might be a small one and yet there might be a smaller one, no larger than an ordinary watch! But, bear in mind, what we are after is not a freak outfit. A microscopic radio receiving outfit could no doubt be built, but we daresay, it would not be very efficient. We have recently seen a European outfit that was quite complete and could be carried around in a walking cane, and this was not a bad idea at all; besides it worked well. This may be a hint for some of our radio enthusiasts."

None of the entries received, after careful perusal, came within the scope above outlined. Most of the outfits could be termed fairly large, and there was not one of them that measured less than about 8 inches long. We do not consider this a small outfit. Quite the contrary it is fairly large. We hinted by calling attention to a European outfit (see above) as to what we wanted, but evidently the few parties who sent in their entries paid no attention to this, and sent photographs not only of fairly large outfits, but everyone of them was commonplace and did not at all comply with the rules of the contest which we here repeat:

"There should be some new features embodied in the outfit that are not known now, or have not been publisht heretofore. It is quite important, and as a matter of fact necessary that the set must have been actually built, that it is either in use, or has been in use."

Not one of the outfits submitted had any new feature that had not been described before. There was little or no originality shown whatsoever. Of all the entries received, there was only one that came within the scope of a *small* outfit, and this was built into a watch-case and had some ear-marks of originality. The judges, however, before awarding a prize wisht to exert their privilege as printed in the rules, viz.:

"The judges also reserve themselves the right to inspect and test the outfit if this should be deemed necessary." Altho several letters and telegrams were sent to the contestant, no answer was received, and the judges had no opportunity to know whether the outfit was bonafide or not. It has therefore been decided to repeat the contest again along exactly the same lines, and in order to avoid a misunderstanding, we have added for the benefit of those who evidently did not understand the purpose of the contest, the maximum size of any outfit submitted.

In other words, if the outfit measures larger than 5 inches long, 3½ inches wide and 2 inches high, *or its equivalent in cubic inches,* it will be barred from the contest. This size does not include the phones if such are used, but otherwise the outfit must be self-contained, and within this space must contain all the apparatus for tuning, the detector

(*Continued on page* 186)

$100 "PORTABLE RADIO" PRIZE CONTEST

WE again make the announcement of the third $100 prize contest entitled **"Smallest Portable Radio Outfit".**

A great many amateurs,—if not the majority,—are intensely interested in a small portable outfit that can be taken about when visiting friends, when going away for week-end parties, for camping and a great many other purposes. Particularly during the summer and fall a good portable receiving outfit is greatly desired and highly prized, as we have been able to satisfy ourselves from experience.

With modern radio apparatus, properly put together, it is possible to receive messages over surprising distances, even with small, but compactly built, appartus, and there is no reason why our amateurs should not be able to turn out something really worth while. In awarding prizes the judges will take into consideration *not only the smallness of the outfit, but its efficiency as well.* In other words, the first prize will not necessarily go to the amateur who builds the smallest outfit, but rather to the one who builds a small one that is efficient as well. Of course the word "small" as used here is rather elastic. In other words, the outfit which can be slippt into the pocket might be a smaller one, no larger than an ordinary watch! But, bear in mind, what we are after is not a freak outfit. A microscopic radio receiving outfit could no doubt be built, but we daresay, it would not be very efficient. We have recently seen a European outfit that was quite complete and could be carried around in a walking cane, and this was not a bad idea at all; besides it worked well. This may be a hint for some of our radio enthusiasts.

Requirements of the Outfit

THE outfit must have means for tuning. It may have one or more detectors. It should have means for receiving messages by sound, which may be the usual set of telephone receivers *or something better.*

There must, of course, be also an aerial of some sort as well as a "ground" or ground connection. Due to the very nature of the contest, it is of course necessary that the aerial be such that it will not take up too much room nominally. Concentrated aerials of the loop type can be used, or any other contrivance that takes up a minimum space, but gives quite a good capacity when unfolded or extended.

Remember that the editors are not looking for freaks. *The outfit must work* and in order to prove it, the contestant must build it, for no entry will be considered, unless it is accompanied by a photograph of the actual outfit.

In publishing the various ideas, all the rights revert to the publishers. The latter also reserve themselves the right to publish manuscripts which were sent in to this contest, altho they are not prize winning articles.

PRIZES OF $100 IN GOLD

First Prize	**$50.00**
Second Prize	**25.00**
Third Prize	**15.00**
Fourth Prize	**10.00**

In that case full space rates will be paid for any manuscript publisht that did not win a prize.

As will be noted, the publishers offer prizes totaling *$100.00 in gold for the best article on the smallest practical and efficient radio telegraph or telephone receiving outfits.*

Several radio experts will act as judges in this contest. Every one of the judges will pass upon the manuscripts submitted, and there can be little doubt that all contestants will be treated fairly and impartially. From the very nature of the contest, we are certain that it will not only bring out the very best there is in the American amateur, but that it will advance the art for portable radio receiving outfits considerably.

Rules for the Prize Contest

THE set to be described may be of the usual receiving type. Vacuum tube type, or crystal detectors may be used at option of builder.

There should be some new features embodied in the outfit that are not known now, or have not been publisht heretofore. It is quite important, and as a matter of fact necessary that the set must have been actually built, that it is either in use, or has been in use. Wild "ideas" or patent descriptions are strictly excluded from this contest. It is also obvious that insofar as this contest is conducted chiefly to bring out NEW ideas, commercial radio outfits are excluded from this contest. It is necessary to state what instruments are used, and if some of the instruments have been bought, the make must be stated. A good diagram of the connections neatly executed in ink is to be furnished. A good photograph, not smaller than 5x7 inches giving at least two views of the set is necessary. A photograph of the builder is also required.

All photographs, diagrams and other data sent in by contestants which are not used will be returned at our cost.

In cases where there seems to be some doubt as to the practicability of the instrument we reserve the right to ask to inspect and test the set; insured parcel post charges at our own expense both ways. Of course, we shall return the instrument promptly. This, however, will not be requested if the photographs and descriptions are convincing.

More than one outfit may be entered by contestants. The contest is open to everyone, radio clubs included, except manufacturers.

The manuscripts should not be longer than 1,500 words; 1,000 words preferred. All prizes will be paid upon publication.

The Contest closes in New York November 15th, and the first prize winning article will appear in the December, 1920, issue. Address all manuscripts, photos, etc., to "Editor Portable Radio Prize Contest," care of this publication.

WITH THE AMATEURS

THIS Deparument is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we make it a rule not to publish photographs of stations unaccompanied by a picture of the owner.

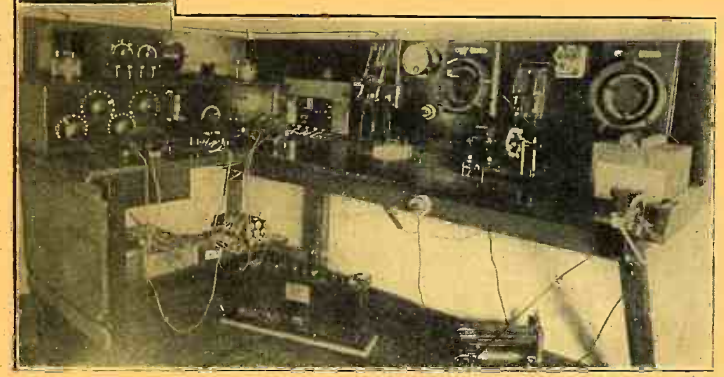
We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures publisht will be paid for at the rate of $2.00.

Station of Elmer B. Hilb

First Prize Winner

FOR a long time I have been going to do this but somehow never quite got to it. You know how it is, fellows—it's called *procrastination* by the "profs" at school. But here's the photo and description at last. I hope it may interest others who follow the "etheric road." Nothing new and startling but nevertheless this station has given me excellent results. Here goes for the description—the photos you see before you.



Elmer B. Hilb Wins First Prize This Month. Of the Many Goog Photographs We Have on Hand His Was the Best and Clearest. Aside from That, His is a Well Arranged Layout.

I have an aerial of the inverted "L" type, which consists of No. 14 aluminum wire stretched upon bamboo spreaders, nine feet long and have three wires ninety feet long and forty feet high.

The lead-in is a No. 8 wire twenty-five feet long, and the ground lead is fourteen feet long.

The transmitting set consists of a Thordarson 1 K.W. flexible transformer, Sayville rotary gap; six moulded condensers connected in parallel; oscillation transformer, heavy contact key; hot wire ammeter, as well as other minor necessary instruments.

The receiving set consists of some very effective instruments, as follows: Navy type receiving transformer, one short wave regenerative set, two 43-plate variable condensers; two pairs of telephone receivers, also a one-step amplifier and detector, which were not in use when photograph was taken. A small 500-meter maximum set for amateur station work was also purchased after photographing.

I also hear many amateur stations working nightly, from the 2d to the 9th districts, also a number of Government stations and ship stations. I hear the calls: NAA, NAE, NAT, NAH, and a great many others, which is pretty fair for this time of the year.

Some of the above-mentioned instruments were constructed by myself, including the short-wave regenerative set, and the one-step amplifier.

RADIO NEWS has a very welcome place in my station, and my only wish is that it be publisht weekly instead of monthly. Some of my very best results are due to the hook-ups found in it. One I recently tried out, "just to see if it worked,"—and I did not think that it would with my set—but no sooner had I hooked it up than NAH pounded in so that I could lay the phones on the bench and still hear it quite plainly.

I think that it would be a fine thing if the amateurs would send out the weather report on barometric pressure, direction of wind and the speed and humidity every evening at certain hours and thus every amateur could tell of the local storms, some that the Government stations could not tell about, due to the locality that they are located in. It may be clear in the place where the Government station is located but outside that area there are small storms that the Government station can not get. The amateurs can and in this way they could be quite useful to farmers and others. I would like to hear from fellow amateurs on novel hook-ups and photographs.

ELMER B. HILB.
Deshler, Ohio.

Kenneth G. Dacy Station

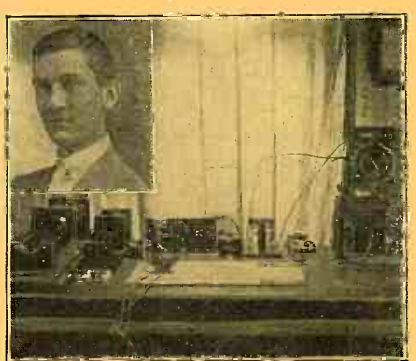
The accompanying photographs are of my station and myself. My receiving set is somewhat "old fashioned" but has given me wonderful results. In the center of the photograph is seen my audio-tron panel. To the left of that are two receiving transformers. The small one, which is an Arlington transformer, has a capacity of 2500 meters. The large one, which is of own make, has capacity of about 10,000 meters. I have a 23-plate variable condenser shunted across the phones, which are Murdock 3000 ohms. Also a 43-plate variable in series with the aerial. In front of the small coupler are two switches which change from one to the other.

My transmitting set consists of a Thordarson ½ K.V.A. transformer, 4 molded Murdock condensers, each having a capacity of .0017 M.F.; Thordarson saw-tooth rotary spark gap, Murdock oscillation transformer and a Murdock change-over switch. The condensers, which are excluded from view in the photograph, are behind the transformer.

My aerial equipment is as follows: For sending and receiving on short wavelengths an aerial composed of four wires, spaced two feet apart, forty feet in height and sixty feet in length is used. For long-distance receiving an aerial composed of one wire, 350 feet in length and forty feet high is used.

With this set I have been able to copy NAA, NAT, NAR, NAJ, NAO, NAD, NAU and numerous amateurs. Under the right conditions my sending set will send about 100 miles.

KENNETH G. DACY, "9-RS"
336 Dean St., Woodstock, Ill.



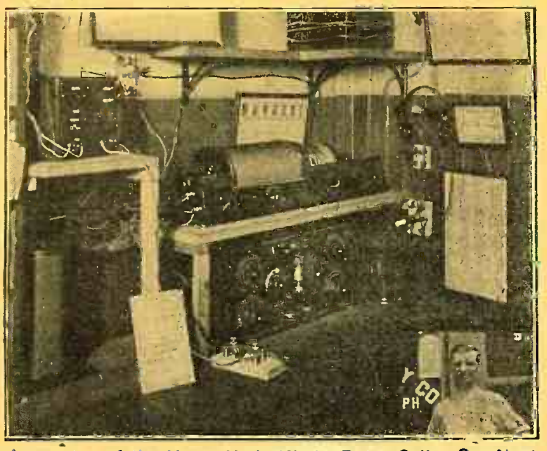
Not Much of an Apparatus Display But This Handsome Young Bird Secures Excellent Results.

Emery G. Smith Station

I GLADLY send you a photograph and brief description of my radio station. The insert on the large photograph is a small likeness of myself.

The general description of my set is as follows: The transmitting set consists of an A. C. Gilbert transmitter having a range of from three to five miles. Amateurs in this locality have heard me quite well, considering the small power of this set.

As for the receiving instruments, these consist primarily of a Deforest audion panel, a short wave regenerative set appropriately built within a cabinet. The cabinet contains an audiotron vacuum tube with grid leak and a filament rheostat, a potentiometer, variometer, a primary switch on the right-hand corner as well as a secondary switch. In the left-hand corner is a loading coil which permits tuning up to 25,000 meters.



Apparatus of the Home Made Kind. Put a Collar On, Next Time, Emery. We Are Almost Ashamed Of You, Or Was It a Warm Day?

I have a home-made plugging-board arrangement by which I am able to change from a long to a short wave simply by plugging in the coupler. I have secured excellent results and hear many government stations in the United States as well as the amateurs of many districts. I also hear wireless telephone conversations from many parts.

Altho I do not expect to win first prize by entering this station in the columns of the "With the Amateurs" page of RADIO NEWS, yet I thought it may possibly be interesting to amateurs who live near by and who would like to communicate with me on amateur matters.

EMERY G. SMITH,
515 N. Rock St., Shamokin, Pa.

Station of H. F. Kohnitz

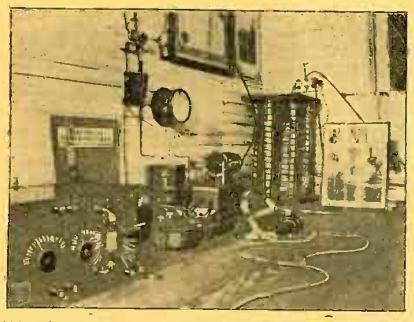
A naval radio operator who does not get enough of "it" during working hours

Wendell C. Roberts Station

My receiving set is composed of a 3000 meter loose coupler which is home-made; an *Audiotron* cabinet with self-contained "B" batteries; Murdock variable and fixed condensers, Murdock 2000 ohm fones, and galena detector. The *Audiotron* can be hooked up for either detector, amplifier for crystal detector, or oscillator within a few minutes which renders it useful at any time. When it is used as a detector, NAA can be heard twenty-five feet from the fones. The filament is lighted by a 100 ampere-hour Exide storage battery and when the rheostat is adjusted, signals do not fade for hours at a time.

My sending set is not very elaborate. It consists of transformer coil, electrolytic interrupter, rotary spark gap, helix, key, and volt-meter. The sending range is only about twelve miles, and the only amateur who is in range has dismantled his station so I hardly ever use it.

My receiving antenna is 138 feet long and 45 feet high consisting of three wires. My sending antenna is of the slant 2-wire type, forty feet long and forty-five feet high at the high end.



Wendell Has a Transmitter with a 12 Mile Range and Nobody Near Enough to Send to. Tough Luck, Boy. Can Any One Help Him Out?

I belong to the R. L. O. A. and carry a Government license, my call being 4CL.

Contributed by

WENDELL C. ROBERTS,
Commerce, Ga.

HERE is a photo of my set and one of myself seated at the instruments. This outfit, with the exception of telephones, transformer and oscillation transformer, is home-made. Being still in the service, and likely to be transferred at short notice, I am unable to construct a larger set due to greater bulk. In this set I have tried to combine efficiency with a minimum of weight and size. The transmitter consists of a Thordarson ½ K.W. transformer, a waxed-in copper foil and photo plate condenser, a Murdock oscillation transformer and a home-made rotary gap and key. (Gap shown has been replaced with a better one since photo was taken.)

The loose-coupler cabinet set at the left is my old "stand-by" of pre-war days with which very satisfactory results are obtained, having copied every station (naval and commercial) on the East Coast and the Gulf and numerous ships at sea, but its day is past and it is used only for local work, being supplanted by the more modern variometer type regenerative set at the right which has been in use but a short time but has already shown its mettle. It is of the widely known type, using two variometers and a vario-coupler.

The antenna in service at the present time is a bit out of the ordinary but also very efficient. I have four wires in the shape of a horizontal fan, the free end covering directions from southwest to southeast, the separation at the free end is slightly over eight feet and the lead-in end ten inches, between each wire. The flat top length is eighty feet and the height is forty feet.

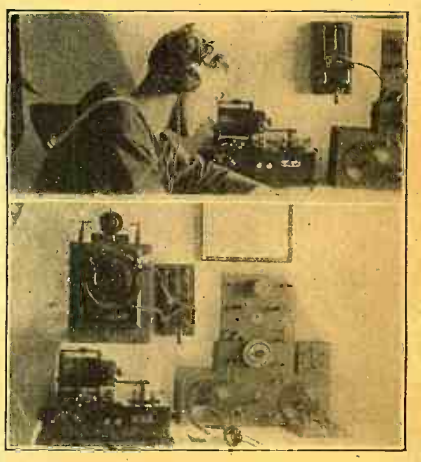
The transmitter has overall dimensions of 16½"x9"x9" and the audion panel, containing two variable condensers, is 12"x9"x6".

The phones used are Baldwins and am alternating between a VT and an audiotron bulb lighted by a 6-60 storage battery. Weather conditions have been unusually poor up here this summer and but little long distance has been covered.

Some time ago I wrote to the construction department of RADIO NEWS regarding the use of the small phonograph records for sale in all Ten-Cent Stores as indicating dials for radio instruments. Their adaptability to this purpose can readily be seen in the photos of my apparatus.

These records can be purchased at any of the large Five-and-Ten-Cent Stores in the country. Care should be taken to get two of the same number as some are slightly larger than others. The scales can be laid off with a protractor and narrow lines cut into the surface with a sharp knife or with a razor blade, and then filled in with white ink such as photographers use. If a numbered dial is desired Roman numerals can be easily made if care is taken, as they consist of straight lines and easy to cut.

H. F. KOHNITZ,
U. S. Navy Radio, Duluth, Minn.



Three Cheers for the Navy. Mr. Kohnitz Is Still In the Service and Is Going Strong. Transmitter and Receiver Layout of Real Merit.

