

ENGA STORAGE

TK  
7800  
E 54  
V. 7  
1701

MAY,  
1919  
20 Ocs.

# ELECTRICAL EXPERIMENTER

## SCIENCE AND INVENTION

OVER  
175  
ILLUST.

Engin  
Serials

REG. U.S. PAT. OFF.

### THE THOUGHT RECORDER

See Page 12



OVER 100,000 COPIES MONTHLY—LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION.



# Learn Electricity



## In the Great Shops of **COYNE**

### IN 3 1/2 MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way, backed by twenty years of success. Hundreds of our graduates have become experts in less than four months. *You can do the same.* Now is your big opportunity. Come—no previous education necessary.

#### Earn \$125 to \$300 a Month

In the Electrical business. Come here where you will be trained in these great \$100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

#### Become an Expert in 3 1/2 Months

No need of taking from 1 to 4 years to become an expert, we have proved this in thousands of cases. The Coyne method of practical training eliminates all books, useless theory and other non-essentials and trains you in just what you need to know to become an expert.

#### Earn Your Way

Don't tell yourself you haven't got the money to come to Coyne. If you have ambition and the nerve of a real man, that's all you need. Dozens of our students every year work in their spare time and earn their living expenses. Dozens of others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

BENNETT W. COOKE, Director

**COYNE TRADE AND ENGINEERING SCHOOLS**

Dept. 25 39-51 E. Illinois Street, Chicago, Ill.

#### Day or Evening Courses

Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment is furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

#### Electricity, Drafting Motion Picture Operating Plumbing

We teach all these trades and professions quickly and in such a thorough, practical way that when finished you are ready to step right into a position of responsibility and big pay.

#### Send Today for Big Free Book

Write today, now, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it now.

#### Learn Drafting

The country is crying for skilled draftsmen in all lines. Thousands of positions open with princely salaries. We give you the advantage of our big shops. No other school can do this. Now is the time to get into this big field. Experts train you under practical working conditions, no books and theory go here. Check drafting on the coupon below and mail it at once for full particulars.

**COYNE TRADE AND ENGINEERING SCHOOLS**  
Bennett W. Cooke, Director  
Dept. 25, 39-51 E. Illinois St. Chicago, Ill.

Please send at once your big Free Book—I am interested in

- Electricity  Drafting  Plumbing  
 Motion Picture Operating  
(Check trade interested in)

**MAIL COUPON FOR FREE BOOK  
NOW!**

Name.....

Address.....

# ELECTRICITY

## AS EXPERTS KNOW IT

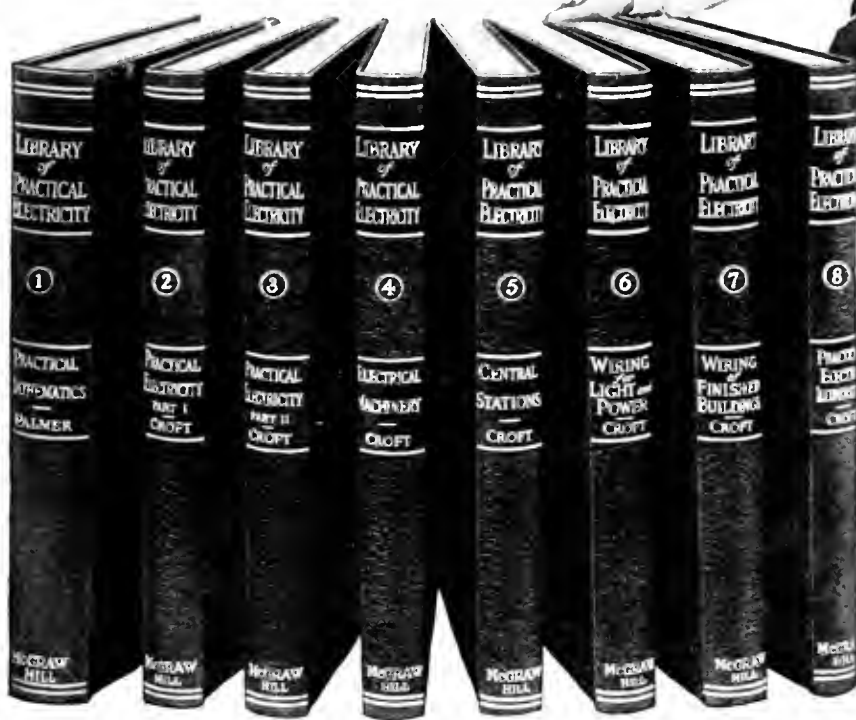
Learn electricity as you would in actual PRACTICE—in accordance with the methods employed by the highest paid electrical experts in America. The New McGraw-Hill Library of Practical Electricity contains the actual working facts which you need in order to succeed in the electrical field. Terrell Croft, formerly with the Westinghouse Company makes the conquest easy for you.

### A new standard in electrical literature

The New Library of Practical Electricity by Terrell Croft marks a new era in electrical literature.

The great field of electrical engineering, with its limitless possibilities of earning power, is brought to you in a form that makes success easy. The Library is a creation—an achievement that is without parallel in technical literature, because it sticks to practice throughout its 3000 pages.

\$2 per month starts you to bigger pay.



Croft's New Library of Practical Electricity. 8 vols.—3000 pages—2100 illustrations

## Now is the time to prepare for a high salary--- Now is the time to master electricity.

Old books won't do. Amateurish books won't do. Books compiled by "desk authors" or men with no practical experience will not serve your purpose.

Practical books are easiest mastered. Practical books, written by practical men, teach you accurately and rapidly. There is nothing in the Croft Library which you cannot understand. Terrell Croft tells you the secrets of success in electricity in plain words, figures and illustrations. Nothing is left to the imagination. There is no guesswork. There is no theory or higher mathematics.

Send now for these eight volumes. No matter how many books on electricity you possess, you are unfair to yourself unless you take advantage of this free examination privilege. No matter whether you are beginner or expert, these books will show you the clear road to success. Inspection will prove this.

**McGraw-Hill Book Co., Inc.**  
239 W. 39th St., New York.



"See them First — Pay afterwards"

A letter that means something to you—

McGraw-Hill Book Company, Inc.,  
239 West 39th Street,  
New York, N. Y.

Gentlemen: In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice.

Respectfully,  
GUY H. PEIFER,  
Chief, Doplan Silk Corporation, Hazleton, Pa.

### Not one cent in advance— Just the Coupon

Examine this new Library for ten full days without expense. Find out for yourself why it is now taking the lead in electrical book sales in America. Use the books as you see fit for ten days. Look at the hundreds of illustrations that clear up all the mysteries in electrical practice. Stick a couple of the volumes in your pockets, and refer to them during the day. Figure out in an instant the problems that have heretofore taken hours.

Then send us \$2 per month for eight months, or return the set entirely at our expense. You risk nothing by returning the attached coupon.

ACT NOW

FREE

**EXAMINATION COUPON**

Name.....  
Home Address.....  
City and State.....  
Name of Employer.....  
His Address.....  
Your Position.....

McGraw-Hill Book Co., Inc.  
239 W. 39th St.,  
NEW YORK

Gentlemen: Please send me the Library of Practical Electricity (shipping charges prepaid) for 10 days' free examination. If satisfactory, I will send \$2 in ten days and \$2 per month until \$16 has been paid. If not wanted I will write you for return shipping instructions.





# Electrical Experimenter

233 FULTON STREET, NEW YORK


Published by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer;) 233 Fulton Street, New York.