Junior Radio Course

Early Forms of Detectors

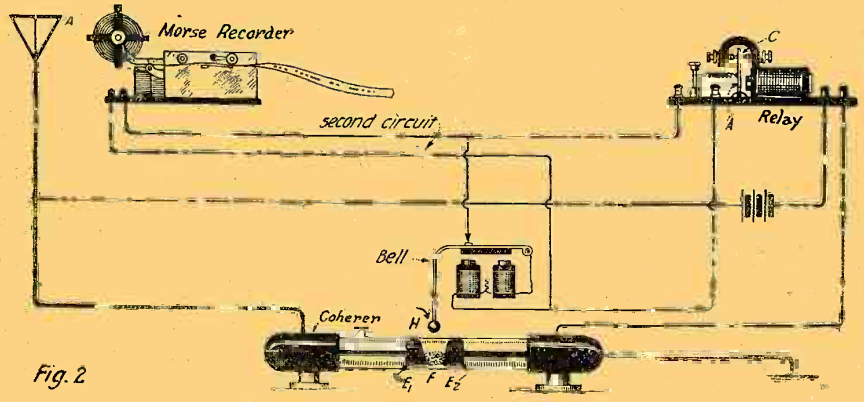


Fig. 2

This Is the Way the Marconi Coherer Is Made to Intercept Radio Waves in Such a Manner That the Waves Cause a Sensitive Relay to Respond and in Turn Operate the Morse Ink Recorder. An Additional Battery Must of Course Be Placed in Series with the Second Circuit.

NOW that we have studied the general outlines of the receiving circuit from an amateur point of view and that we have explained what is supposed to take place in a receiver from the time the radio signals are pickt up by the aerial and heard within the telephones, let us look into the whys and wherefores of receiving a little more closely. We can do no better thing just now than to take up the history of early detectors.

In order that you have a better understanding as to the reasons which led up to the wonderful development of present-day detectors, the vacuum tube in particular, it is necessary that we first devote a little time to the several pioneer forms of receiving radio waves. To the old-timers of radio telegraphy such instruments as the Coherer and the Magnetic Detector make them think of the science as youthful beginners would think of Noah's Ark. In other words, the Coherer days may be said to have been the *beginning* of the beginning.

THE COHERER.

In its first form the Coherer consisted of a glass tube having two metal electrodes arranged in a plunger fashion within the inside of the tube which enabled them to be drawn closer or farther from a given center point. A small space remained in the center in which was placed a large number of very small pieces of some suitable metal. This metal was composed of small granules or filings of pure nickel to which had been added a small percentage of silver.

Note well Fig. 1 for a better understanding of what we have just said. E, E are the metal electrodes which are heavily silver plated. P, P are the plunger rods which are, of course, adjustable. T is the glass tubing, while F are the filings we have just mentioned.

Professor Branly, a French scientist, is the man generally credited with having developt the Coherer to a point where it could be used as a radio wave indicator of much greater sensitiveness than the forms which were then used. It was, however, greatly improved by Marconi along the following lines:

Consider Fig. 2, where the Marconi Coherer consists of a glass tube with two electrodes having wedge shapes as shown so that when the bell-hammer H taps against the side of the tube there will be no jamming of the metal filings F. The tube, of

Fig. 1

General Scheme of an Early Form of the Coherer.

course, lies in a horizontal position. In order to secure dryness inside the Coherer, which is very desirable for proper operation, Marconi exhausted the tube of air so that in reality it was also a vacuum tube, tho much different indeed from the present-day vacuum tube or audion.

The manner in which this radio wave indicator was made to operate is as follows: When the aerial A pickt up signals transmitted by a distant spark coil, the waves were forced to travel thru the Coherer on their way to the ground G, as represented by the heavy line. However, since the waves had to pass the two electrodes, E-1, E-2, they caused a decrease in the natural resistance of the filings placed between the two electrodes. Now, since the two ends of the electrodes were connected to a small battery and a sensitive Relay, the *decrease of resistance* was just sufficient to cause enough electricity to flow thru the magnets of the relay so as to make its armature A close the contact points C. Of course, under ordinary conditions, that is when no waves are flowing thru from the aerial to the ground, the natural resistance of the filings is too great to allow enough current to pass thru to the relay; therefore, the relay armature remains open.

To proceed in our explanation. When the waves have past thru and therefore caused the contacts at the relay to close, the bell-hammer H will begin to vibrate and at the same time will tap the Coherer tube gently and in such a way that the filings will be disrupted and brought back to their original *higher resistance.* In other words, the radio waves cause them to *cohere** and the radio signal having ceased, the bell-hammer *decoheres*† the filings. If it were not for this bell-hammer the relay would remain closed indefinitely even after the wave had ceased. At the same time that the bell-hammer is vibrating, enough energy is passing thru the second circuit to operate the armature of the Morse Recorder so as to cause it to print a dash or a dot upon a thin strip of tape. If the radio signal is a short one such as a *dot,* the relay armature remains closed a short time, while if the radio signal is a long one such as a *dash,* the relay armature remains closed a longer time. These short and long intervals are, therefore, recorded on a tape by means of a small inking pen.

Thus you have the original Coherer system which was the start of Marconi's fame. This system was very ideal for the reason that messages were recorded either by sound upon a sounder or bell, or graphically recorded upon a piece of tape so that if the instruments were all properly tuned and adjusted there was no need of an operator being constantly on duty. On the other hand, the great fault was that the Coherer was not sensitive to *feeble* radio waves, such as those coming from a long distance. In fact the instrument was hardly effective beyond fifty miles unless a very powerful transmitter was used at the sending end. For that reason the fame of the Coherer was short lived and the radio scientists cast about for a more sensitive radio wave indicator or detector.

THE MICROPHONE CONTACT COHERER.

A very simple form of Auto-Coherer or Detector is the one shown in Fig. 3 which employed a microphone contact. Indeed, this is probably one of the earliest forms

* *Cohere—to stick together; to hold fast as parts of a mass.*

† *Decohere—to loosen from a common mass; the disconnection of particles.*

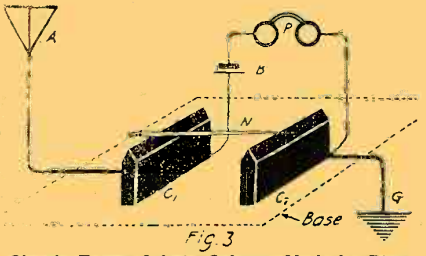
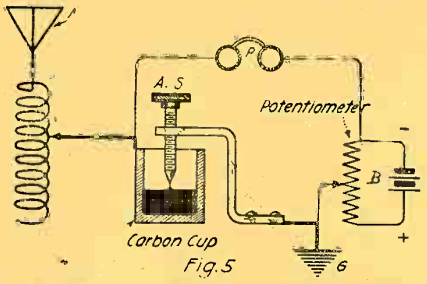


Fig. 3

Simple Form of Auto-Coherer Made by Placing a Needle Upon the Top of Two Small Carbon Blocks.

of receiving devices employed in the radio art and dates as far back as 1879.

Two small carbon or graphite blocks C-1 and C-2 are placed on a horizontal base



This Is the Bare-Point Electrolytic Detector Using a Wollaston Wire and a Small Carbon Cup.

with their upper ends sharpened to a knife-like edge. A short length of steel wire, or sewing needle is placed on top of the sharp carbon edges in such a manner that when radio waves pass thru from the aerial A to the ground G there is likewise a decrease of resistance in the battery-phone circuit (B P). This change of resistance causes a microphonic buzz in the telephone receivers P which is heard by the operator. Altho this form of detector proved very unreliable and impractical it was, nevertheless, a step in the right direction and led to the development of the Crystal Detectors which we are all familiar with. Its chief advantage over the Coherer is that it was *self-restoring* and did not necessitate the the complicated arrangement of the tapping Decoherer shown in Fig. 2.

THE ELECTROLYTIC DETECTOR.

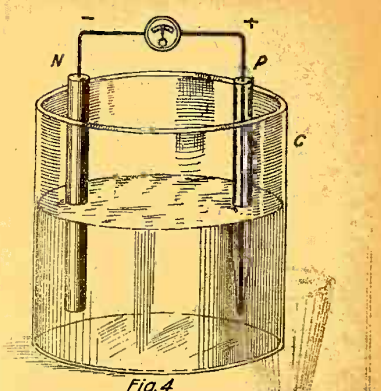
As we have already said, the Coherer receiving device as well as its modified forms even after it had been developt to a fairly satisfactory stage, proved effective only for very small distances, possibly up to one hundred miles, as compared to the thousands of miles ordinarily met with at the present day. This need led to the invention of many forms of detectors by British, German, French and American investigators. So many were devised, in fact, that several lessons could easily be entirely devoted in describing them. This is hardly necessary because there is no need of their being brought to your attention at present when there are so many and more important subjects yet to be discust.

By abandoning former systems of *visual* and *loud-responding* arrangements such as those employing the Coherer, one of the most useful and sensitive electrical devices was brought to the aid of the radio art in the form of the Telephone Receiver. By means of its use all manner of detectors were at once possible. The Electrolytic Detector is one which proved very effective and sensitive and radio distances jumpt from 50 miles to 500 miles, and more, without employing higher power transmitters than were then in use. According to radio history it would seem that the Electrolytic Detector was developt by several radio scientists namely Messrs. Ferrié, Fessenden and Schlömilch something like fifteen years ago.

Fig. 4 shows a simple form of the Electrolytic Detector. C is a very small glass cup or container. N is a metal electrode which forms one side of the circuit and which is connected to the negative end of a small cell. P is a glass tube thru the center of which has been enclosed a very fine platinum wire coated with silver. This is known as Wollaston wire. The glass tube comes to a sharp point at the part immersed in the liquid or electrolyte, which is pure distilled water to which has been added a percentage of nitric or sulfuric acid in the proportion of 4 to 5 parts water and 1 part acid. At the end of the sharpened glass point the very fine platinum wire protrudes for a very short distance. The arrangement is in reality a very small primary cell so that if it were connected to a sensitive galvanometer the indicator would show the presence of a very minute amount of electricity.

Fig. 5 shows another type of Electrolytic Detector—the so-called bare-point type—from which we may derive the following explanation. As soon as electromagnetic oscillations, or radio waves, are pickt up by the aerial A, and travel thru the little cell on their way to the ground G, a slight increase in the natural current of the Electrolytic Detector takes place so that with the assistance of the current B, regulated by the potentiometer, a clicking or buzzing sound is heard in the telephone receivers P, corresponding to the dots and dashes of the radio signals. As soon as the oscillations cease, of course, the current in the circuit flows to a normal value and remains that way until new oscillations are received.

In this type of Electrolytic Detector one of the electrodes is formed by means of a small carbon cup instead of glass, while the fine Wollaston wire protrudes at the point dipping into the acid which eats up the silver coating until nothing remains but the platinum wire which is then practically invisible. The adjustment screw A. S. permits the raising or lowering of the point until a suitable adjustment has been secured, which in this case is usually at the very top of the liquid and in such a manner that the wire draws up a small amount of acid in the hump form shown in this illustration. The electrolyte in this instance is a 10% to 20% solution of nitric acid.



One Type of Electrolytic Detector. It Is Really a Small Galvanic Cell as May be Proved by a Sensitive Meter.

The disadvantage of this form of detector is that it was very sensitive to external shocks causing the hump of liquid to frequently separate itself from the wire thereby opening the circuit. Another disadvantage is that heavy static or loud signals cause the point to frequently burn out. These undesirable conditions necessitate frequent adjustments and altho the Electrolytic Detector proved very useful and sensitive for several years it was abandoned as far as practical radio telegraphy is concerned and was replaced by various forms of Crystal Detectors.

In our next lesson we shall describe the Marconi Magnetic Detector as well as several forms of Crystal Detectors or rectifiers which have been widely used, and a suitable analogy of their action will be given.

QUESTIONS FOR THIS LESSON.

1. What is the Coherer Detector?
2. What was the disadvantage of the Coherer and why was it discarded?
3. What important electrical instrument permitted the development of crystal and other forms of detectors?
4. Describe the microphonic-contact detector.
5. Describe the Electrolytic Detector.

Dictionary of Technical Terms Used in Radio Telegraphy and Telephony*

Potential Slope—The curve plotted for graphically showing difference of potential between any given points of a uniform resistance. Variation of potential due to any cause.

Potentiometer—A device for tapping off any desired fraction of an existing Potential drop and for applying it to the points required. It is quite distinct from an ordinary variable resistance.

Poundal—F.P.S. Unit of Force. That force which acting on a mass of one pound gives it a velocity of one foot per second. Equal to 13,825 dynes, C.G.S. Units.

Power—Rate of doing work. See Horsepower, Force de Cheval, and Watt.

Power, Apparent—In an A.C. circuit is the product of Volts by Amperes.

Power Electric—See Watt.

Primary Cell—See Simple Cell, Bichromate, Bunsen, Clark, Daniell, Dry Cell, Grove, Leclanche, and Weston Cell.

Primary Circuit—First circuit. A circuit supplying current to another which is called the secondary circuit.

Primary Tuning Inductance—Variable inductance in the primary closed oscillatory circuit.

Protractor—An instrument for measuring angles. Generally in form of a semicircular piece of brass or celluloid, graduated in degrees.

Pt—See Platinum.

Puncher—See Perforator.

Pyrites—Compounds of iron and sulphur. Three most important are Ferrous Sulphide, FeS, the Bisulphide, FeS2, and an intermediate one known as Magnetic Pyrites, Fe3S4.

Quadrature—Two currents differing in Phase by a quarter of a period.

Quenched Spark—A form of spark which, owing to the arrangement of the discharger, extinguishes itself rapidly after allowing a few oscillations to pass, thus permitting the secondary or aerial circuit to oscillate with its own natural frequency without interacting with the primary.

Quicklime—See Calcium Anhydrous.

Quicksilver—See Mercury.

Quod Vide—Q.V. Which see. Refer to.

Quenched Spark Transmitter—A radiotelegraphic transmitter employing a quenched spark.

Radiating Circuit—One which radiates, i. e., throws out energy in form of ether waves. The aerial circuit.

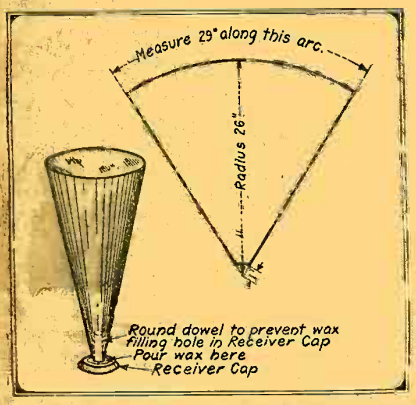
Radiation—The transmission of energy thru space in the form of electromagnetic waves. If these waves are very short, namely, a small fraction of an inch, the radiation is called heat or light; if the waves are much longer the wavelength being measured in feet or miles, it is called electromagnetic radiation.

(*Continued on page* 187)

* *This Dictionary was started in our March issue*

Junior Constructor

A LOUD SPEAKING HORN FOR AMATEUR RADIO STATIONS.



A Loud Speaking Horn Constructed Along These Lines Has Given Mr. Templeton Good Service.

Most of the radio amateurs I know desire a loud-speaking horn for their station. I describe herewith such a horn, which I constructed and which has given me good service.

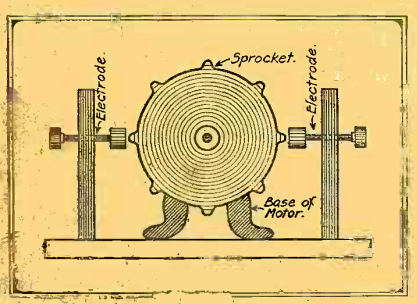
To build the horn, first secure a sheet of bristol board, or some similar material, and cut it out as in the accompanying sketch. This piece is next rolled into the shape of a cone, and fastened. For fastening I used some good glue and reinforced the seam with black linen thread, sewing it with a needle for most of its length. When the glue has dried cut off the point of the cone, leaving a hole of about ½ inch inside diameter. The dimensions given will make a horn 24 inches long, with a 9 inch opening at the large end, and allow ½ inch of material for the seam lap.

Now secure a receiver cap (a 25-cent one from any electrical supply store will do). Cut a piece of wood into a dowel that will snugly fit thru the hole in the receiver cap.

Next, place the cap, *with the threaded side down,* on a table top. Push the dowel into the hole and support the horn so that it will stand upright, the dowel fitting thru the small end of the horn. While the outfit is in this position carefully pour some melted black sealing wax into the depression of the receiver cap, around the horn. When the wax has hardened *carefully* remove the dowel, and the horn is ready to use. You may now screw your best receiver into the cap and connect up, placing the horn in any position desired. Any standard 'fone will fit the horn. As a last touch, a coat of black insulating varnish on the horn will make as nice appearing piece of apparatus as one could desire.

Contributed by D. B. TEMPLETON.

BICYCLE SPROCKET ROTARY GAP.



Yank Your Dad's Old Bicycle Out of the Cellar and Use Its Sprocket Like This.

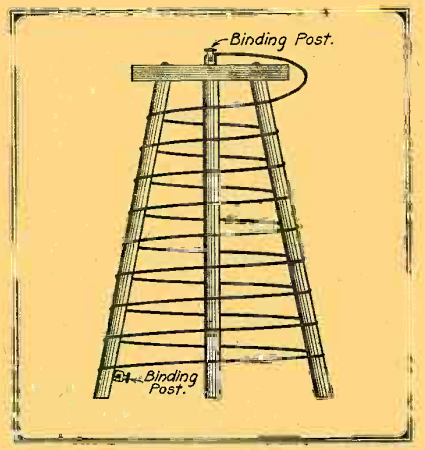
I have been experimenting with the radio telegraph for some time and like many others I have found that a rotary spark gap works much better with a transmitter set than a stationary gap does. I know there are a lot of young boys who would like to have a rotary but somehow cannot afford one.

I have found how to make one that will work well with a set and will not cost much. First go to some bicycle shop and get a rear wheel sprocket with about ten teeth on it, then get a piece of hard fibre and make a plug that will screw in the hole, put a hole thru the center and fit it on the shaft of a small motor, place the motor on a base and then put some electrodes on and you will have a very satisfactory rotary spark gap. The construction of this rotary is of course similar to others, what is new in this one is the use of a bicycle sprocket.

Contributed by WM. EDWARD MOORE.

EASILY CONSTRUCTED HELIX.

Here is a sending helix which may be constructed by the average amateur in very short order making use of a few odds and ends.



Three Sticks of Wood, a Small Upright and Some Heavy Wire with Two Binding Posts and a Few Screws Make This Helix.

The legs of this simple inductance are 11" long and the round top disc is 5½" in diameter. The diameter of the legs and disc may be 1" or so. Use No. 10 B. & S. copper wire and wind this around a lard bucket after which slip it off and stretch the spiral until each turn is about 1¼" apart. After this fasten the ends of the inductance to the binding post as shown in the above sketch.

It is of course essential that a suitable cone shape form, such as the above mentioned bucket, be used in order to shape the coil as illustrated.