Vol. VII. Whole No. 73

MAY, 1919

No. 1

THE THOUGHT RECORDER.....Front Cover	RECLAIMING METAL DUST FROM FLUE GASES..... 26
From a painting by Howard Brown	TRY THESE ON YOUR AUTO..... 27
FUTURE RAPID TRANSIT..... 7	THE TRUE WIRELESS—By Nikola Tesla—Special Feature Article 28
WILL MAN FREEZE THE EARTH TO DEATH..... 8	AMPLIFIER BOOSTS SIGNALS 1,000,000 TIMES..... 31
By E. T. Bronsdon	MULTIPLEX RADIO SYSTEM ADOPTED BY U. S..... 32
HOW THE FRENCH LOCATED SUBMARINES..... 9	NEW FRENCH AND AMERICAN AUDIONS..... 32
VEHICULAR TUNNEL UNDER THE HUDSON RIVER..... 10	NEW REGENERATIVE VACUUM TUBE CIRCUITS..... 33
By H. Winfield Secor	By Samuel D. Cohen
THE THOUGHT RECORDER—NO. 2 FUTURE INVENTIONS..... 12	PRACTICAL CHEMICAL EXPERIMENTS—TESTING OF WOOL, COTON AND LINEN..... 34
By H. Gernsback	EXPERIMENTS IN RADIO-ACTIVITY. PART III..... 35
PARIS LETTER, by Jacques Boyer, Paris Correspondent of the ELECTRICAL EXPERIMENTER..... 13	By Ivan Crawford
LOCATING ENEMY GUNS BY FLASH AND SOUND..... 14	THE CONSTRUCTOR—THE "NOISELESS" PHONOGRAPH..... 36
NOVEL ELECTRICAL TALKING SIGN..... 15	By Thomas Reed
RELIEVING THE SUBWAY CAR CRUSH. By Sidney Gernsback..... 15	AUTOMATIC BELL RINGING ATTACHMENT FOR EIGHT DAY CLOCK..... 37
MY INVENTIONS, PART IV, by Nikola Tesla..... 16	By T. A. Neelin
THE NEW YORK AÉRO SHOW..... 18	HOW-TO-MAKE-IT DEPARTMENT—PRIZE CONTEST..... 40
MONSTER ESCALATOR FOR NEW YORK SUBWAY..... 20	WRINKLES, RECIPES AND FORMULAS. Edited by S. Gernsback..... 42
BRITISH SUBMARINE LOCATER..... 21	LATEST PATENTS..... 43
PUTTING IT OVER ON FRITZ..... 22	WITH THE AMATEURS—LABORATORY PHOTO CONTEST..... 44
By K. K. Saumerin	SCIENCE IN SLANG—THE SPECKS IN SPACE..... 45
COLD LIGHT—WHAT IT IS..... 23	By Emerson Esterling
POPULAR ASTRONOMY—ASTRONOMICAL DISTANCES..... 24	"THE ORACLE"..... 46
By Isabel M. Lewis	



## EDITORIAL

### Practical Science

**T**HE wonderful age in which we are living has never been paralleled in history. We have more comforts, more conveniences, more of everything than human beings ever had, since the creation of the world. Nevertheless, our lives become more and more complex, as time rolls on, while the average human being becomes more perplexed at the strange surroundings in which he finds himself.

Our electro-mechanical age brings forth new surprises constantly, and he who does not know the rudimentaries of mechanics, electricity and general physics is like a blind man in a circus. He hears what is going on, but all is meaningless to him—he cannot get the full benefit of the performance.

Where humanity now finds itself surrounded by machines, and by electrical wires at every hand, it behooves every man to know something about them. Thousands of lives are lost every year because laymen refuse to learn a little about science in general. They get killed because they fight short-circuits with water, when ten minutes of study would have told them that water is a conductor, and that a few handfuls of dry sand—which is a non-conductor—would have saved the life, and the house which burnt down due to the short-circuit. If the father had told his boy that a wet rope is a good conductor for electricity that boy would be alive today. Instead, the boy threw the wet rope over the high tension line, while holding it in his hand, and was killed.

If the six hundred auto owners who were asphyxiated last year—the casualties become larger each year—had known a bit of chemistry, they, too, would be living today. But they insisted upon running their engines in a garage with closed doors, and unfortunately, you can't smell carbon monoxid, even if it is deadly.

Then, too, hundreds of people perish in snow storms every year quite unnecessarily. Usually they freeze to death. The white man runs about in a frenzy when he knows himself lost. He becomes overheated, and the

perspiration soaks his clothing. Finally he sinks down into the snow, exhausted, and if it is cold enough he is soon frozen stiff. Now Eskimos, who have learned a bit of science by hard experience, prefer to live pleasantly thru the worst snowstorm, with the temperature below zero. If the Eskimo becomes lost in the wilderness he knows better than to run about aimlessly. He promptly digs a cave into the snow, with the entrance away from the wind, using only his hands for tools. Inside of ten minutes he is safely ensconced in a comparatively warm shelter. He then closes up the entrance almost entirely, sits down, drops his head on his knees, and has a refreshing sleep. The next morning he digs himself out, and is on his way.

If the writer had not known something about electricity, he, too, might not be here to write these lines. As a boy he went down into an unoccupied cellar. The wind blew the wooden door shut, locking him in, as the iron latch was outside. The only other exit was an open window hole barricaded with stout iron rods, thru which the wind roared. The temperature was below zero. The cellar was empty, save for a few wooden crates, the object of the visit. The cellar being distant from the house and other habitations, the parents away, and the caretaker off for the night, there was every possibility of his freezing to death. No tools to break down the door, no matches to make a fire. But there was a portable light, with two large electric dry cells in a wooden box, which the writer had brought along to light his way.

He unraveled the stranded electric cord and extracted a single thin copper strand an inch long. With this he short-circuited the dry cells. The wire became white hot. A piece of paper was touched to it, which burst into flame; a broken piece of crate wood was ignited by the flame, and a fire soon roared. A burning crate set the cellar door on fire, and in ten minutes the adventure had come to a close.

H. GERNSBACK.

The ELECTRICAL EXPERIMENTER is published on the 15th 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, 25 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 change your address notify us promptly, in order that copies are not miscarried or lost. A green wrapper indicates expiration. No copies sent after expiration.

All communications and contributions to this journal should be addressed to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contribu-

tions 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.

ELECTRICAL EXPERIMENTER, Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered U. S. Patent Office. Copyright, 1919, by E. P. Co., Inc., New York. The contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Breatano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulation.



# The Secret of Being a Convincing Talker

## How I Learned It in One Evening

By GEORGE RAYMOND

**"H**AVE you heard the news about Frank Jordan?"

This question quickly brought me to the little group which had gathered in the center of the office. Jordan and I had started with the Great Eastern Machinery Co., within a month of each other, four years ago. A year ago Jordan was taken into the accounting division and I was sent out as salesman. Neither of us was blessed with an unusual amount of brilliancy, but we got by in our new jobs well enough to hold them.

Imagine my amazement, then, when I heard:

"Jordan's just been made Treasurer of the Company!"

I could hardly believe my ears. But there was the "Notice to Employees" on the bulletin board, telling about Jordan's good fortune.

Now I knew that Jordan was a capable fellow, quiet, and unassuming, but I never would have picked him for any such sudden rise. I knew, too, that the Treasurer of the Great Eastern had to be a big man, and I wondered how in the world Jordan landed the place.

The first chance I got, I walked into Jordan's new office and after congratulating him warmly, I asked him to let me "in" on the details of how he jumped ahead so quickly. His story is so intensely interesting that I am going to repeat it as closely as I remember.



**FREDERICK HOUK LAW**

As educator, lecturer, executive, traveler and author few men are so well equipped by experience and training as Dr. Law to teach the art of effective speaking. His "Mastery of Speech" is the fruit of 20 years' active lecturing and instruction in Eastern schools and colleges preceded by an education at Oxford Academy, Amherst College, Columbia University, The Teachers College, Brown University, and New York University. He holds the degrees of A.B., A.M., and Ph.D.

Dr. Law is the author of two novels, two books of poetry, and editor of six school text-books. At present he is lecturer in English in New York University. Lecturer in Pedagogy in the Extension Work of the College of the City of New York, Head of the Dept. of English in the Stuyvesant H. S. and writer of the Weekly Lesson Plans for The Independent.

"I'll tell you just how it happened, George, because you may pick up a pointer or two that will help you.

"You remember how scared I used to be whenever I had to talk to the chief? You remember how you used to tell me that every time I opened my mouth I put my foot into it, meaning of course that every time I spoke I got into trouble? You remember when Ralph Sinton left to take charge of the Western office and I was asked to present him with

the loving cup the boys gave him, how flustered I was and how I couldn't say a word because there were people around? You remember how confused I used to be every time I met new people? I couldn't say what I wanted to say when I wanted to say it; and I determined that if there was any possible chance to learn how to talk I was going to do it.

"The first thing I did was to buy a number of books on public speaking, but they seemed to be meant for those who wanted to become orators, whereas what I wanted to learn was not only how to speak in public but how to speak to individuals under various conditions in business and social life.

"A few weeks later, just as I was about to give up hope of ever learning how to talk interestingly, I read an announcement stating that Dr. Frederick Houk Law of New York University had just completed a new course in business talking and public speaking entitled 'Mastery of Speech.' The course was offered on approval without money in advance, so since I had nothing whatever to lose by examining the lessons, I sent for them and in a few days they arrived. I glanced through the entire eight lessons, reading the headings and a few paragraphs here and there, and in about an hour the whole secret of effective speaking was opened to me.