Contributed by BILL JOHNSON.

WATCHCASE GRID LEAK.

A simple and very nice looking grid leak may be made with an old watchcase. Cut a piece of white drawing cardboard to the size of the watch face. This may be fastened on with small screws as the face was.

Punch the holes for the small short screws and draw heavy pencil lines around each to make good connection.

Connect wires to these screws on the back of the cardboard. The wires are brought out thru the stem.

This compact grid leak may be secured to the panel by means of screws thru the back of the case.

Every Real Boy Has an Old Dollar Watch Laying Around. Use the Case For a Grid Leak.

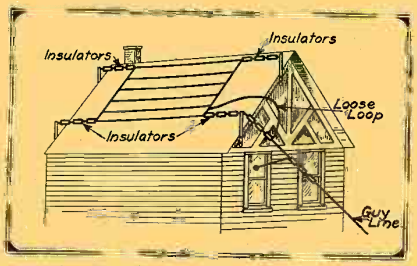
When finished it makes a good instrument and may easily be varied by removing the front glass.

Contributed by FREDERICK METCALF.

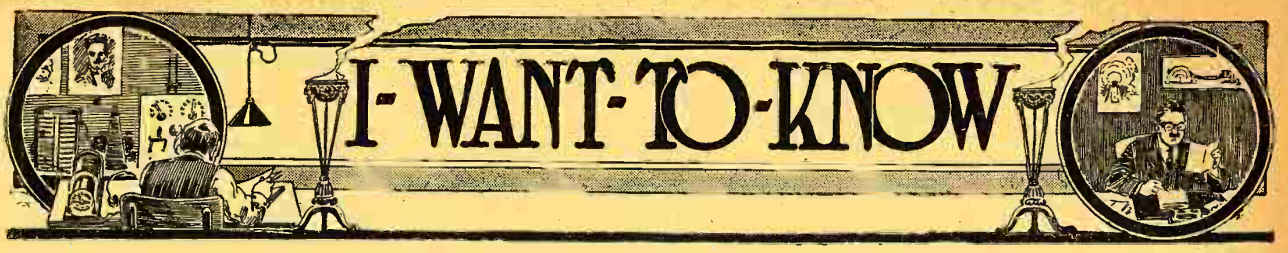
NEVER MIND THE MAST.

One of the chief difficulties encountered by the amateur station builder is the erection of a suitable mast or antenna support. This may be dispensed with and good results obtained from an antenna stretched over the roof of most any house. The sketch shows how the antenna may be placed on the ordinary sloping roof house. The wires need not be elevated from the roof more than a foot or two, altho the higher the better. Two pieces of stout wood, two inches by four inches, will be sufficient, fastened at each end of the room form the supports for a square or rectangle of wire, insulated by several porcelain cleats in series at each support. Across this square or rectangle may then be connected as many wires as desired and the lead in wires taken off wherever most convenient to the entering insulator. The strain of the leading in wires should be taken up by one of the uprights and slack allowed from there to the connection to the antenna proper in order that it be not subjected to any strain or pull from the lead-in. If such an antenna on one side of a roof is not sufficiently large a similar one on the opposite side of the roof might be built and the two connected together. Pull all wires fairly tight to prevent sagging and possible grounding, and remember what happened to Dr. Cook of Polar fame, because of poor connections. Therefore SOLDER, SOLDER, SOLDER.

Contributed by GEO. F. PATRICK.



Forget the Tall Masts, Says Patrick of New Orleans—Do It This Way.



THIS Department is conducted for the benefit of our Radio Experimenter. We shall be glad to answer here questions for the benefit of all, but we can only publish such matter of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to pencilled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editor a personal favor if you make your letter as brief as possible.

NUMBER OF AMATEURS WITHIN 800 MILE RADIUS OF NEW YORK.

(202) Eduard Hubner of New York City, asks:

Q. 1. About how many amateurs are there with an an 800 mile radius of New York City?

A. 1. We cannot answer this definitely. Offhand we would say that there must be approximately 20,000 radio amateurs of all descriptions located within the above area. This of course includes all manner of experimenters who use transmitters as well as those who have small receiving sets which does not necessitate a license and where of course it is impossible to obtain an accurate record.

Q. 2. Where may I purchase a large transmitting bulb like the one used by Mr. Gowen in his excellent article which appeared in the April issue of RADIO AMATEUR NEWS?

A. 2. We suggest that you write to the Deforest Tel. & Tel. Co., No. 1397 Sedgwick Ave., N. Y. City. They will gladly send you complete information concerning this tube.

THE RIGHT TO CONSTRUCT PATENTED ARTICLES.

(203) Allen L. Hall, Portsmouth, N. H., writes:

Q. 1. Can devices, instruments, etc., be constructed for personal use by experimenters which have been publisht in RADIO NEWS or in the ELECTRICAL EXPERIMENTER and which are patented but not made for sale?

A. 1. Yes, the experimenter may construct such patented articles providing it is solely for his own use and not for sale or personal gain. There have, however, been law suits based on this, tho rare.

METALS USED IN CONSTRUCTION OF VACUUM TUBES.

(204) Donald H. Selchow, Exeter, N. H., asks:

Q. 1. How may the capacity of a condenser (variable or fixt) be determined?

A. 1. This information was given under the title "Condenser Capacities and Constants", in the "I Want to Know" page of the June issue of RADIO AMATEUR NEWS, page 703.

Q. 2. What are the metals used for the grid, for the plate and the filament of modern vacuum tubes?

A. 2. The grid and the plates of vacuum tubes usually are made of copper and nickel, respectively, tho this may sometimes differ with various manufacturers. The filaments are usually of tungsten and in some cases coated with an oxide.

Q. 3. Please refer me to a book which deals with the complete construction of vacuum tubes.

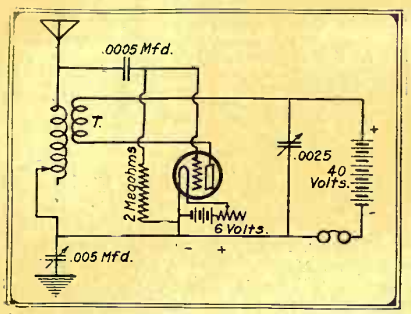
A. 3. We do not know of such a book. The manufacture of vacuum tubes is a highly specialized process, involving expensive apparatus as well as secret processes. There have, however, appeared articles on the construction of vacuum tubes from time to time in various publications. We refer you to page 279 of the December issue of RADIO AMATEUR NEWS which contains an article entitled "The Construction of Vacuum Tubes", by R. S. Hawkins. This article gives a very good description of the manner in which to go about in order to construct amateur vacuum tubes.

SPARK RECEIVER AND OSCILLATOR CIRCUIT.

(205) J. H. Schmidt, Mobile, Ala., writes:

Q. 1. Please publish a simple vacuum tube circuit capable of receiving either dampt or undampt signals.

A. 1. A circuit suitable for receiving dampt or undampt wave signals is shown on this page. This hook-up is simple yet reliable when used with the proper constants. It will be noted that there is but one variable inductance. This naturally is much easier to construct than the usual



A Simple Dampt-Undampt Circuit Employing One Single Inductance In Addition to a Tickler Coil.

loose coupler. A honeycomb or duo-lateral coil may be employed provided it is tapt at regular sections so that it may be varied by means of a multi-point switch. The tickler coil inductance should have a natural wavelength slightly below that of the tuning inductance except for very short amateur wavelengths, when these two coils should be about the same. When it is desired to receive spark, or dampt waves, the tickler coil coupling is loosened from the tuning coil to such a point that the circuit ceases to oscillate. On the other hand, undampt waves may be intercepted by increasing this coupling to the point where sustained oscillations are set up in the circuit. In the latter case, a musical note of any desired pitch is heard depending upon degree of detuning.

STANLEY'S TEXT BOOK ON RADIO.

(206) Leon Garais, Buenos Aires, Argentina, asks:

Q. 1. Are the Armstrong regenerative, and the Ultraudion circuits equivalent and are they suitable for the reception of undampt waves?

A. 1. Altho these circuits are not the same, they are modifications of each other and accomplish the same end. They may be used for the reception of spark or arc signals. The regenerative or "tickler" circuits are applicable to long waves provided the feed back coil has enough inductance to keep the vacuum tube oscilalting at the consequent lower frequencies.

Q. 2. Where may I purchase a copy of Rupert Stanley's Textbook on Wireless Telegraphy announced in the February issue of RADIO AMATEUR NEWS, and what is the price?

A. 2. We suggest that you communicate with the publishers, Messrs. Longmans, Green & Co., 443 Fourth Ave., New York. This work comes in two volumes at $10.00 for the two.

SYNCHRONOUS AND NON-SYNCHRONOUS ROTARIES.

(207) Wm. L. Jepson, Brooklyn, N. Y., writes:

Q. 1. Would an umbrella type aerial, 20 ft. high, composed of 12 strands of No. 14 wire, each 30 feet long, be as efficient for reception as one 300 foot single wire span?

A. 1. It is a matter of individual requirement and purpose rather than efficiency. The umbrella type aerial you mention would prove quite effective for short wave reception such as from 200 to 600 meters and possibly more. On the other hand, the 300 foot antennae would prove useful for long wave reception and particularly for undampt long distance work.

Q. 2. Please explain the difference between a non-synchronous and synchronous rotary spark gap.

A. 2. Ordinarily, a rotary spark gap consists primarily of a wheel having projecting points with a stationary electrode on each side of the wheel. The spark jumps from one stationary electrode to one of the moving points flowing across the wheel and then, after leaving the corresponding gap on the other side, passes out of the second stationary electrode. The number of sparks per second is thus determined by the speed of the wheel, which is motor driven, and, therefore, signals of a very high pitch are produced. This system of spark gap is known as a "non-synchronous rotary". A. for the "synchronous rotary gap", the speed is so maintained as to bring the knobs near each other at just the moment when the high potential alternating voltage upon the condenser reaches its maximum value, positive or negative. Thus, 500 cycles will produce 1000 sparks per second. This regular occurrence gives smooth and efficient operation, and a pure musical tone. This synchronizing is made possible by attaching the rotating spark gap element to the shaft of the motor-generator which charges the condenser. This sort of gap is called the "synchronous rotary spark gap."

CORRESPONDENCE FROM READERS

A LETTER.

Editor of RADIO NEWS:

Sir—I feel I must just write you a few lines thanking you for the great benefit I have received from your very fine magazine. Unlike your contemporaries, you treat radio fair and square in all phases. The part I most appreciate is the space you donate to the English amateur. Being an Englishman I can see how this help binds the two great countries who are raising the radio art to its justified place in the world. Co-operation of American and English amateurs, aided by sane radio legislation, will, I am sure, be the means to an end to accomplish this.

I have a station (3F1) located at above address, serial 130 feet long, two wires 6 feet spread 75 feet high, 3,000 metre coupler crystal receiving set can copy New York and many other places, also N.A.A. I just recently made a new departure in earth connections. I dug a hole 4 feet deep in which I sunk a pail full of water; into this I dropt 50 inches of wire in a coil and soldered the lid on. I find that the signal strength has improved 50 per cent.

Yours for another successful year of RADIO NEWS,

MR. H. L. VAUGHAN.
273 Roxton Road, Toronto, Canada,

IS SYRACUSE, N. Y., ON THE RADIO MAP?

We recently wrote to J. E. B., a correspondent in Syracuse, asking him to send us news of the doings of local amateurs. His reply was short and sweet and to the effect that if there were any amateurs in Syracuse and its vicinity he had yet to hear of them. He went on to say that the majority of Syracusians were "apple eaters" and not wireless hams.

Is this so? And if so, how come? The editors of RADIO NEWS would like to hear from some other correspondents residing in Syracuse, for we believe the above statement unfounded.

BREAKING UP THE H.C. OF GRID CONDENSERS.

Editor RADIO NEWS:

While trying out a new hook-up when the regular grid condenser was nowhere to be found, having been lost, strayed or lured away from home, I hastily hit upon using an old burnt-out audiotron in its place. Using the grid as one electrode and the plate as the other, signals from a distance of 1500 miles were copied with the customary receiving set consisting of coupler, loading coils, audion, and condensers.

I hope that this will be of value to some stray reader or two who may be shy a grid condenser.

ALLEN HART,
c. o. Service Radio School.
902 Pa. Ave., N. W., Washington, D. C.

SHORE READING ROOMS FOR OPERATORS AFLOAT.

Appreciate RADIO NEWS very much indeed, as I find all the boys afloat do. Steps should be taken to maintain some sort of club headquarters in connection with establisht Club at Colon, Canal Zone, where different Radio publications could be obtained, and where the many radio operators arriving there could meet, in fact this should be done at all large ports; hardly a separate club, but some connection with establisht ones of near character.

S S San Jose, of the San Francisco and Canal Zone run.

WM. WOODRIDGE,
Room 410, 268 Market St.
San Francisco, Calif.

WHO WAS THE FIRST LADY "OPR" ANYWAY?

Editor RADIO NEWS:

I am writing you in regard to a story publisht in your March number of the RADIO AMATEUR NEWS entitled "The Autobiography of a Girl Amateur." The young lady does not give her name so I cannot direct this letter to her personally.

In her article the young lady refers to a Miss A. G. Parker as being the first lady operator on the Atlantic and most likely in the world. It is my desire to contradict this statement and most likely the records in the New York office of the Radio Corporation will confirm my statements.

As the young lady stated in her article probably some old timer would slap down his aerial switch on her and so here goes.

I think the Pacific coast can really boast of having the first real honest-to-goodness lady radio operator. Her name was Mrs. Turner who was radio operator on the *S S Indianapolis* running between Seattle and Tacoma, Washington. She held down that job the entire summer of 1909. And the Pacific coast can say that it had two other lady operators before Miss Parker's time. One was Miss A. J. Lindsay who was holding down old "PO," the Portland Hotel, Portland. Oregon, from about the first of May 1910 until some time in the winter of that same year. And another Miss Godfrey who held down "DW," Everett, Washington, from the early part of June, 1910, until the station was closed down in November of the same year. I cannot give you the exact dates of these appointments as upon inquiry at the office of the Radio Corporation at Seattle, I learned that these records had been destroyed but was told that I could probably get them from New York if I cared to take the trouble to write for them. And another lady operator we had out here was a Miss May Belle Kelso who had a "Certificate of Skill" and was operator on the *S S Mariposa* sailing between Seattle and Seward, Alaska. The *Mariposa* belonged to the Alaska Steamship Company of Seattle.

I was personally acquainted with all these young ladies in question with the one exception of Mrs. Turner.

And I am very well acquainted with Miss Kelso as after she was relieved from duty on the *Mariposa* she was placed on the land line in the city office of the United Wireless Company in Seattle, and as I was at that time in charge of the old University Campus station of the "United" I had every reason to become well acquainted with her as she was a large failure as a wire operator and I used to have to send to her at the speedy rate of about ten words per minute for a long time until she was able to handle the wire fairly well before she left the office. During the time she was operator on board the *Mariposa* she was in a slight accident while in Alaskan waters and according to report conducted herself very well. The *Mariposa* tried to go up town at a small town by the name of Valdez but only succeeded in cutting her way thru about fifty feet of the wharf. She then decided it was too hard a job to travel overland and stopt. (*Hallett means the ship—Ed.*)

I would like to have this letter brought to the attention of the young lady who wrote that article in the March issue and as her name is unknown to me I am taking this medium of reaching her and am very much in hopes that it will reach her directly or thru the RADIO AMATEUR NEWS.

Yours truly
G. C. HALLETT.
141 East 54th Street, Seattle, Wash.

Good for you, George, for being acquainted with so many young ladies. You must indeed be a popular young man with the fair ones, and we envy you—we were not so fortunate when we, too, sailed the seven seas in search of Love, Romance, Adventure and clear Havana cigars back in 1912. *On the other hand, shame on you for so besmirching the professional "rep" of Miss Kelso. It is not at all chivalrous nor Sir Walter-like. Our only hope is that Miss K. will read these lines and answer you accordingly.—The Associate Editor.*

To Amateurs, Professionals and Others

LAST November and December we started a correspondence page where we intended to publish some of the many letters we receive each month from our ever-increasing hordes of readers.

ALAS, for our good intentions! The press of important matters and the necessity of finding space for some important contributions caused us to set the above correspondence heading in a far corner of a lower drawer of our editorial desk and there it has lain for many months. Incidentally, many interesting letters have accumulated meanwhile, some of which have become outlawed, as it were.

NOW we wish to resume this page so that our readers may be given the opportunity to express their likes and dislikes, their views on timely radio topics, criticisms, comments, something new they have seen or heard, and in general, WHAT THEY THINK.

COME on, fellows, you know what we mean. Let us hear from you one way or the other. Pretty hot weather and all that sort of thing but nevertheless WRITE IN—WRITE IN—WRITE IN. Make this page your stamping ground—well, if you like it better, your writing ground, then.

MAKE your letters dignified, conservative and ethical if you so wish, or make them gossipy, newsy, humorous or timely; it does not matter. Just let us her from you, it will be a pleasure to read you and afterward print the letter if it is the least bit interesting to others.

—*The Editors.*

ROBINSON BROTHERS AT IT AGAIN.

Editor RADIO NEWS:

It may be of interest to you and your readers to know that we have just received a letter from Mr. I. W. Copeland, D. D. S., 8-JM., Ashland Ohio, stating that he has heard our radiophone very clearly at that point, and that both voice and music come in very QSA on a one-step amplifier, using honeycomb coils.

You will recognize that this is quite remarkable for a little set, radiating less than one ampere, as the distance is approximately from 600 to 625 miles, air line.

Thinking that this may be of more than passing interest to the radio fraternity in general, showing the advantages of C W, etc., we are, out for still greater records,

HUGH AND HAROLD ROBINSON.
"2QR," 13 Walnut Street, Keyport, N. J.

(*Continued on page* 181)

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 188-190

"Wired Wireless" Experiments in the U. S.

(*Continued from page* 134)

The staff at the Signal Corps Laboratory at the Bureau of Standards experimented with bare wires laid in fresh water with satisfactory results.

Telephone and telegraph communication was established between Fort Washington, Maryland, and Fort Hunt, Virginia, across the Potomac River below the city of Washington. As in the previous experiments, a bare No. 12 phosphor bronze wire was strung in the water. The transmitter was an electron tube oscillator which delivered a current of about 270 milliamperes to the line at a frequency of about 600,000 cycles a second. At the receiving end of the line an electron tube and a 6-stage amplifier were used without any ground connection.

With this arrangement good tuning was obtained at each end of the line and telegraphic and telephonic transmission secured over the bare wires immersed in the fresh water.

When the vacuum tube is used by the insertion of a telegraph key in the circuit, to intermittently stop and start the oscillating waves, that is produce dots and dashes, it is possible by means of the oscillating audion to carry on radio telegraphy using undampt radio frequency waves.