"For example, I learned why I had always lacked confidence, why talking had always seemed something to be dreaded whereas it is really the simplest thing in the world to 'get up and talk.' I learned how to secure complete attention to what I was saying and how to make everything I said interesting, forceful and convincing. I learned the art of listening, the value of silence, and the power of brevity. Instead of being funny at the wrong time, I learned how and when to use humor with telling effect.

"But perhaps the most wonderful thing about the lessons were the actual examples of what things to say and when to say them to meet every condition. I found that there was a knack in making oral reports to my superiors. I found that there was a right way and a wrong way to present complaints, to give estimates, and to issue orders.

"I picked up some wonderful pointers about how to give my opinions, about how to answer complaints, about how to ask the bank for a loan, about how to ask for extensions. Another thing that struck me forcibly was that, instead of antagonizing people when I didn't agree with them, I learned how to bring them around to my way of thinking in the most pleasant sort of way. Then, of course, along with those lessons there were chapters on speaking before large audiences, how to find material for talking and speaking, how to talk to friends, how to talk to servants, and how to talk to children.

"Why, I got the secret the very first evening and it was only a short time before I was able to apply all of the principles and found that my words were beginning to have an almost magical effect upon everybody to whom I spoke. It seemed that I got things done instantly, where formerly, as you know, what I said 'went in one ear and out the other.' I began to acquire an executive ability that surprised me. I smoothed out difficulties like a true diplomat. In my talks with the chief I

spoke clearly, simply, convincingly. Then came my first promotion since I entered the accounting department. I was given the job of answering complaints, and I made good. From that I was given the job of making collections. When Mr. Buckley joined the Officers' Training Camp, I was made Treasurer. Between you and me, George, my salary is now \$7,500 a year, and I expect it will be more from the first of the year.

"And I want to tell you sincerely, that I attribute my success solely to the fact that I learned how to talk to people."

\*\*\*\*\*

When Jordan finished, I asked him for the address of the publishers of Dr. Law's Course and he gave it to me. I sent for it and found it to be exactly as he had stated. After studying the eight simple lessons I began to sell to people who had previously refused to listen to me at all. After four months of record breaking sales during the dulllest season of the year, I received a wire from the chief asking me to return to the home office. We had quite a long talk in which I explained how I was able to break sales records—and I was appointed Sales Manager at almost twice my former salary. I know that there was nothing in me that had changed except that I had acquired the ability to talk where formerly I simply used "words without reason." I can never thank Jordan enough for telling me about Dr. Law's Course in Business Talking and Public Speaking. Jordan and I are both spending all our spare time making public speeches on war subjects, and Jordan is being talked about now as Mayor of our little town.

So confident is the Independent Corporation, publishers of "Mastery of Speech," Dr. Law's Course in Business Talking and Public Speaking, that once you have an opportunity to see in your own home how you can, in one hour, learn the secret of speaking and how you can apply the principles of effective speech under all conditions, that they are willing to send you the Course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete Course will be sent, all charges prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the Course, send only \$5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

FREE EXAMINATION COUPON

### Independent Corporation

Publishers of The Independent Weekly  
Dept. L-1105 119 West 40th Street, New York

Please send me Dr. Frederick Houk Law's "Mastery of Speech," a Course in Business Talking and Public Speaking in eight lessons. I will either re-mail the Course to you within five days after its receipt, or send you \$5.

Name .....

Address .....

..... Elect. Exp. 5-19

# The Burgess BLUE BOOK

## for all Practical Men and Electrical Students

(See review of this book by Editor in December issue of your Electrical Experimenter page 568)

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Con-

nections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

### WHAT PRACTICAL MEN SAY ABOUT THE "BURGESS BLUE BOOK"

Received your "Blue Book" and must say it is the best book I ever saw. I showed it to a friend of mine and he refused to give it back to me but he paid me a dollar and told me to get another. Rather than be without this book I am sending Money Order for three of them so I can show them to two more of my friends and have one left for myself. Wishing you would mail them at once. I am

Yours very truly,  
JOSEPH BRAITH, Electrician,  
Madison, Wisconsin.

Your "Blue Book" received and it is just the book I have been looking for. Please mail me three more by return mail for which I am enclosing Money Order. Respectfully,

V. E. JOHNSON, Western Union Tel. Co.,  
Marion, Ohio.

Have received the copy of the "Burgess Blue Book" and am very well pleased with the easily found formulas and data contained in it. I am enclosing Money Order for four additional copies.

Very truly yours,  
THURE C. ANDERSON,  
Ridgeway, Penn.