When it is desired to telephone the key is omitted and the radio frequency or "carrier" waves produced continuously, except that it is varied or modulated in amplitude corresponding to the voice of the speaker at the transmitting station.

The wave passing from transmitter to receiver is of radio frequency and is called the "carrier" wave, corresponding to the wire carrying the voice current in wire telephony.

In connection with these experiments the Signal Corps also developed a reasonance wave coil. The coil is in the form of a long helix wound with a large number of turns on which the stationary waves are produced by the incoming radio signals. An electron tube is used as the detector, the grid being connected to the point of maximum potential on the coil.

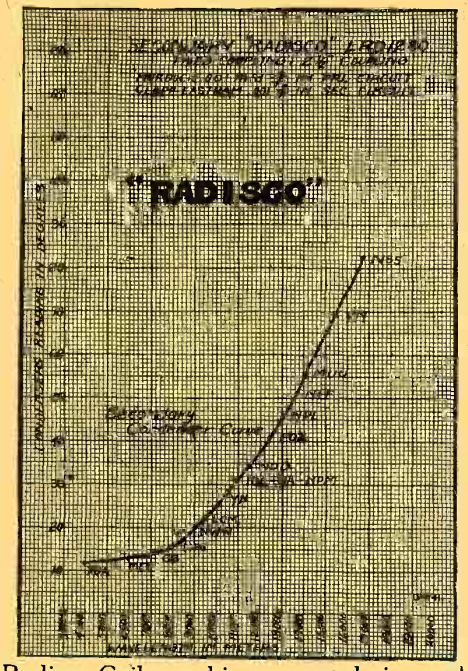
The reasonance wave coil may be used either as part of the usual antenna system or part of a line wire, or it may act itself as the antenna for picking up the energy of the signals. In the latter case the coil may be either free at both ends or grounded at one end. Good results have been obtained in either case.

It has also been found that the open coil has directional properties and can be used as a goniometer not only for horizontal measurements, but for vertical measurements as well. This form of radio goniometer has that great advantage that it permits not only of determining the planes where the signals are strongest, but also the direction from which such signals proceed.

In the older art of ocean telegraphy the elaborateness of line construction has already reached a practical limit. The best Atlantic cable of the present day is limited in operation to electric waves of frequency of the order of 10 per second. The electrical construction is such as to limit the potential employed on any long cable to from 50 to 80 volts. The relative values of the line constants in any ocean cable preclude the possibility of ocean telephony.

The most promising hope of improving the line construction of ocean cables, therefore, would be to abandon the present method of design and construction and to start with the simple case of bare wires in water, using high frequency currents and study the necessary changes to produce optimum or best transmission.

(*Continued on page* 164)

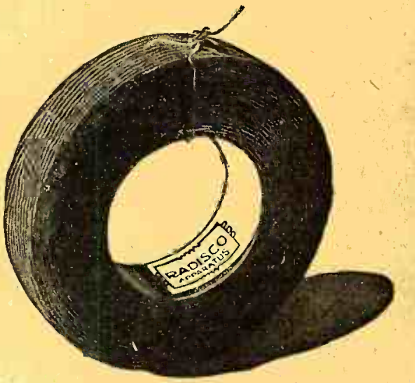


The Performance of RADISCO COILS Long Wave Work

Every radio man knows that the service derived from universal wound coils has been proven to be more efficient than bank wound or pancake inductances.

As a performer in long wave reception they rank highest. The curve illustrated herewith proves our contention; this curve, prepared by a first district man, shows the actual performance of Radisco Coils for long wave work.

The main features to be considered in purchasing coils is the correct design, size of wire and character of insulation; another important point is structural strength, and last but not least, is price consistent with the cost of manufacture.



Radisco Coils combine correct design and material, good appearance and reasonable strength, with creditable performance and prices that are not excessive. Made in 17 sizes, tapped and plain, wave length range from 200 to 20,000 meters. Priced from 70c to $4.85.

You can duplicate such work with a set of these inductances, which can be had from any of our agents listed below.

In purchasing these coils be sure that the trade mark "RADISCO" is on every one you buy and be sure of getting serviceable apparatus of proven merit.

ALBANY, N. Y.
E. L. Long,
21 Magnolia Terrace

ATLANTIC CITY, N. J.
Independent Radio Supply Co.,
118 So. New Jersey Ave.

BALTIMORE, MD.
Radio Engineering Co.,
614 No. Calvert St.

BEINVILLE, QUEBEC, CAN.
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Co.,
88 Broad Street
Branch: 15 Temple Street,
Portland, Maine.

BROOKLYN, N. Y.
Kelly & Phillips Electric Co.,
312 Flatbush Ave.

CHICAGO, ILL.
Chicago Radio Laboratories,
1316 Carmen Ave.

EUREKA, PEORIA ILLINOIS
Klaus Radio Co.

KANSAS CITY, MO.
McCreary Radio Supply,
4th & Delaware Sts.

LOS ANGELES, CALIF.
The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.
K. & L. Electric Co.,
427 Olive Street

NEW ORLEANS, LA.
L. A. Rose,
121 Camp Street

NEWARK, N. J.
A. H. Corwin & Co.,
4 West Park Street

NEWCASTLE, PA.
Pennsylvania Wireless Mfg. Co.,
507 Florence Ave. "8HA"

OMAHA, NEBRASKA.
O-B Radio Supply Co.,
406 Brown Building.

PHILADELPHIA, PA.
Philadelphia School of Wireless Telegraphy,
Broad and Cherry Streets

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington Street

PITTSBURG, PA.
Radio Electric Co.,
3807 Fifth Ave.

SEATTLE, WASH.
Northwest Radio Service Co.,
609 Fourth Ave.

SCRANTON, PA.
Shotton Radio Mfg. Co.,
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.
Electric Service Co.,
585 Armory Street

ST. LOUIS, MO.
The Benwood Specialty Co.,
3424 Olive Street

TORONTO, ONT., CAN.
The Vimy Supply Co.,
585 College Street

WICHITA, KAN.
The Cosradio Co.,
1725 Fairmount Ave.

Responsible Dealers: Write for interesting sales proposition on Radisco apparatus

If none of the above agencies are in your vicinity or do not give you the desired information on Radisco Coils, communicate with

RADIO DISTRIBUTING COMPANY : : Newark, New Jersey

(*Continued from page* 162)

The use of a high frequency "carrier" has the inherent advantage that the distortion phenomena accompanying present methods of long distance telephone transmission are eleminated, and we are principally concerned with the problem of attenuation. The most suitable voltage may be employed and present multiplex methods may be utilized. The electron tube is available for both the generation and the reception of the waves.

Data worked out as a result of all these experiments was presented to the scientists. Dr. Squier stated, however, that "The phenomena associated with the transmission of high frequency waves over bare wires in the earth or water are obscure and complex and that he had not formulated a definite theory at the present time."

"Wired Wireless" Experiments in Germany

(*Continued from page* 135)

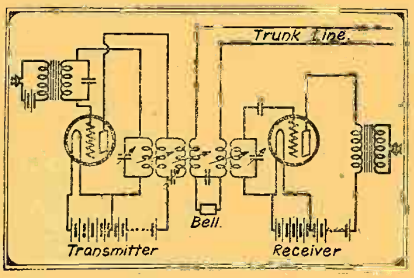


Fig. 1. Schematic Wiring Diagram of the System as Applied to Multiple Telephony.

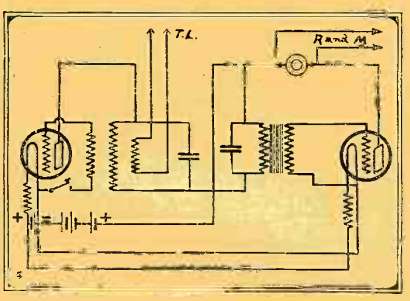


Fig. 2. Schematic Diagram of Connections for "Wired Wireless" Telegraphy.

readily bridged during the war. The distance between Berlin and Magdeburg being covered with a transmitter tube of only .3 watt, without any intermediary amplifier. These, however, are by no means the limits in range; the distance between Berlin and Weimar having recently been bridged with a transmitting energy of only .03 watt on a 5 mm. copper line.

Vacuum tube transmitter sets with feedback coupling were used as sources of energy, altho successful experiments with another type of transmitting device offering special advantages are nearing conclusion.

POWERFULLY SPEAKING.

Ellan—"Russia ought to show great development in radio."

Tenna—"Why so?"

Ellan—"With all those Poles and the frequency of revolutions, there must be some power behind it."

L. E. THORPE.

Radio Frequency Amplification

(*Continued from page* 142)

so that changing the resistance of the secondary to secure the decrement required to pass the side frequencies affects the load on the tube. What is desired is to get as high a potential V_1 across the transformer primary as possible. This requires the load impedance to be high as compared with the internal tube impedance. Increasing r_2, therefore, militates against this and the best results can only be secured by careful adjustment of all of the factors, coupling, resistance and inductance to the frequency involved.

EFFECT OF TRANSMITTER DECREMENT AND ATMOSPHERICS.

It appears that this type of amplifier functions most effectively on incoming waves of low decrement and that atmospheric disturbances which are always highly dampt or else actually dead beat may be eliminated to a very considerable degree.

Curve "b" of Fig. 4 shows a train of oscillations in a receiving circuit such as would be produced by a spark transmitter operating at 3,000 meters wave length and decrement 0.12. The decrement of the receiver for this curve was taken as .08. Curve "a" is similar but drawn for an excitation of high decrement, 2.08, approximating a static disturbance of the same frequency as that to which the receiver is tuned, i. e., 3,000 meters. These curves can both be represented by equations of the form of the one shown in equation 1 at the beginning of this paper, in which the Fourier's series gives the equation of the envelope curve of the oscillations.

For the curve "b," that is, the case of smaller damping, the different amplitudes of the harmonics and of the constant term in the representative series are as follows:

$$\begin{aligned} V &= 7.86 \\ V_1 &= 12.23 \\ V_2 &= 5.92 \\ V_3 &= 3.72 \\ V_4 &= 2.09 \\ V_5 &= 1.56 \\ &\cdots\cdots \\ V_{10} &= 0.40 \end{aligned}$$

For curve "a" with high decrement the constants are:

$$\begin{aligned} V &= 23.6 \\ V_1 &= 38.4 \\ V_2 &= 24.0 \\ V_3 &= 19.2 \\ V_4 &= 14.3 \\ V_5 &= 12.2 \\ V_{10} &= 6.3 \\ &\cdots\cdots \\ V_{20} &= 3.36 \end{aligned}$$

The amplitudes of the fundamental and various harmonics in the two cases are plotted in Fig. 5 assuming the fundamental to be 1,000 cycles as in the usual spark transmission. It is seen that the amplitudes in the highly dampt signal fall off much less rapidly than those of the more lightly dampt signal. This means that in the former case a great deal of the total energy is contained in the harmonics, and if these are not past thru the amplifier, there will not only be distortion but loss in strength of signal as well. The use of a feebly dampt spark transmission with an amplifier tuned just sharply enough to pass the principal harmonics or side frequencies produced therefore gives a system which *largely eliminates static disturbances.*

In this respect the present arrangement is more effective than the ordinary radio fre-

(*Continued on page* 168)

(*Continued from page* 166)

quency amplifier. In the latter the presence of strong signal oscillations at the detector, after having past the amplifier, amplifies the static in the same way that a locally produced frequency would, so that when the receiver is tuned to the incoming signal very loud sounds are caused by the static. These diminish rapidly, however, *as the receiver is detuned,* because the signal energy then falls off and the ratio of this, the equivalent local oscillation amplitude, to the static amplitude being thus reduced there results a much greater than proportionate decrease in the endodyne amplification effect on the static, as has already been shown by Major Armstrong in another paper.* But in the new amplifier only the fundamental and the first few harmonics of the static impulse are amplified by these interactions and thus much of the energy of such disturbances is lost.

SUMMARY AND CONCLUSIONS.

The above discussion has referred particularly to signals produced by spark transmitters, but the same general considerations are involved in telephone transmissions, except that in the latter the harmonic side frequencies to be considered will not generally exceed 2,000 cycles. The only point concerned in the case of sustained wave reception is that involving the passage of the incoming frequency directly thru the amplifier and this should be avoided with sustained waves for the same reasons that have been given to cover spark transmission.

Several practical considerations have been omitted from the discussion. Of these one of the most important is the difficulty that is encountered in placing the circuits of a high frequency amplifier with their transformers in a box in such a way that sharp tuning may be obtained and yet not have the whole or part of the system go over into oscillation. This involves careful adjustment of the various couplings and the resistances of the circuits and the proportions and arrangements are usually different for every wave length. It is suggested that an improvement might be made in this type of amplifier over the circuits that have been drawn by Major Armstrong, in which he uses air core tuned transformers in all of the stages of the amplifier, by the use of a tuned air core transformer behind the first detector tube feeding the first stage of the amplifier and with the stages following this coupled by means of carefully designed iron core transformers. The latter keep down stray field, and it has been found possible to build such transformers so as to get practically the maximum attainable amplification from the tube. By this arrangement the sharpness of tuning required in the amplifier is furnisht by proper design of the first air core transformer, and the troubles experienced from coupling back, when several stages all tuned to the same frequency are employed, is avoided by the use of the iron core transformers which follow.

Two kinds of distortion are to be avoided. The first is caused by the passage of the incoming frequency directly thru the amplifier. The second is due to the more or less complete elimination of the harmonic side frequencies in passing thru the amplifier due to excessively sharp tuning. The type of amplifier in question is best suited to use on very short wave lengths, at least below 300 meters. At long wave lengths it is difficult to avoid distortion of the first of the two kinds mentioned which in the case of spark signals results in a mushy, harsh note. Above 600 meters this type of distortion may be expected to occur over a band of wave lengths from 15% to 30% above and below that for which the amplifier is designed.

As regards an estimate of the allowable

* *E. H. Armstrong—Proc. I. R. E., April,* 1917.

(*Continued on page* 170)

(*Continued from page* 168)

sharpness of tuning in different cases, it would appear that this lies approximately between the limits set by decrements corresponding to 0.2, as about the sharpest tuning allowable, to about 0.8 for the broadest tuning. The latter would not be allowable except perhaps for the reception of very short waves. These figures apply only to the case where several tuned transformers are used in cascade in the amplifier. If the arrangement using one air core transformer and the balance iron core broadly tuned instruments as just described be used, the tuning of the first air core transformer might be made considerably sharper than this, of the order usually found in ordinary receiving tuners.

In general, the basic frequency to be used in the design of the amplifier may be higher for long wave lengths than for short up to a certain point, the practical limit being in the neighborhood of 400,000 or 500,000 cycles for the reception of 6,000 meter spark signals. For very long waves the beat frequency cannot be made so high.

The analysis indicates that the amplifier can be made to be freer from interference from highly dampt spark stations and static disturbances than the usual types.

There is one other point that has not been mentioned altho I know it has already occurred to Major Armstrong himself. That is the question of the extent of the loss, if any, in effecting the change of incoming signal frequency to the value for which the amplifier is built. An experiment made at Camp Alfred Vail, N. J., in which the signal received on a simple non-regenerative tube was compared with that obtained by Major Armstrong's arrangement using a separate heterodyne, a rectifying tube for the super-audio note, and a detector tube, indicated that about equal signals were obtained by each method. Apparently the heterodyne amplification in the second case just about makes up for the loss which accompanies the change in frequency.

An "Amateur" Station Operated on a Commercial Scale

(*Continued from page* 143)

merly in charge of the *Times* station, and was abandoned because of the fact that it was found to have no directional value and merely resulted in a cutting down of the signal intensity.

Fig. 4 is a diagrammatic sketch of one type of antenna tried out by the Navy Department. Altho the sketch shows but one antenna, several of the same type were used in an effort to ascertain whether or not the Bellini-Tosi type of loop would prove advantageous here. Keeping the points B and C directly opposite each other this loop was swung thru an arc of 180 degrees without having any effect on the incoming signal. Later the whole was made into a complete triangle and used as a regular antenna by connecting it to one side of the primary circuit and the other side of the circuit to the ground. This, of course, resulted in greater signal intensity.

In connection with the above described apparatus many circuits were tried, but the results produced never justified making any changes in the set which is used for continuous copying.

One outstanding feature of the work done in the *Times* tower and the one which has baffled many of the radio engineers in New York is the fact that a loop antenna at this station has absolutely *no directional effect*. One of the best instances of this phenomena was observed from the fact that a loop of very large proportions, and, by the way, one of the finest pieces of engineering, was built and installed on the roof

(*Continued on page* 172)

(*Continued from page* 170)

of the twenty-fifth floor, under the direction of Mr. Lesh, which *could be rotated throughout a complete circle without causing any noticeable change in reception.*

This 10-foot loop is made of 3 x 3-inch wood section, pivotally mounted on a very sturdy base and braced securely above. On the cross-trees small porcelain insulators are attached by means of screws and the wire is wound around these insulators. In winding this loop a system of *banked winding* was employed and one complete turn was made, first on one side of the cross-arms then a complete turn on the opposite side of the cross-arms. Whether this system of winding loops has been used before is not known, but it has the effect of allowing the wires to be well spaced, and enough turns may be utilized to make the loop efficient on long waves without the necessary unwieldy construction of the so-called "cage" loop, which is being used at present in the most up-to-date long-distance receiving stations. However, and strange, to say, even this loop failed to cause any directional reception.

One theory advanced for this peculiar phenomena is that the tower in which the station is located is covered entirely, except for the windows, by a copper wall, which, it is averred, acts as a screen or reflector, thus causing the loop to be acted upon almost equally by signals *from any direction because of the energy reflected by the copper wall.*

This wall is some six or seven feet from the nearest point of the loop, and why it should have this effect upon it is not fully understood. Loops, when operated but a short distance above the ground, are known to have a directional effect, and why this wall, which is grounded, should cause any difference cannot be determined.

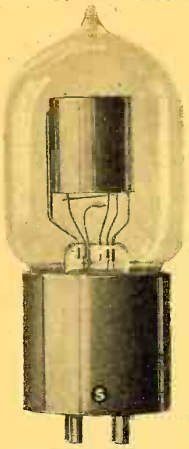
Many other unusual conditions have entered into the operation of the *Times* station which have been investigated by many of the radio engineers in the vicinity of New York for solution, and several of the latest theories have been exploded very thoroly when put to test. All sorts of static-elimination circuits have been tried, but none have been found satisfactory, except one—cutting off the filament current.

NOTES ON POZ.

Doubtlessly the official logs of the various Government stations offer a very complete record of trans-ocean receiving conditions in this country, and from them it will probably be observed, or could be observed if they were open to public scrutiny, that reception from any given station in Europe varies considerably in different sections of this country. This variation, no doubt, will be found to have but little regularity, and receiving conditions which may be good in one section one day may be very poor the next, due to constantly fluctuating local conditions and the prevalence of static disturbances, especially during the summer months. Quite an accurate log has been maintained at the *Times* station, and some of the facts may be of interest to the trans-ocean radio observer. Most of these observations have been compiled by using the signals from Nauen (POZ) as a standard, and it has been observed that when this station was not readable the same condition generally obtained in regard to the other European stations, except at times when it was possible to copy the signals from Stavanger, Norway, altho such instances were rare and probably due to shorter distance rather than any specific properties of the intervening ether.

With the exception of a few instances lasting anywhere from one to five hours, signals were completely copyable at the *Times* station until the fifteenth of March, this year, when static interference began breaking in on the reception at about five

(*Continued on page* 174)



THE A-P ELECTRON RELAY
Price $6

ASK HIM—

ASK THE AMATEUR—HE KNOWS—

"Local operators who have tried the Relays report them the best detector they have ever used, with the result that they are selling like hot cakes. We predict an enormous demand for the tube this coming season."

Extract from a testimonial sent us unsolicited by a large Chicago radio dealer. (Name furnished upon request.)

THESE TUBES

These tubes — tbe A-P Electron Relay and the A-P VT Amplifier-Oscillator—manufactured under the De Forest Audion and Fleming patents.

Other patents applied for and pending.

A SUGGESTION

A combination of an *A-P Electron Relay* as the initial detector or oscillator with two or more *A-P VT tubes* as amplifiers is the ideal receiving combination for long distance reception. The price of the *A-P VT Amplifier-Oscillator* — designed by Naval radio experts—is $7. "Use the tube the Navy uses."

Ever on the alert for apparatus of greater efficiency, amateur operators have adopted our new type *A-P Electron Relay* so quickly and so enthusiastically during the four months it has been on the market that we merely say now—"Ask the amateur—he knows." The most sensitive detector of damped waves—spark or modulated C W—ever produced, and equipped with the SHAW standard four-prong base, the *A-P Electron Relay* is the logical tube for the amateur who seeks maximum signal strength and highest operating efficiency.

Price $6. Immediate deliveries. Order from your dealer or write direct. Descriptive pamphlet free upon request.

ATLANTIC RADIO SUPPLIES CO.
8 Kirk Place—Phone Market 1575—Newark
NEW JERSEY
Reference—National Newark & Essex Banking Co.

PACIFIC RADIO SUPPLIES CO.
638 Mission Street—San Francisco
CALIFORNIA
Reference—The American National Bank—San Francisco

Sole Distributors for Moorehead Laboratories, Inc.

Better Apparatus at Lower Prices

is making our business grow by leaps and bounds. We have the most complete stock in the country ready for the big fall rush and are in a position to make

PROMPT DELIVERY ON ALL ORDERS

COPPER AERIAL WIRE

50c per 100 Feet

Another large shipment of this excellent solid copper wire has just been received by us. The gauge is No. 14 and the wire runs 80 feet to the pound. We also sell No. 12 gauge at 80c per 100 feet. This size approximates 50 feet to the pound.

A few of the items you can save on

Esco tested Galena, per sack	25c
Esco tested Silicon, per sack	30c
Panel type rheostat, shipping weight one pound	$1.00
4-prong V.T. socket on base, shipping weight one pound	$1.50
Slightly used telephone plug and jack, shipping weight 4 ounces, complete	85c

AudioTrons, Mooreheads and Marconi Bulbs, immediate delivery.

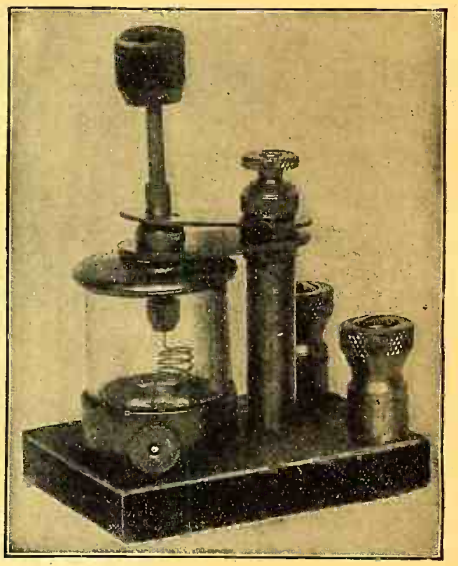
Cash in registered letter, check or money-order must accompany all orders. If shipment by parcel post is desired include postage, otherwise material will be shipped by express collect.

Our illustrated catalogue of 48 pages is now ready. 15c in stamps will secure a copy. This amount will be credited on your first order for $1.50 or over.

Electrical Specialty Company

Dept. R—48-50 South Front St., Columbus, Ohio
Dept. R—20 North 9th St., Philadelphia, Pa.

TWO STORES FOR YOUR CONVENIENCE



Weather Proof Crystal Detector

The type of the detector illustrated is being sold at prices ranging as high as $4.50. Our price is $2.80. This instrument is absolutely dust and moisture proof. The crystal, which is one of galena mounted in a block of Woods metal, is encased within a glass cylinder rendering it impervious to atmospheric conditions. Has ball and socket joint. Shipping weight 1 lb. Price $2.80.

(*Continued from page* 172)

o'clock in the afternoon (local summer time) and from that date on static increased almost regularly up to the present time, which is now a genuine roar. Periods have been observed lasting for a week or more, during which signals were readable at all times of the day and night until about the middle of May, when the periods of complete twenty-four-hour-a-day reception were confined to about one day a week and from that time up to the present the reception has been cut down to possibly eight hours a day, beginning from two to four o'clock in the morning and lasting until about three to five in the afternoon. The days during which it is possible to receive the entire twenty-four hours are now rather few.

The traffic handled by the Nauen station is received for distribution at the Navy Receiving Station at Otter Cliffs and traffic from this country to Germany is sent thru the Navy station at Annapolis. By watching the operation of these two stations it is possible for the men in the *Times* station to secure a very good check on their own reception. For instance: If Annapolis sends a service message to Germany asking for repetition of some of the messages coming to this country, all of which are serially numbered, it is possible to go over the messages received at the *Times* station and ascertain whether the messages asked for have been received there. Similarly, if a group of messages have been missed at the *Times* station, and there is no call from the Annapolis station for Nauen to repeat them, it is safe to assume that the reception at Otter Cliffs was 100 per cent readable.

By carefully compiling accurate data on static conditions and signal intensity at the various receiving stations of this country and making a careful comparison, it may be possible to draw some conclusions concerning the advisability of securing certain receiving locations for certain seasons of the year. This, of course, means a very large job, but it would certainly be worth while if reception was improved.

Inasmuch as the receiving set upon which the observations at the *Times* station are made is of a standard type and possesses no static-elimination devices, it may well be assumed that these observations could be duplicated in most instances on any other set in the metropolitan district.

It is understood by the writer that the location of the receiving station at Otter Cliffs was decided upon by the Navy Department because of the fact that it is not only nearer to the European stations, but *seems to be less affected by static than other sections of our coast line.* Several of the *Times* operators, formerly employed at Otter Cliffs, say that the reception there is generally much better than in New York, all other conditions being equal.

A very good check on much of the trans-ocean reception, most of which is done at the Otter Cliffs station by the use of separate receiving stations for various stations on the other side, may be made by following the transmission of the Naval station at Annapolis, which keeps the European stations informed concerning the reception here. Altho Fig. 1 shows this circuit as applied to long-wave reception with the aid of the heterodyne, for the reception of dampt waves of any length, any loose coupler or similar device may be connected with its secondary output circuit to the points S and S^1, the heterodyne not being used in this case.

MUCH ADO ABOUT NOTHING.

WISE GUY—"Why is radio telegraph like a foolish quarrel?"
RUBE—"I dunno."
WISE GUY—"Because it's like having words over nothing."

Leroy H. Kise.

Lecture on Vacuum Tubes Via Radiophone

By Lieut. Ellery W. Stone, U. S. N. R. F.

A Unique Speech Delivered Over the De Forest Radio Telephone Installed in the California Theatre at San Francisco, California, June 23, 1920

GOOD evening, gentlemen, this is Ellery W. Stone speaking. I can assure you that it affords me a great deal of pleasure to address you tonight in what is probably the first lecture ever delivered over the radio telephone, and in so doing I must express my thanks to the DeForest Company and to the management of the California Theatre, who have accorded me this privilege.

I shall take this opportunity to say a few words on the subject of vacuum tube operation for the benefit of those operators, experimental, commercial and naval, who may be using them in their receiving sets. While the theory of vacuum tubes is, of course, quite thoroly understood, it has occurred to me that a few points on the actual operation or adjustments of vacuum tubes for most efficient results might be of interest.

You will, of course, appreciate the fact that without charts or diagrams it is somewhat difficult to present any sort of a talk on radio, but I shall endeavor to make the subject as clear as possible under the limitations of the attendant circumstances.

Vacuum tubes may be roughly divided into two classes, hard and soft. By a hard tube, or amplifier-oscillator, we mean one in which there is no trace of gas left in the tube, insofar, of course, as it is humanly possible to so exhaust it. A soft tube, or detector, on the other hand, is one in which a small trace of some gas is deliberately retained in the tube. This gas may be air, composed largely of oxygen and nitrogen, or traces of mercury vapor, or some of the rarer gases such as argon, neon or helium. Commercially, however, such gas as is present in soft tubes is usually air, nitrogen or mercury vapor.

Soft tubes are used for detector purposes, while hard tubes are used for amplification and the generation of oscillations. Hard tubes should be used, therefore, for regenerative work and amplifying work in a receiver, and for oscillation work for transmitting purposes in an undamped wave telephone or telegraph set.

As you all know, the principle on which a hard tube works is that of the *pure electron discharge* radiated from the heated filament while with the soft tube, the electrons radiated from the filament break up the molecules of gas purposely left within the tube into positive and negative ions. In addition to the radiated electrons themselves, these positive and negative ions separated from the original molecules through their collision with the radiated electrons, also serve as the carriers of the plate current, which is the current made audible in the telephone receivers.

You are familiar with the characteristic curve of vacuum tubes in which the plate current is plotted against different grid potentials, the potential of the grid being measured with respect to the negative side of the filament. However, in order that this action may be visualized, I would suggest that you draw a curve as follows: Take a pencil and draw to the right a horizontal line about a half inch long. Now curve this line upwards until it is almost straight up and down or vertical for a distance of two inches. Now curve this line a half inch to the right again until it is practically horizontal. The ordinates or vertical components of this curve are plate current, the abscissae or

horizontal measurements are grid potential. The grid potential half-way up the curve is zero, to the left it is negative and to the right it is positive. This curve is approximately the characteristic curve of the vacuum tube. From this curve it will be observed that for very minute changes in the grid potential, this potential is that of the incoming radio wave, very large values of the plate current, relatively speaking, may be triggered through the telephone receiver. The vacuum tube thus acts as a sort of relay, the radio potential being used to relay the energy supplied by the B battery through the telephone receivers. As another analogy, we may cite the trigger effect of a pistol. The relatively light pressure of the finger on the trigger, corresponding to the radio wave potential on the grid, serves to release the chemical energy stored in the powder charge of the cartridge, the latter corresponding, of course, to the electrical energy of the B battery.

Referring again to the characteristic curve of the average vacuum tube, the sensitivity of any one tube depends upon the steepness of this curve, for the steeper the curve, the more B battery energy will be released for a given change in grid potential, that is to say—for a given strength of received radio current.

In the soft tube, the steepness of this curve depends upon the potential applied to the plate and the degree of ionization present within the tube. Under our present conception of electronic radiation from a filament, we believe that the heat generated within the metal due to the passage of the electrical current imparts such tremendous activity to the electrons contained within the metal that they cannot be restrained and are driven off into space. If we surround the filament wire with gas under atmospheric pressure, this pressure will tend to restrain the electrons so that they cannot leave the wire. On the other hand, as we pump out the tube, the diminishing gas pressure makes it very easy for the electrons to leave. The higher the vacuum, that is to say, the lower the pressure on the wall of the filament, the more electrons will be radiated for a given filament temperature.

As we exhaust the tube, however, we are removing molecules of air from the enclosed space so that there will be fewer molecules left to be broken up into positive and negative ions by the bombardment of the electrons. Thus, for maximum ionization, which depends upon maximum electron radiation coupled with a maximum number of molecules to be broken up, we must obtain a happy medium between these two opposing actions. If we pump the tube too much, we shall have plenty of electrons radiated but not enough gas molecules to be broken up, On the other hand, if we do not exhaust the tube enough, we shall have plenty of gas molecules present to be ionized, but not enough electrons radiated to bring such ionization about. The difficulty in detector or soft-tube manufacture, therefore, is to obtain that exact pressure which will give maximum ionization. At the laboratories of the Pacific Radio Supplies Company, we have been able by very careful manufacture, to obtain this exact gas pressure, and in our new detector tube, the Electron Relay, have brought out a detector for the reception of spark signals or radio telephone speech which we believe cannot be equaled.

The soft tube has a disadvantage, however, which makes it impracticable for amplifier work. While the detector curve is very steep, due to the ionization effect, and is hence a very efficient amplifier of the rectified current charge built up on the grid, the curve has a very low saturation point. (The saturation current is the upper flat portion of the curve.) That is to say, if too much potential be applied to the plate, the increased velocity of the electrons complete-

(*Continued on page* 179)

$6.00

No. 488

Chemical Laboratory

We present herewith to our friends our **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English System and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the 100 Experiments are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and Smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make Chemical Colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

Price $6.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)
Immediate Shipment

The Boy's Electric Toys

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.
No. 2002 "The Boy's Electric Toys," outfit as described.....$6.00
IMMEDIATE SHIPMENTS

$6.00

No. 2002

"The Livest Catalog in America"

IN this cyclopedia you will find all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Code Practice Sets, Primary Batteries, Storage Batteries, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Microphones, Loud Talkers, Electro-magnets, X-ray Tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc. IN A WORD THE MOST COMPLETE CATALOG IN PRINT.

FREE —20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

ELECTRO IMPORTING COMPANY
231A Fulton St., New York City

I enclose herewith 10 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 22 as described.

NAME .....

ADDRESS .....

STATE.....R.N. 9-20

The Electro Importing Co.,

231A Fulton Street "Everything for the Experimenter" New York

(*Continued from page* 176)

ly ionizes the gas, the familiar blue glow manifests itself, and a fluctuation in the grid potential produces no effect in the plate current. For amplifier work, therefore, it becomes necessary to pump the tube to a very high vacuum so that there shall be no upper limit to this curve within the operating range of the grid potential, whether the tube be used on the first or last step of a multistage amplifier. On our amplifier vacuum tube it is possible to secure tremendous amplification of the grid energy. In order that the curve in a hard tube should be as steep as possible, it is desirable to apply a fairly high potential to the plate so that our VT Amplifier-Oscillator should be used with A B battery of from 60 to 110 volts.

The generations of oscillations by a vacuum tube is in reality simply an adaptation of its amplifying properties. We may connect the plate circuit back into the grid circuit by one or two of three methods. By employing a tickler coil, we secure inductive coupling between these circuits; with a feedback condenser, we secure *electrostatic or capacity coupling;* and with resistances or variometers we secure *conductive coupling* and such electrostatic coupling as may be obtained from the close proximity of the tube elements and load wires of the two circuits.

By connecting the plate circuit back into the grid circuit and by causing an initial fluctuation of the grid potential, as by grounding any of the grid circuit leads with the finger, or simply throwing the filament into circuit, this transient variation of the grid potential will be amplified in the plate circuit. This will be fed back into the grid circuit and reamplified in the plate circuit. The whole process repeats itself many times, and the final magnitude of the oscillating currents being limited by the tube constants and the operating plate potential. This generation of radio frequency, undampt oscillations thru regeneration, is similar to the howler circuit used on the wire telephone in which a telephone receiver is held a short distance from the transmitter. A sound made in the vicinity of the system will be reamplified back and forth between the receiver and transmitter, the only limit to the sound heard in the receiver being its current carrying capacity and the maximum possible amplitude in which the diafram can vibrate.

Hard or amplifier tubes are commonly operated on 6 volts A battery or filament potential and from 60 to 110 volts B battery. Adjustments of filament current and B battery are not critical.

With the detector tube, on the other hand, the necessity for an exact electronic radiation so as to secure maximum ionization with a given gas pressure makes it necessary to have a very fine regulation of the filament rheostat. The plate potential should be varied in steps of not more than 3 or 4 volts, but best operation will be secured when a high resistance potentiometer is connected across part or all of the B battery.

With our tube, the filament current should be adjusted to from four to five-tenths of an ampere. This means that the filament will be burning at a little more than red heat. The plate potential varies with different tubes, but every effort is made to bring them to a gas pressure such that their best operating point will be with a potential of 35 volts on the plate. Some tubes, however, may run as high as 60 volts.

If the filament current or plate potential on the detector tube be too high, a hissing sound will be heard. The filament current should now be slightly reduced, possibly the plate potential as well—the detector will now be adjusted for best results. In adjusting the detector or electron relay, be sure that adjustments are made on weak signals. By running up the plate potential or filament current, signals from nearby stations can be made very loud, but this adjustment will be a very poor one for the

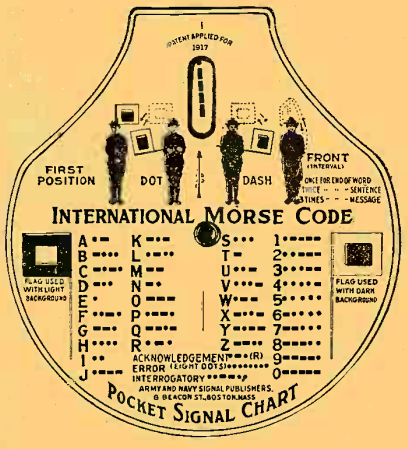
It will pay you to read the Classified Ads. Turn to pages 188 to 190.

reception of distant stations. If the correct adjustment is made for weak signals, strong signals will, of course, be received with sufficient intensity, whereas if the adjustment be made for loud signals, the weak ones may often be lost.

Gentlemen, I think this will conclude my remarks for the evening. I thank you.

A NEW WAY TO LEARN THE CODE.

A publishing company of Boston has recently placed on the market an interesting little device called the Pocket Signal Chart. This is a circular cardboard wheel which revolves in such a way that each letter of the alphabet appears at an opening in dot and dash characters, thus enabling the beginner to quickly recognize as well as memorize the alphabet. On the other side of the chart is a similar arrangement whereby a semaphore code is shown suitable for boy scout work.



By Revolving a Small Cardboard Wheel, Not Visible in This Illustration, the Letters of the Morse Code Appear at the Upper Slot. The Figure 9 Is Now Visible.

We suggest to our junior readers that they obtain one of these clever charts and "get busy" on that long deferred intention to learn the continental Morse Code

Correspondence from Readers

(*Continued from page* 160)

HERE IS THE PROOF.