Dear Sir:—There can be no possible question as to the service you are rendering Electrical Workers. To date I have received 78 Burgess Blue Books and hope my friends will dup-

licate their order to you. Go ahead with this good work.  
Yours truly,

EDW. C. RAY,  
Brooklyn, New York.

I am enclosing three dollars for which please send me three copies of the "Burgess Blue Book". I showed the copy I got last week to some friends and three of them asked me to get them one.

Very truly yours,  
CHAS. H. DAVIS,  
Los Angeles, Cal.

I received your "Blue Book" and after I looked over it I see that it is a very useful book. After I showed it to some fellows they wanted a copy also and I am enclosing Money Order for which please send me three at once. Yours very truly,

R. S. SWANSON,  
St. Paul, Minn.

I received the three books I sent for and the next day I sold them. The fellows think they are well worth the price. Please send me three more for which I am enclosing Money Order. Yours very truly,

R. S. SWANSON,  
St. Paul, Minn.

### NOTICE

To help get the "Burgess Blue Book" to the men who need it the most, we have established a resale discount to which those who have purchased a book from us are entitled. In this way the "Blue Book" is sold by those who know its value and we feel that this arrangement is much more satisfactory to the purchaser, than if he bought it through the regular book-selling channels. The book practically sells on sight, as a man engaged in practical work realizes when he sees it, it contains information which is extremely useful and which is difficult to obtain.

**The Burgess BLUE BOOK Will Be Shipped, Postpaid, on Receipt of \$1.00**

Send dollar bill, money order or check. I guarantee satisfaction or will return your money if you decide not to keep the book after using it for five days

**BURGESS ENGINEERING CO.,** YORKE BURGESS, Consulting Engineer  
747 East 42nd Street Chicago, Illinois



**Was  
\$100**

**Now  
\$57**



## The Famous Oliver For Free Trial—Then Save \$43

This is the identical \$100 Oliver, Model 9, our latest and best. We continue to sell it under the plan we adopted during the war.

We learned economics then in selling which enable us to save the \$43 it formerly cost us to sell you an Oliver.

We learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Only our sales plan has changed. Not the Oliver. Our new plan is to ship direct from the factory to you, depending upon the Oliver to be its own salesman.

You may order direct from this advertisement, without sending a penny. The coupon brings an Oliver for free trial.

When the Oliver comes to you, let it prove its superiority and saving. You be the judge, with no eager salesman present to influence you.

If you do not agree that it is the finest typewriter built, regardless of price, simply return it, express collect. Even the outgoing transportation charges will then be refunded.

The Oliver for \$57 makes a \$100 price appear extravagant. Remember this is not a second-hand or rebuilt machine. If any typewriter is worth \$100, it is this brand new Oliver.

Furthermore, it is as easy to buy The Oliver as it is to try it. If, after trying it five days you decide to keep it,

you merely pay \$3 per month until the \$57 is paid. This is less than 10c per day.

This Oliver is being bought by the thousands. Our plan, conceived when this country entered the war, has met a tremendous welcome. We have repeatedly increased our production facilities. Note at the left a few of the great concerns using the Oliver. And remember that it is being bought by thousands of individuals. It has been aptly called the people's typewriter.

In every particular, this splendid Oliver is the finest that 24 years of experience can produce. A better typewriter is impossible. It has all the latest improvements. It is noted for its handsome appearance, richly enameled olive green and polished nickel; its durability and workmanship. Do you know of any typewriter which combines so many advantages, yet offered at such a low price and easy terms?

This Oliver has a standard keyboard. So anyone may turn to it without the slightest hesitancy. It is speedy and has an untrifling action—with lightest touch.

Don't buy—don't rent—until you have investigated this fine economical Oliver. Note that the coupon below brings either an Oliver for Free Trial, or further information.

**Canadian Price, \$72**

**The Oliver Typewriter Co.**

675 Oliver Typewriter Bldg.

Chicago, Illinois

### Some of the famous users

U. S. Steel Corporation

Pennsylvania Railroad

Nat'l City Bank of New York

Morris & Company

Encyclopedia Britannica

Boston Elevated Railways

Otis Elevator Co.

Corn Products Refining Company

Columbia Graphophone Co.

N. Y. Edison Co.

Hart, Schaffner & Marx

Diamond Match Co.

Baldwin Locomotive Works

American Bridge Co.

**Over 700,000 Sold**

(4.02)

**Save \$43 by using  
this coupon**

THE OLIVER TYPEWRITER COMPANY  
675 Oliver Typewriter Building, Chicago, Ill.

Ship me a new Oliver Nine for five days free inspection. If I keep it, I will pay \$57 at the rate of \$3 per month. The title to remain in you until fully paid for. My shipping point is..... This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of 5 days.

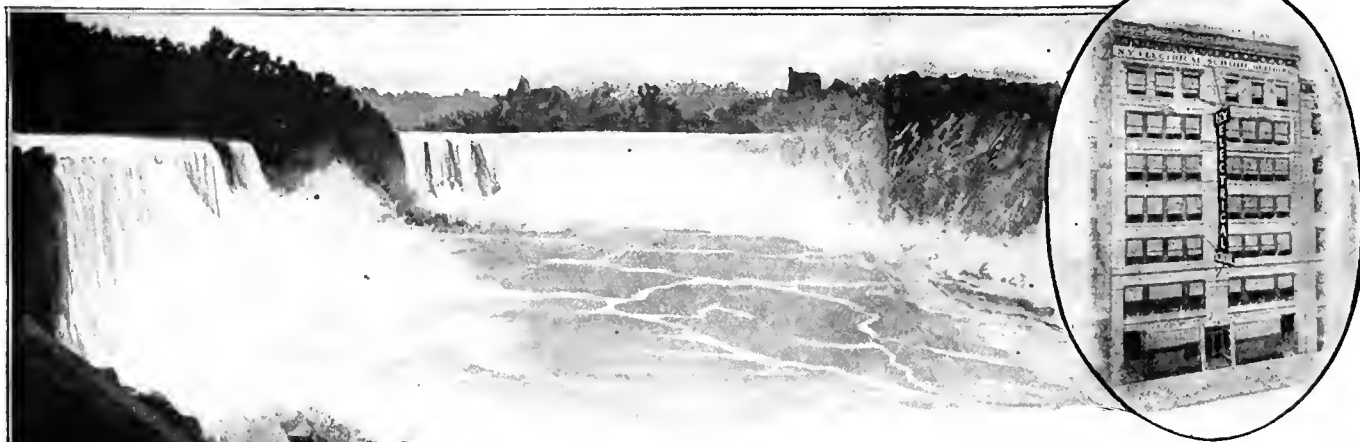
Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address .....

City .....State .....

Occupation or Business.....



# Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing*. That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

## The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business method and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

### Over 5,500 Graduates are Successful Men in the Electrical World

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

Let us explain this course to you in person. If you can't call, send now for 64-page book—it's FREE to you



New York Electrical School  
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

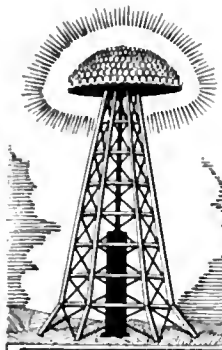
.....(NAME)

.....(ADDRESS)