Robinson Bros., Keyport, N. J.

Dear Sirs: In the July issue of RADIO NEWS, I notice a description of station 2QR.

It may be of interest to you to know that I heard you several times in June, both music and voice on a one-step De Forest outfit. Could not get the address on account of heavy QRM and QRN but distinctly heard the station call several times and remembered it on account of beginning with Q.

That beats, by several times, the distance record you supposed you had in the article in "RN." This CW stuff is a queer proposition. It has a way of sneaking thru where we least expect. I have been heard over 30 miles on 1 audiotron bulb in some experiments.

Hope to hear you many times in future.

Very truly yours,

DRS. COPELAND & LIVINGSTON, *Dentists.*
By I. W. Copeland, 8-JM, Ashland, Ohio.

A RADIO DISTANCE RECORD.

First Amateur (rushing into laboratory of friend): "Hey, Bill, I sent a message over ten thousand miles!"

Second Amateur (excited): "How did you do it? With your new transformer?"

F. Amateur: "Naw, with a two cent stamp."

Contributed by PERRIN ADAIR.

MR. LOGWOOD PLEASE NOTE!

Inquisitive Layman—Is it true, they are using trees now for receiving radio messages?"

Radio Bug—"Yes, De Forest wireless is getting to be very popular!"—*Paul Briniotte.*

Navy Broadcasts for Amateurs

Code Translations for Month of July

[Ed. Note: Each month an abstract of the amateur code messages sent out by the New York Radio Station NAH will be publisht in Radio Amateur News. *The purpose of this is so that amateurs who copy this code may have a means of checking up what they have received and thus know how they are progressing in receiving ability.]*

The following messages were broadcasted in the Amateur Radio Code by Navy Radio Station, New York, N. Y., on 1,500 meter wavelength, during July, 1920.

July 1—Code Two—Boy Scouts of America advise quote American Red Cross is considering the development of a plan to co-operate with the Navy and Boy Scout Radio system in its emergency work it is announced by Boy Scout Headquarters unquote.

July 2, 3, 4, 5—No broadcast sent, owing to urgent government work.

July 7—Code Four—USS Brooklyn of Pacific Fleet reports good results using telephone at ten am with USS Birmingham distance one hundred twenty five miles period this work was also done by distant control.

July 8—Code Two—Following received quote radio compass was used July 7th nineteen twenty to navigate Navy seaplane F dash five dash L comma ninety five miles and return comma from Norfolk to pick up USS Ohio at sea unquote.

July 9—Code Four—Following received quote Junior Achievement Bureau will pay full expenses for forty boy scouts to attend Eastern States exposition Springfield Massachusetts in September period apply to Boy Scout Headquarters two hundred fifth avenue newyork city unquote.

July 10—Code Six—Following received quote radio amateurs requested to report receipt of broadcasts to nearest boy scout headquarters promptly as possible period this system is operated for public service and your co-operation is needed unquote.

July 11—Code Eight—Following received quote Judson P Freeman National Field Scout executive reports that Boy Scout radio amateurs throughout middle west are standing watch and picking up amateur broadcasts unquote.

July 12—Code Ten—Following received quote local councils boy scouts of america are requested to secure publication at least weekly of data concerning amateur broadcasts including hour of transmission and wave length used unquote.

July 13—Code Two—Following received quote east side YMCA radio club offers to send lecturers to talk at boy scout meetings or gatherings of other organizations desiring information about radio unquote.

July 14—Code Four—Following received quote code practice class is conducted by East Side YMCA radio club for its members period fine club room with transmitting and receiving station open daily to members period write for further information unquote.

July 15—Code Six—Radio is being used for the first time to report International Yacht races period wireless bulletins are being distributed broadcast through various news agencies.

July 16—Code Two—Reporting the progress of the yacht race by radio was successfully accomplisht Thursday afternoon.

July 17—Code Four—Following received quote boy scouts of america have appointed Mr. Schiff chairman of American delegation to the first International conference of boy scout executives at London England unquote.

July 18—Code Six—It is understood Mr West chief scout executive boy scouts of america is proceeding to London on the Steamer Imperator where he will take part international boy scout conference.

July 19—Code Two—Photographs of the international yacht race taken from aeroplane off Sandy Hook appeared in newspaper being sold on the streets of newyork ninety minutes later.

July 20—Code Four—The Lafayette transatlantic radio station located near Bordeaux France is expected to have a transmitting range of at least twelve thousand miles.

July 21—Code Six—The steamship Victorian is scheduled to make wireless telephone tests during the latter part of July with the St Johns Newfoundland radio station from a point in midocean.

July 22—Code Two—Following received quote wireless telephone message was received July twenty first at Chelmsford comma near London comma England comma from SS Victorian at sea then six hundred miles distant unquote.

July 23—Code Eight—Attempt at transatlantic communication by wireless telephone will be made July twenty third from St Johns Newfoundland to Poldhu or other British station.

July 24—Code Ten—Seventy eight Navy athletes of whom thirty one have won places on American team will sail on USS Frederick July twenty six for Antwerp.

July 25—Code Two—Following received quote cash prize of ten dollars is offered by seascout radio commodore boy scouts of america newyork city for best report on amateur broadcasts for month of august period mail copy of broadcast daily unquote.

(Continued on lower part of opposite page)

Government Radio Position

UNITED STATES CIVIL SERVICE
EXAMINATION.
RADIO OPERATOR
September 7, 1920.

The United States Civil Service Commission announces an open competitive examination for radio operator. Vacancies in the Lighthouse Service, at salaries ranging from $960 to $1,200 a year, with $1 per diem additional for subsistence, and in positions requiring similar qualifications thruout the United States, at these or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

Appointees whose services are satisfactory may be allowed the increase granted by Congress of $20 a month.

All citizens of the United States who meet the requirements, both men and women, may enter this examination; appointing officers, however, have the legal right to specify the sex desired in requesting certifications of eligibles. For the present vacancy male eligibles are desired.

At present there is a vacancy in the Eleventh Lighthouse District Headquarters, Detroit, Michigan, at $1,080 a year, for duty on the tender *Marigold*.

It is also expected that there will be other vacancies in the near future.

Competitors will not be required to report for examination at any place, but will be rated on the following subjects, which will have the relative weights indicated on a scale of 100: (1) Physical ability, 15. (2) Education, 20. (3) Practical experience as radio operator, 65.

COMPETITORS WILL BE RATED UPON THE SWORN STATEMENTS IN THEIR APPLICATIONS AND UPON CORROBORATIVE EVIDENCE.

Applicants must have a good common school or equivalent education, and have had at least two years' experience as an operator, either on board a vessel or at a wireless telegraph station doing a commercial business.

Applicants must have reached their twenty-first but not their fortieth birthday on the date of the examination. Age limits do not apply to persons entitled to preference because of military or naval service. To be entitled to retirement with an annuity, employees in this position must reach their seventieth birthday and have served fifteen years.

Applicants must submit with their applications their unmounted photographs, taken within two years, with their names written thereon, which will not be returned to them. Proofs or group photographs will not be accepted.

Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C., the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii, Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif., Old Customhouse, St. Louis, Mo., Administration Building, Balboa Heights, Canal Zone, or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R.

Applications should be properly executed, excluding the medical and county officer's certificates, and must be filed with the Civil Service Commission, Washington, D. C., prior to the hour of closing business on September 7, 1920.

Issued July 30, 1920.

Navy Broadcasts For Amateurs

(*Continued from opposite page*)

July 26—Code Four—Communication by telephone was establisht July twenty fifth between St Johns Newfoundland and SS Victorian then six hundred fifty miles east comma ship in dense fog with six hundred yards visibility.

July 27—Code Four—Resolute comma New York Yacht Club entry comma today successfully defended the Americas cup in the fifth and deciding event of the International yacht races.

July 28—No broadcast sent, owing to urgent Government work.

July 29—English: Government regulations state that wireless will not be used when Time Signals are being sent except for distress messages these time signals are sent from eleven fifty five to twelve Noon and nine fifty five to ten pm seventy fifth meridian time.

July 30—No broadcast sent, owing to urgent Government work.

July 31—English: The old battleship Ohio is being dismantled and will be used as a floating target during the fall battle practice of the Atlantic Fleet.

HOW ABOUT A FLEE-BITE?

"Just had some scientific food."
"What was it?"
"Alternating current pie."
"How's that made?"
"Has a current every other bite."

D. GUIGUE.

"Mystic Waves"

(*Continued from page* 151)

wireless waves. He agreed to aid me and I gave him one hundred dollars," the woman told him.

"I will do my best, madam, and try to capture the rest of the brutes," answered Howard.

"Remember, I pay well, Mr. Grant," the demented person said.

Grant, however, decided to let matters stand as they were. It would not be easy to convict Leonard on the word of an unbalanced woman. Also, he could do very little in the case of the woman. He did not care to have either arrested. He was satisfied; he had his wonderful set back again and in perfect condition.

Again we may hear the "mystic waves" from Howard Grant's station race thru the ether toward far-away cities like Chicago and New York.

[Editor's Note: This story is based upon actual fact. In one instance the author experienced a similar robbery and in another instance a lady with similar hallucinations gave no end of trouble to certain government officials during the Great War.]

Radio Digest

(*Continued from page* 152)

and better understand advanced works on radio but who thru lack of systematic training in pure science and physics may be handicapt by lack of necessary fundamental knowledge.

A general survey of physics is given and much space devoted to the aether and space; matter force and motion; harmonic motion; wave motion; atoms and molecules; chemical action; heat and temperature. Useful chemical names and formulae are included as well as the meaning of chemical symbols and formulae. A good book for one who intends to follow radio from an engineering point of view.

Contains 176 pages and is properly illustrated. The book is publisht by The Wireless Press, Inc., New York.

"One of the Gang"

(*Continued from page* 148)

vicious type of non-synchronous rotary in a metal casing. The din was terrific, and in the midst of it the boss came rushing down from his office and wanted to know why his gang wasn't contributing to the general celebration. I don't know what he wanted. A little more and he would have had a gang of deaf operators on his hands. Nothing would do but one of the men must climb to the top of the 250-foot antenna tower and float a flag therefrom.

At that time there was born in me an overwhelming ambition to view the world from the top of the steel mast. It was an ambition I was in no hurry to gratify, as there was some sort of ruling against it, and I didn't want to lose my job just yet. As a matter of fact, I did climb the tower two days before I left the factory. The round trip took me nearly half an hour, but the view was certainly worth the effort.

On the day of the real armistice, altho I realized there would be no work, I traveled to the factory because if there was going to be any fun I wanted to be in on it. There was plenty. We marched all around that part of the country, and then set out for Elizabeth, some five miles away. We went thru Elizabeth and kept on going. Then we had to come back. That was the hardest day's work I ever put in. I was a fine looking specimen. A tin pan was suspended from my waist so that it rattled on the cobblestones when I walked. Also I carried a large gasoline can which I beat with a hammer. And I walked beside the man who carried a placard which announced to the spectators that this was the Test Dept. and to H—— with the Kaiser.

After that there wasn't so much to do, and as you all know what happens to idle hands, I am sure you won't be surprised to hear that matching pennies became the rage. I complained to the boss that I did not have enough work to keep me busy, and he told me quite severely that a good *man* could always find something to do. I concluded then that I was not a good man, and I guess they agreed with me because they transferred me from the test room and apprenticed me to the engineer who was developing the Weagent Valve. I spent a month in that department as general assistant to everybody, making filaments, making plates, washing glass exhausting bulbs, doing everything in fact except blow glass, and that was about the only thing in the factory I didn't do.

Taken all in all, it was a wonderful experience for me. Don't think that because I had a good time the work wasn't hard. It was, but I made up my mind that as long as I was rated as a tester I could work just as hard as the others. And that reminds me, though I don't know why it should, of one little story which I often tell with much relish. One of the testers (not a regular factory hand, but a war worker like myself) was swearing quite outrageously. Another man, not of our department, reminded him that there was a lady present. (He meant me.) To that the tester replied, "Oh, don't mind her. She's one of the gang. She's as tough as the rest of us." I was taken somewhat aback, as I didn't know I was rated in the "tough" class. But I was glad he called me "one of the gang," because that is what I wanted to be, and I am glad they accepted me as such.

P. S. to the Ed.—I have enjoyed writing this almost as much as I enjoyed the actual happenings. Some time may I write you a thesis on "Wild Radio Stations I have met" and include therein my impressions of NAA and the beautiful Telefunken installation on the Leviathan, and a few trick ham sets? M. C. B.

P. S. to M. C. B.—Surely, provided the story is not too tough!—Editor.

Experimental Regenerative Circuit

(*Continued from page* 147)

ting the sliders at the right spot. NDD will also come in occasionally, thereby knocking the sap out of some of my cherisht theories, viz.: that the more turns you put on your tuner, the longer wave you get, as I find that with the small aerial described above, that NSS can be heard calling IDO, LCM, UA, YN, MUU, etc., with about twenty-five turns between the aerial and ground, and most amateurs come in with about ninety or one hundred turns, Arlington with around seventy.

We intend to try this hookup out presently as a short range radio phone by inserting a transmitter in the ground and using 220 volts DC for the plate circuit.

While experimenting with a one-step amplifier, home-made, on the above hookup, after turning the DETECTOR filament out, and disconnecting one wire (I forget which one) some high power C W station came in very loud sending a very long "Cipher" message. This might have been Mars, China or "just POZ." However as soon as we discover something definite about this latter hookup we will let you in on the secret: QRX till then.

Concerning Our Recent Prize Contest

(*Continued from page* 153)

or vacuum tube, etc. The aerial may or may not be contained in such an outfit. Note particularly that we have stated above the cubic inches of the outfit. Therefore, it would be permissable if somebody wanted to build an outfit into a walking cane to send in his entry without being disqualified, as long as the cubic feet of the outfit did not exceed the amount given above.

To show what can be done, we print on another page a small portable outfit designed by Mr. J. McLaughlin of Fairhaven, N. J. If Mr. McLaughlin had entered this outfit, he certainly would have been awarded a prize, but unfortunately he was too late in entering it on his own admission, because he had no time to test it.

This outfit was submitted to us under date of August 6th, while the actual contest had closed in New York under date of July 12th. We hope that there will be no further misunderstanding, and that we shall be able to award the prizes as we originally intended to do. Come, boys, let us hear from you soon.—*The Editors.*

Dictionary of Radio Terms

(*Continued from page* 157)

Radiation Resistance—The quality of an antenna in virtue of which radiation of energy takes place. It may be measured by the quotient of the rate of radiation reckoned in watts by the mean square value of the current in the antenna.

Radii—Plural of Radius.

Radiogoniometer—Calibrated instrument containing the two fixed aerial coils and swinging coil of a Bellini-Tosi Direction Finder.

Radiogram—An American expression employed to denote a message sent by Radio-telegraphy.

Radio Compass (also named Direction Finder, Goniometer, which see)—A radio receiving device making use of a loop antenna capable of revolving its plane in any given direction so as to secure maximum signal response and thereby locate the direction of a transmitter. In American practice, however, the *minima* signal response is used instead of the maxima as the latter is not sharp enough for accurate work. Also several radio compass stations are employed simultaneously at various points of the coast, enabling the plotting and accurate securing of a ship's position. Also employed by other leading maritime nations on a similar plan of action, tho not always the same radio system of direction finding. The Bellini-Tosi method is probably the pioneer system in Europe.

Radiograph—American term used to denote a message sent by Radio-telegraph. Correctly refers to an X-Ray photograph.

Radio-Telegraph—One which depends upon the radiation of electrical energy in form of ether waves. Popular terms are wireless telegraph and radio.

Radio-Telephony—Transmission of speech by means of electro-magnetic ether waves.

Radius—A straight line from center of a circle to any point on its circumference.

Ratio—Relative values of quantities of the same kind, or number of times the one is contained in the other.

Reactance—The resistance, impedance, experienced by a current in a coil of wire, other than the ohmic resistance, is due to that current acting back on itself by induction. This is called Reactance. See Inductance, and Back E.M.F., also Impedance.

Reaction Circuit—A circuit comprising a Vacuum Tube Amplifier so arranged that part of the magnified energy in the plate circuit is led back to, or caused to react upon, the grid circuit, thus increasing the original energy received by the grid and greatly magnifying the response to weak signals. The coupling between the grid circuit and plate circuit may be magnetic or electric. Also known as Regenerative, Armstrong or Franklin circuit, and Ultra Magnifier or Ultraudion.

Receiver—See Detector.

Recorder—A telegraphic instrument which automatically records messages sent over a telegraphic system.

Rectifier—Apparatus which converts A.C. into pulses of direct current. Certain crystals have this property. See various Detectors.

Red Lead or Minium—Pb_3O_4.

Reduce Wavelength of Aerial—Add capacity in series. This method may be halved without serious loss of radiation.

Reflecting Galvanometer—See Mirror Galvanometer.

Regenerative Circuit (often called the Armstrong circuit)—*See Reaction Circuit.*

Relay—An instrument containing a sensitive magnet which, upon receiving a weak current from one circuit, closes another circuit of higher power.

OPPORTUNITY AD-LETS

Follow these advertisements every month. Reliable advertisers from all over the country offer you their most attractive specials in these columns.

Classified advertising rate three cents a word for each insertion. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Objectionable or misleading advertisements not accepted. Advertisements for the November issue must reach us not later than October 12.

THE CIRCULATION OF RADIO NEWS IS OVER 40,000

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York, N. Y.

Agents Wanted.

Agents—"STICK-ON" Locks render open windows absolutely burglar-proof. Sale season now on; act quick. Sample 25 cents. Transo Co., Greenville, Ohio.

Automobiles.

Build your own speedster or racing body; write today for money-saving pamphlet showing different styles. Floege's System of Body-building, North Chicago, Ill.

Aeronautics.

Aviators Make Big Money. Twenty to forty minutes' daily instruction. You can learn in three weeks. Send stamp for illustrated booklet. Tells how. Philadelphia Aero-Service Corporation, Real Estate Trust Building, Philadelphia.

Salesmen Wanted.

Salesmen, City or Traveling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to $10,000 a year. Employment services rendered members. National Salesmen's Training Association, Dept. 164M, Chicago, Ill.

Help Wanted.

Railway Traffic Inspectors earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM 122, Standard Business Training Institute, Buffalo, N. Y.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate 5665, St. Louis, Mo.

Detectives make big money. Travel, be your own boss. Either sex. We instruct, small cost. Write Johnson's Detective School, 232 Sheldon Avenue, Grand Rapids, Michigan. Dept. A.

Be a Mirror Expert. $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors, French method. Free prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Instrument and Meter Experts wanted everywhere. Our graduates earn big money. We train you to be meter engineer and hold responsible position. Write for our Special Offer. Fort Wayne Correspondence School, Dept. 405, Fort Wayne, Ind.

Electrical Supplies and Appliances.

Water Locating by Mansfield's water finder is interesting and profitable. Particulars from Edwin Mansfield & Co., 94 Victoria Road, New Brighton, England.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E. E. A course of the theory and practise of electricity for the experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New experiments are described and explained and nearly every application of electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton Street, New York.

For Inventors.

Inventors—Models, dies, tools. 28 years' experience, work guaranteed, lowest price. Manufacturing of specialties our hobby. Peerless Die & Tool Co., 121 Opera Place, D. B., Cincinnati, Ohio.

Formulas.

Invisible Inks. Seven kinds. Also other formulas. Eight cents and stamp. Jean C. Love, Freedom, Pa.

Entirely New Formula for recharging dry cells, never before published, and several other formulas, 25 cents. No stamps. Howard E. Freshwater, Cadiz, Ohio.

For Men.

Detectives Earn Big Money—Travel; great demand; experience unnecessary; we train you; write for free particulars. American Detective System, 1068 Broadway, N. Y.

For Advertisers.

Don't Experiment. White space is too costly. Let Jacobus write your advertising. Letters, $3.50. Jacobus Advertising Service, 1073 Sanford Ave., Irvington, N. J.

Business Opportunities.

Start Business of Your Own. Twenty-four plans, $1.00. Joel Tillberg, Proctor, Vermont.

Any Vulcanizer Can Save $100.00 a week through studying "Vulcanizing Improved and Simplified." Trebles production and saves material. Twenty section repairs done by students in one day. Send $5.00 for copy and save two men's wages. Special courses for beginners. Prehn Vulcanizing College, 1554 S. Wabash Ave., Chicago, Ill.

Turn Your Spare Time into money for that apparatus you want. Start a profitable, permanent home business. Steady weekly income. No investment but your brains and spare time. Positively no soliciting, agency proposition. Write today. Address Opportunity, Box 175, Fredonia, N. Y.

Patents For Sale. To sell, buy or obtain patents, write Patent News, 309, Washington, D. C.

New Auto-Knitter. Half price. Earn at home. I. D. Matteson, Swansea, Mass.

Substantial Manufacturing Corporation wants capable men to establish branch and manage salesmen; $300 to $2,000 necessary. Will allow expenses to Baltimore as explained. Address Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

JOEL TILLBERG
BOOKS, PICTURES, POST CARDS
P. O. Box 201

PROCTOR, VT.,
July 10, 1920

Radio News,
New York City

Gentlemen:—

Your letter of the 8th inst. received. I am enclosing 12-word ad. to be inserted for one year in the classified columns of Radio News under heading "Business Opportunities."

I have received fine results from my little ads. in Radio News.

Sincerely yours,
JOEL TILLBERG.

Printing.

3,000 Two Color Labels, $1.25. Irvin J. Wolf, Station E, Philadelphia.

Radio League Members—50 name cards with emblem of League printed, 45 cents; 100 letterheads and envelopes with emblem, $1.75. Printing Arts Press, 483 East 24th St., Paterson, N. J.

Patent Attorneys.

Millions Spent Annually for Ideas! Hundreds now wanted. Patent yours and profit. Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 301, Patent Dept., American Industries, Inc., Washington, D. C.

Postcards and Pictures.

Artistic Poses—Substitutes for living models. Select and artistic collection of Life Studies of the best and most famous models in the U. S. and Europe. One-half dozen, $4.50; 1 dozen, $8. Particulars for stamp. National Specialties, 32 Union Sq., New York City.

1920 Bathing Girls, prettiest ever, and hand colored; 4 for 25 cents. Chas. Durso, Dept. 50, 25 Mulberry St., New York City.

Postcards. Western views, cowboys riding, roping bad horses, Indians, chiefs, dances, etc. Six for 25 cents. The Glieds Photograph and Art Studio. Okemah, Okla., P. O. 125.

Everything in Postcards. Live-wire list free. Worth-while samples 25 cents. Mention subjects preferred. Mutual Supply Co., Bradford, Pa.

For Boys.

Daylight Movies! See "Novelties."

Books.

Nature Facts married and engaged people should know, concisely given, 25 cents. Central Sales, 601 Ninth Ave., New York.

Wanted—Back issues of Radio Amateur News and Electrical Experimenter. Boston Magazine Exchange, 109 Mountfort Street, Boston, Mass.

Subscription Agents—Best magazine proposition. Make big money. Write for particulars. Concordia Magazine, 9-A Water St., York, Pa.

Just Off the Press. Design and Construction of Audion Amplifying Transformers (Radio and Audio-Frequency Types). By Edward T. Jones, late Associate Editor Radio Amateur News. The transformers shown in this book have never been described in print before and have usually been considered a manufacturer's secret. The designs are very rugged and simple. A book that every radio "bug" should have. Written so you will understand every word. Price 25c postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton Street, New York City.

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless"—theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Flexible cloth cover 75c postpaid. Stiff cloth cover $1.25 postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton Street, New York.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E. E. A course of the theory and practice of Electricity for the Experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New experiments are described and explained and nearly every application of Electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c postpaid. Stift cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton Street, New York.

Every Entertainer—Here's a valuable book. More than twenty rough-rhyme recitations with a playlet of Love, Remorse and Revenge, with "Miracle of Mother's Heart" and French Cloister Romance. Pleases whole house; pictures; 1920 Dazzler. Get these Happy Howls; $1. Trend Pub. Co., 652 39th St., Brooklyn, N. Y.

Blueprints.

If You Would Like to Have a blueprint of your pet hook-up send sketch and money order for 90 cents and get letter-size blueprint with your name in title. Extra prints 15 cents each. Thomas Halloran, 32 Vliet St., Cohoes, N. Y.

Correspondence Courses.

Dollars Saved. All kinds of used correspondence courses sold. (Courses bought). Lee Mountain, Pisgah, Alabama.

Chemicals.

Chemical Apparatus. Inventory sale. Many bargains. Lists free. Altman Co., 223-25 East 110th St., New York.

Phonographs.

Phonograph. Records and player-piano rolls bought, sold, exchanged. Write us. Fuller, Wichita, Kan.

Rubber Stamps.

Rubber Stamps Made to Order. McCaddon Company, Zanesville, Ohio.

Stamps and Coins.

Stamps, 50c. Catalog value, 15c. Particulars and Approvals. Stampcraft, Hanford, Cal.

500 Different Stamps, $1.40; 200, 30c.; 100, 13c.; approvals. Michaels, 5600 Prairie, Chicago.

Stamps! One hundred different valuable—quarter (coin) postpaid. Carl Masson, 76 Boylston St., Jamaica Plain, Mass.

Song Poems.

Have You Song Poems? I have best proposition. Ray Hibbeler, D115, 4040 Dickens Ave., Chicago.

Short Stories. Manuscripts Wanted.

Idea Exchange—Magazine especially published for Amateur Inventors and Authors. Year $1. Copy 10 cents. Brookings, So. Dak.

Scenery for Hire.

Collapsible Scenery for all plays. Amelia Grain, Philadelphia, Pa.

Health.

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., SB, Baltimore, Md.

Pyorrhea (Rigg's Disease—Bleeding or Swollen Gums)—Hundreds have been helped by our successful home treatment. Purifying, healing, preventative. Full month's treatment, consisting of a very beneficial massage paste and an antiseptic tooth-cleansing paste to be used in place of your ordinary dentifrice together with full directions for treatment, $1 postpaid. Or write for free Booklet "R," Pyorem Mfg. Co., 439 Seventh Street, Brooklyn, New York.

Exhausted Nerves—Stomach trouble, constipation treated by successful New Vital Dietary. Food Therapist, 811 North Fourth Street, Camden, N. J.

Instruction.

Attention: Central States Amateurs! It is no longer necessary for you to go a long distance to attend a good wireless school. Our school successor to the Graceland Radio Institute, Lamoni, Iowa. Complete modern equipment. Experienced instructors. Only 30 minutes' ride on electric car from Kansas City. New classes first of every month. Positions guaranteed. Catalogue free. Central Radio Co., Independence, Mo. (See our sales department advertisement elsewhere.)

Miscellaneous.

Electrical Tattooing Machine, $3, $5 and $7. Catalogue for stamps. J. H. Temke, 1019 Vine, Exp., Cincinnati, Ohio.

Tattoos Removed. Simple process. Satisfaction guaranteed. Pharmaceuticals and instructions for $1. No stamps. Alfred Hogue, 45 Gale Ave., Pittsfield, Mass.

News Correspondents.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Novelties.

The Reliable Weather Prophet—Send 10 cents for me, hang me up. I will tell you when it will rain or shine. Particulars for stamp. National Specialties, 32 Union Sq., New York City.

Daylight Moving Pictures! Wonderful little machine, thousands sold; 35 cents postpaid. Altman Co., 225 East 110th St., New York.

Office Devices.

Multigraphs, Addressographs, Duplicators, Sealers, Folders. Less than half price. Guaranteed one year. Pruitt Company, 112-C North La Salle, Chicago.

We Buy for Cash; employ expert mechanics to thoroughly rebuild, and sell for about half manufacturers' prices, Multigraphs, Addressing Machines, Duplicators, Folders, Sealers, etc. All machines guaranteed serviceable as new. Office Device Exchange, 22 Quincy St., Chicago.

We Buy for Cash, Rebuild and Sell for about half new price, Multigraphs, Addressing Machines, Duplicators, etc. Don't be misled by firms infringing on our name. We are the original Office Device Company, 154-C West Randolph. Chicago.

Telegraphy.

Telegraphy (both Morse and Wireless) and Railway Accounting taught quickly. Tremendous demand. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. **Dodge's Institute,** M St., Valparaiso, Ind.

Wireless.

De Forest Audion Bulb, round type, unused, $4. Set of eight Universal (honeycomb) coils, unmounted. Wavelength 150 to 4,500 meters, $4 for the set. Pair Imperial 'phones with headband and cord, $3.75. Add postage. Money refunded if not satisfactory. H. Butterworth, 609 Greene Ave., Brooklyn, N. Y.

Have You Heard About Our Sets? Write for description of them; $15, time; $35 undampt Amateur Builders Supply Lab., 1315 E. High St., Davenport, Iowa.

Amateurs! Be up to date, get one of our complete receiving sets mounted on beautiful formica panel. Good sets for beginners at reasonable prices. Get blueprint. Clarence Haberer, 621 39th St., Louisville, Ky.

Experimental Wireless Stations. Edelman; 320 pages wireless telephony, telegraphy, loops, amplifiers, etc. Just out. New dope on wireless. Price $3. R. Walles, 3118-14, Wash., D. C.

Audels' Easy Lessons in Wireless on approval. Five days' free examination. Price 50c., or book may be returned after five days. Stratton Electric Company, 215 Federal St., Greenfield, Mass.

Amateurs—Vacation times will soon be over. Why not fix up that station of yours for the winter season? Let us help you by supplying you with the best apparatus in the radio world, and at the most reasonable prices. For transmitting results, why not try an Acme transformer? Write for our prices on these transformers. Write us your needs; we can supply you. Radio Mail Order Supply Co., 533 West End Ave., New York City.

Wireless—Continued.

Switches and Switch Points. 3-16-inch dia. by 5-16-inch high tapped with 4-36 screw. Brass and N. P., 48 cents and 60 cents dozen. Send stamp for circular. Liberty Radio Supply Co., 6808 Aberdeen St., Chicago, Ill.

Radio Bugs. Detroit now has a Radio Supply House to meet the demands of the Central States amateurs. Send for descriptive literature. A. F. Krause & Co., 689 McDougall, Detroit, Mich.

Good Radio Receiving Sets, $8.50 and Up. Panel transmitting sets, $30.95 and up. Radiophone apparatus, wire, supplies of all kinds. Catalog 6R for two-cent stamp. Pocket code card free. Jenkins, 923 Purchase St., New Bedford, Mass.

Double Pole Western Electric Single Head Set, with nickeled head band and cord, $1.75; steel lever legless sending key, $1.00. Silk wound 200-meter coupler, $5.50. Prepaid in U. S. A. E. Hancock Co., Austin, Texas.

Read It and Weep. Two 43-plate variable condensers equipt with Corwin dials, $5 each; 13-plate, same equipment, $3; 12x12 Bakelite panel, $3.75. Myron Hotchkiss, Monrovia, Cal.

Attention: Central States Wireless Amateurs! The Sales Department of the Central Radio Co. (best radio school in Central West; see ad elsewhere) is successor to Arthur B. Church, wireless specialist, and carries a complete stock of the leading makes of radio equipment. Exclusive agents for Grebe radio apparatus. Prompt deliveries on mail orders. Amateurs in vicinity of Kansas City and Independence, visit our salesroom and select what you need. Catalogue mailed free for names and addresses of six live Central West amateurs. Write today. Central Radio Co., Independence, Mo.

At Last—Large chart of Armstrong's latest short-wave amplifier. Absolutely the finest hook-up in existance. Offered to the amateurs who desire the most efficient in receiving apparatus. Complete constructural data, including 3-foot blueprint of hook-up of exceptional beauty. Postpaid in mailing-tube, 75 cents. Enola Scientific Chart Company, 3326-17 St., Washington, D. C.

Bargains! Panel 9½x13½, containing variable, tapped honeycombs, coupling and switches, audion-ultra switch, rheostat, socket, condenser and leak, 8 posts. Instruments unconnected, $15. Rotary, transformer, oscillation transformer, $35. Practically new. Write for descriptions. Gilbert Countryman, Geneseo, N. Y.

Galena Crystals at half market price. Two crystals in sealed container prepaid to any address on receipt of twenty-five cents. Nine for a dollar. Stamps not accepted. Blair Coursen, 55 Hitchcock Hall, Chicago, Ill.

Radio Clubs. Stock up with Bakelite. Sheets 7/32x12x38 inches, $8.75. A. K. Laing, Radio Supplies, Pelham Manor, N. Y.

Best Gray Cardboard Tubing. Heavy-wall, for loose couplers, etc. 3½ and 4 inches diameter, 3c per inch, 25c per foot, postpaid. A. K. Laing, Radio Supplies, Pelham Manor, N. Y.

Radio Men—Concentrate your buying. We can supply practically all types and makes of apparatus on the market. Let us quote prices on apparatus you may need. Write today. Federal Radio & Research Laboratory, 20 Rush St., Somerville, Mass.

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless"—theory, practise and history. A clear, concise course on every phase of this subject; 160 pages—350 illustrations, 30 tables. Flexible cloth cover, 75c. postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton St., New York.

Just Off the Press. Design and Construction of Audion Amplifying Transformers (Radio and Audio-Frequency Types). By Edward T. Jones, late Associate Editor Radio Amateur News. The transformers shown in this book have never been described in print before and have usually been considered a manufacturer's secret. The designs are very rugged and simple. A book that every radio "bug" should have. Written so you will understand every word. Price 25c postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton St., New York City.

How to Make Wireless Receiving Apparatus. 100 pages—90 illustrations. Only strictly modern radio apparatus are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered, 35c postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton St., New York City.

The How and Why of Radio Apparatus—By H. W. Secor, E. E.—This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general. This newest of Radio Works, cloth bound in Vellum de Luxe, Gold Stamped and Hand Sewed, has 160 pages. Size of book, 6 x 9 inches. The How and Why of Radio Apparatus, postpaid, $1.75. Experimenter Publishing Co., Book Dept., 236-A Fulton St., New York City.

Photo Developing.

Print Your Photos on Silk, very beautiful and attractive pictures. Send only $1 for package of silk, prepared; postage prepaid. F. Irsa, Elizabeth, N. J.

Exchange.

Will Exchange good telegraph outfit for variable condenser. Communicate with Gerald Williams, Academy St., Presque Isle, Me.

Exchange—Six-shot, hammerless, 20-gauge pump gun in perfect condition for wireless goods, or sell $35. Woolfries, 127 Mohawk, Waterloo, Iowa.

Sell—Small chemical laboratory, $15. Complete, 2 loose coupler receiving sets, $4.50 each. Robert Worth, 1843 East 12th St., Brooklyn, N. Y.

Exchange—V. P. Kodak for head-set. Lewis Vest, Elkins, W. Va.

Compelled to Sell. Mostly all new, some slightly used, in service for one month. Duck's New Receiving Transformer, $18. Brandes 2,800-ohm 'phones, $6. Rotary Spark Gap Motor, $7. Many other apparatus. List sent on request. Great bargains. William Vollkommer, 48 Windsor Pl., Brooklyn, N. Y.

For Sale—Radio receiving outfit. Guaranteed to receive FL.—P.O.Z.—I.D.O.—X.D.A. and all U. S. high-powered stations, damped and undamped. Other experimental things thrown in the bargain. First money order for $75 takes it. All letters answered. Eugene Vaars, Robbinsdale, Minn.

For Sale—Navy type receiving transformer, buzzer, rheostat, 1-in. coil, oscillation transformer, aerial switch and Benjamin Air Rifle. Raymond Taylor, Monticello, Ill.

Bargains. Emil J. Simon Co. $200 naval airplane receiver complete with audion control and bulb. Leather case 13x8x7. Range 275 to 2,500 meters, damped or undamped. Would make a fine portable set, as it is very compact. This instrument is brand new and is complete, with instructions. Price only $55. One Tremaine honeycomb coil cabinet mahogany case, rubber panel; 3 beeko variable condensers with radisco indicating dials, cost $60 without coils, will sell complete with 600-meter coils. Price only $45. George Sprouls, 5530 N. American St., Phila., Pa.

Sell—Short-wave loose coupler, $12. Audion control for above $5. Two slide tuning coil, $3.50. Want one-half-kw. Thordarson Transformer. Clarence Sartain, Alamo Heights, San Antonio, Texas.

For Sale—New $15 Duck Co. Arlington Coupler, $9; $25 violet-ray machine, $12. Raymond Schlegel, 1118 N. Negley Ave., Pittsburgh, Pa.

Radio 8-MT. for Sale. Two-step amplifier short-wave set with B battery and bulbs. (One Western Electric & Marconi V. T.'s and Tron. One pair mica diaphragm 'phones, new, $15; one 6-volt, 60-amp. storage battery, $15; one rotary gap (1-6-h.p. motor, 7,000 r.p.m.), $20; 1 pancake O. T., $5; 3 sections Murdock molded condenser in large size rack, $8; 1 oil-immersed glass-plate condenser for 1 kw., $20; ½-kw. Packard transformer, $10. Write for descriptions. R. M. Sincock, Box 1135, Uniontown, Pa.

For Sale—3,500-meter coupler, $7.50; Doron Universal Detector, $1.50, all nearly new; prepaid. J. W. Reynolds, Camp Quartermaster Office, Camp Meade, Md.

Amateurs—Wonderful diagrams of transmitting, receiving and radiograms, etc. Only 15 cents. Radio Laboratory, 12 Otis St., Medford, Mass.

For Sale—One I. W. Thordarson, $18; Murdock Oscillation Transformer, $4.50; $21 for both. Marconi V. T. Class 2, 15 hours' service, $5.75; miscellaneous for sale. V. Robey, Bethesda, Md.

Complete Wireless Receiving Set for sale and part of sending set. Price $70. Send money by P. O. money order. Jack Palmer, Ashville, N. Y.

Bargains—Must quit radio game. Audiotron and cabinet complete, $9; Arlington loose-coupler, $4.50; 31-plate variable condenser, $1.50; Murdock 3,000-ohm 'phones, $3.75; ½-kw. moulded condenser, $3.75; Murdock oscillation transformer, $2.50; Sayville rotary gap, $7.50; ½-kw. Packard transformer, $9; aerial switch, $1.25. Old issues E. E. 20 cents each. Instruments absolutely guaranteed in good working order. Money talks. S. W. Pierson, Carrollton, Ill.

For Sale or Exchange—One G. E. arc lamp in good condition. Reflector is missing. Will sell for $12, or will exchange for suitable wireless instruments. Write Forrest Pilgrim, Box 326, Gainesville, Ga.

For Sale—Paragon rheostat, new, $1. Charles Pyne, Navy Yard, Brooklyn.

For Sale—De Forest LC-101 mounting, $7.50; coils L-250, 200, 150, 100, 75, $5; Gen. Rdo. 111-C inductor, $10; Murdock .0005 variable, $2.25. E. Otto, 2355 Concourse, New York City.

Let's Swap! Whatd'ye got? Whatd'ye want? Three months dime. National Exchange Medium, Detroit.

How to Make Wireless Sending Apparatus. 100 pages—88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" than any other book we know of. Paper bound, 35c. postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton St., New York City.

(*Exchange—Continued on page 190*)

OPPORTUNITY AD-LETS

(Continued from page 189)

Exchange—(Continued.)

Exchange—Bosch 2-cyl. 45 type ZEV magneto for 1-6 or ¼ hp. induction motor. State make and rating. M. E. Nantz, El Cerrito, Cal.

4,000-Meter Navy Type coupler for sale, $10. William Lang, Springfield Ave., Rutherford, N. J.

For Sale—Two good Ford coils, $2 each; ¼-inch coil, $1.75; ½-nch coil, $2.25; high-speed storage battery, motor make good rotary, $7. Reginald La Bunker, 1227 Olive St., Leavenworth, Kan.

For Sale—No. 2 Omnigraph, new; 15,000-meter navy type loose coupler; one ½-inch coil, 8-V., 30-A.H. storage battery, new; audion control cabinet with bulb, battery and two condensers. Write Thomas King, Island Park, Dayton, Ohio.

For Sale—The following used equipment will be sacrificed. Make offer for the lot, or in part. De Forest audion No. R J5/53; De Forest audion amplifier, Type EJL; Clapp-Eastham tuning set; Murdock rotary spark gap, 1-10 hp.; Clapp-Eastham key; antennae switch; Holtzer-Cabot receivers, 1,500 ohms; four resistance switches; seven Murdock condensers, No. 483; Clapp-Eastham ammeter, 0-10 amps. Address Lee H. Harris, Amityville, L. I.

For Sale—Amateur wireless equipment tron adapter, $1.25; Daisy pump gun, $2; twelve Radisco coils; send for list and prices. All new. R. French, 1675 Pilgrim Pl., Akron, Ohio.

Bargain—Electro Importing Co. Sayville receiving cabinet, never used. Cost $28, sell for $18. Want regenerative set. Kenneth Dixon, Agra, Kansas.

Wanted—Induction motor stator punchings with 2¼-inch hole. M. E. Nantz, El Cerrito, Cal.

Blueprints for 5-mile radiophone. Using audiotron bulb as power tube, also specification for building, 25 cents. Loren Davis, care Davis & Harris, Willson Chase Bldg., St. Petersburg, Fla.

For Sale—Arlington tuner, $5; small tuner, $3; audiotron panel, $8; De Forest audion, with round bulbs, $10; Murdock variable, $3; same for panel mounting, $2.50; Brandes superior 'phones, $4; navy type, $10; Murdock fixed, 50 cents; ball and socket detector, 50 cents. All good condition. Carl Carlson, 5814 Stanton Ave., Pittsburgh, Pa.

Wanted an Omnigraph, 15-dial preferred. State particulars. Write Albert H. Buch, Tawas City, Mich.

For Sale or Trade. 15,000-meter coupler, also 1,000-shot Columbian air rifle. Ralph Beitel, 1411 E. High St., Davenport, Iowa.

Trade Wireless Apparatus for generator. Whatcha got? Whatcha want? L. Andrews, 1315 E. High St., Davenport, Iowa.

Wanted—Small sending set, send at least 15 miles or more. Give full description. Also a portable set .001 variable condenser. Good pair navy type receivers, guaranteed; 100-amp., 600-V. ground switch. State lowest price. Charles M. Butler, 70 Arlington St., Hyde Park, Mass.

Sell—Two couplers, 1,500 honeycomb, hot-wire meter. Want—Amplifying transformer. Write W. Copeland, Warsaw, N. Y.

For Sale—One brand-new 3,500-meter loose coupler, $11.50; one brand-new variable condenser, 17-plate, $3.50; one pair Murdock double-set, 5,000-ohm 'phones, $5. Write for description of other instruments and material. F. H. Helmer, Jr., Merced, Merced County, Cal., R. F. D. No. 3, Box No. 35.

Attention—Eight-panel De Forest panel honeycombs, B Bats Burgess, $10; mounting two variables, etc., $35; $16 Blitzen coupler, $8; panel was used one week, fine results. First money order for either takes it. Both $40. John Yorkhem, 1014 Central Ave., Sandusky, Ohio.

500 cycle, 1 K.W. Crocker-Wheeler motor-generator with starter rheostats. Hartman and Brown frequency-meter and hot-wire ammeter. All mounted on fine marble switchboard and practically new, including transformer. Must be disposed of. William Bohn, 439 East 84th St., New York City.

Sell—2-inch coil—$5.50 or exchange. Want transformer. Elmer O'Neill, Downer's Grove, Ill.

Exchange—(Concluded.)

Sell—New Mignon R.L.C. 5. $40.00. Lester Peck, Austin, Minn.

For Sale—Complete 200-20,000 meter receiving cabinet 15x18x22 inches, mahogany-finished birch; bakelite panel. Contains two 43-plate variables; Chamber's coupler; long-wave regenerative coupler with dead-ended secondaries; tube socket; variable fixed condensers; rheostat; adjustable 44-volt "B" batteries; nickel-plated metal thruout. With Audiotron and Murdock phones if wanted. Panel mounted on oak sub-base—wired with Litz. Space for variometers. Copies IDO, LCM on loop. Cost $80.00. Sell for $55.00. Gap rotor on ½-inch shaft with pulley, bronze bushings and bearings. Bakelite disc 11 inches diameter, eight studs 1/10 inch wide, adjustable. With 1/16 h.p. 60-cycle induction motor, $20. Alone, $10. Complete ¾ K.W. transmitter for sale. Also 3-step amplifier. Details for stamp. Donald Alexander, 209 Elm Street, Bangor, Maine.

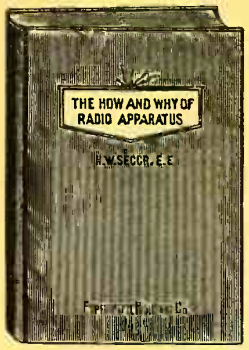
Wanted—Motor generator set to run on 110 volts A.C. and deliver 350 to 500 volts D.C. E. E. Frey, 72 Mapes Ave., Newark, N. J.

150-18,000 meter Receiving Set, including Grebe CR2 and DeForest honeycomb coils, variable condensers, etc., complete. Copy 9ZN and IDO. Two-step amplifier, Grebe detector cabinet, 6-60 storage battery, Clapp Eastham rectifier, ½ K.W. Packard transformer, Murdock small rotary gap, aerial switch and oscillation transformer. Cheap for cash. Make offer. A. P. Southworth, Chestnut St., Wakefield, Mass.

Omnigraph, 5 dials, Continental; transformer, with socket plug for city lighting current; Bunnell key; all new. Otis buzzer, second-hand. Complete transmitting and receiving practice any speed. No batteries required. Guaranteed perfect order. $12 gets $25 outfit. You'll have to hurry. "Radio," Terminal Hotel, Atlanta, Ga.

SPECIAL VACATION PREMIUM OFFER

With a Year's Subscription to Radio News or Science and Invention (Electrical Experimenter)



This newest of Radio works, bound in flexible velum and hand sewed, has 160 pages. Size of book 6 x 9 inches.

	REG. PRICE
Offer A Science and Invention (Electrical Experimenter) for one (1) year with The How and Why of Radio Apparatus	$3.00
	$1.75
	$4.75

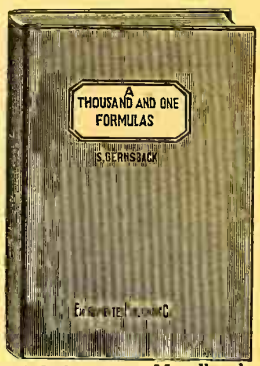
Offer C Science and Invention (Electrical Experimenter) for one (1) year with A Thousand and One Formulas

SPECIAL PRICE OFFER, A or C, $3.75

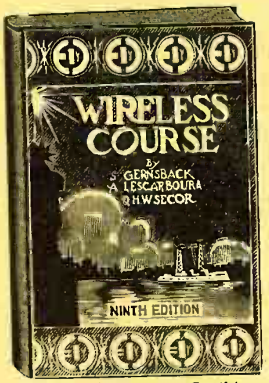
	REG. PRICE
Offer B Radio News for one (1) year with The How and Why of Radio Apparatus	$2.00
	$1.75
	$3.75

Offer D Radio News for one (1) year with A Thousand and One Formulas

SPECIAL PRICE OFFER, B or D, $2.75



A Laboratory Handbook for the Experimenter. Bound in flexible velum. 160 pages. Size 6 x 9 inches.



Book is bound in flexible Velum; has 160 pp. Size 7x12 inches.

	REG. PRICE
Offer E Science and Invention (Electrical Experimenter) for one (1) year with Wireless Course in 20 Lessons	$3.00
	$1.25
	$4.25

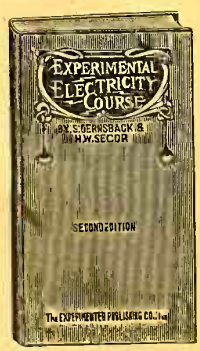
Offer G Science and Invention (Electrical Experimenter) for one (1) year with Experimental Electricity Course

SPECIAL PRICE OFFER, E or G, $3.50

	REG. PRICE
Offer F Radio News for one (1) year with Wireless Course in 20 Lessons	$2.00
	$1.25
	$3.25

Offer H Radio News for one (1) year with Experimental Electricity Course

SPECIAL PRICE OFFER, F or H, $2.50



Book is bound in flexible Velum; has 160 pp. Size 5x9 in.

Printed on heavy paper, paper bound. Size 5 x 7 inches. Fully illustrated. The latest book out.

Book has 100 pages. Size 5 x 7 inches. 88 illustrations. Paper cover printed in two colors.

Book has 100 pages. Size 5 x 7 inches. 90 illustrations. Paper bound, in two colors.

	Reg. Price	Special Price to you
Offer K Science and Invention (Electrical Experimenter) for one (1) year with Design and Construction of Audion Amplifying - Transformers. How to Make Wireless Sending Apparatus. How to Make Wireless Receiving Apparatus.	$3.00	$3.25
	.95	
	$3.95	
Offer L Radio News for one (1) year with Same Books as Offer (K)	$2.00	$2.25
	.95	
	$2.95	

EXPERIMENTER PUBLISHING COMPANY, Inc.,
236-A Fulton Street,
New York City, N. Y.

Dear Sir:

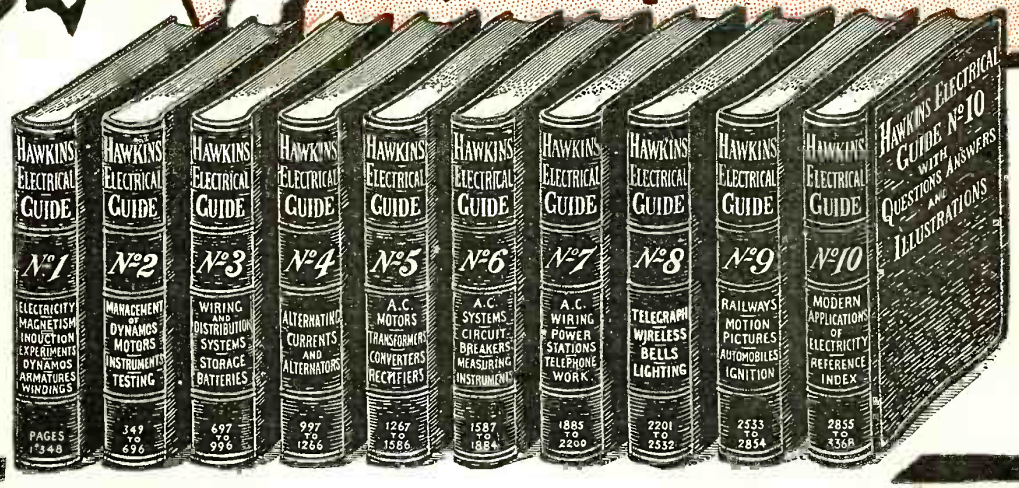
I accept your offer .....Enclosed find $.....
in payment of premium and one year subscription.

Name.....

Address ..... Town..... State.....

R. N. 9-20

Every Electrical Man Wants These Books and we ship them for your inspection FREE



Flexible Covers — Handy Pocket-Size Volumes

10 Volumes — 3500 Pages — 4700 Pictures

$1 Per Volume

$1 Per Month

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly." C. J. Cornell, U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble." H. Marshall, Steamer M & B No. 2, Walkerville, Ont.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY - USE THE COUPON

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters—wattmeters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

THEO. AUDEL & CO.
72 Fifth Ave.
New York, N.Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature.....

Occupation.....

Employed by.....

Residence.....

Reference..... R.N. Sept.

LEARN WIRELESS

At Home Quickly and Easily

WIRELESS is the hinge upon which swing the doors to success. It is the very foundation of the road which leads to many professions, vast in scope, big in responsibility, satisfying in progress and salary.

A trained Wireless Operator with initiative and ambition can easily fulfill his ideals for a successful future; one including a position filled with vital enterprise, adventure, and financial success.

Attractive Work—Alluring Salaries

Radio offers interesting work in pleasant environment, besides substantial salaries. Radio Operators' salaries start at $125 a month with all living expenses—board, lodging, laundry, etc.—paid. When totalled and added to salary, it means $200 or more a month, at the very start. Advancement to higher positions with bigger pay is readily accomplished.

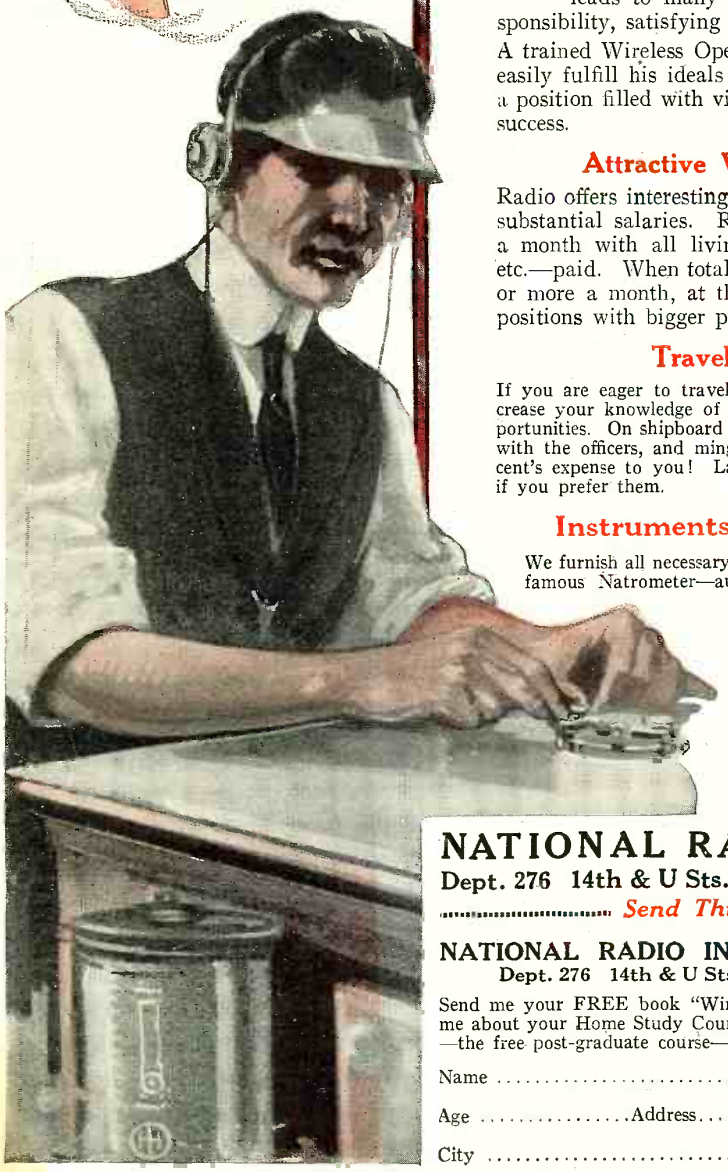
Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, wireless offers unequalled opportunities. On shipboard you are rated as an officer, living and eating with the officers, and mingling with the passengers. All without one cent's expense to you! Land Wireless positions are just as attractive if you prefer them.

Instruments Furnished Every Student

We furnish all necessary books and equipment *with our course*. Our famous Natrometer—automatic transmitting and receiving set—is among this outfit. This instrument sends you messages at varying speeds just as you would receive them from distant wireless stations—and is operated entirely without the use of "aerials".

BOOKLET FREE—It explains how we helped hundreds of ambitious men and women, and how we can give you a thorough Wireless training in your spare time, at home, by mail, and help you secure a worth-while position.



NATIONAL RADIO INSTITUTE

Dept. 276 14th & U Sts., N. W., WASHINGTON, D. C.

Send This Coupon Today

NATIONAL RADIO INSTITUTE,
Dept. 276 14th & U Sts., N. W., WASHINGTON, D. C.

Send me your FREE book "Wireless The Opportunity of Today". Tell me about your Home Study Course in Wireless Telegraphy and Telephony —the free post-graduate course—and your Special Instrument offer.

Name .....

Age .....Address.....

City .....State.....

THE CAREY PRINTING CO. INC
NEW YORK