# New York Electrical School

29 West 17th Street, New York





# ELECTRICAL EXPERIMENTER

H. GERNSBACK - EDITOR  
H. W. SECOR - ASSOCIATE EDITOR



Vol. VII. Whole No. 73

MAY, 1919

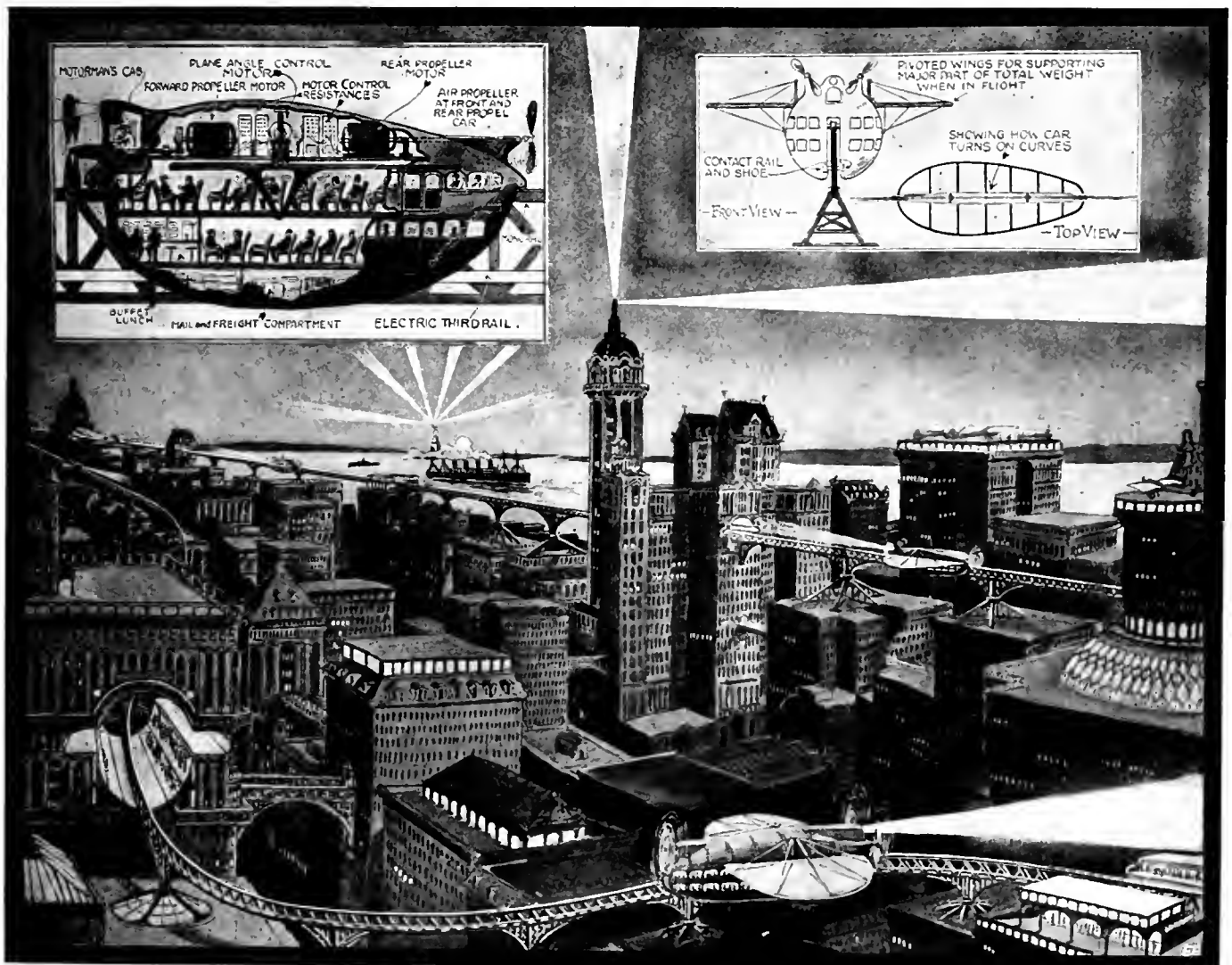
No. 1

## Future Rapid Transit

PEOPLE who have traveled abroad will remember having seen the remarkable suspended aerial railway of Elberfeld (Germany), the cars having wheels on the roof instead of underneath, and but one rail being used. This form of construction gives, among other considerations, much greater flexibility to the speeding cars or trains, as for example when they wish to turn sharp curves at comparatively high speed. Possibly many will remember having seen this

interesting suspended railway in the motion picture travelogues given by Burton Holmes. It has always seemed to us, however, that these cars have a little too much freedom of movement to make the ride as comfortable as it might be to the passengers, owing to the constant swinging or side-wise rolling motion produced by this cradle suspension arrangement. Apparently there are other people who have entertained similar ideas, for in the accompanying illustration there is shown a new development of a

monorail car, which might be termed an "Aerial Monollier," and which has been recently invented and patented by the celebrated French engineer, M. Francis Laur of Paris. As M. Laur points out in his description of the invention, his scheme relates to an improvement in a vehicle for use in high speed locomotion in connection with a monorail or single track. A very novel idea of the project is a passenger-carrying vehicle somewhat in the form of  
(Continued on page 66)



The Aerial Monollier of Tomorrow—Equipt with Wings. Like an Airplane, It Will Skim Along Thru the Air, Guided by the Monorail. The Cars Are Propelled by Motor-Driven Propellers, Which Derive Their Power from Third Rails, as the Car Glides Along at Speeds of 200 to 300 Miles Per Hour. When in Motion the Entire Weight Is Practically Carried by the Wings, the Same as in an Airplane.

# Will Man Freeze the Earth to Death?

By E. T. BRONSDON

**T**O RENT: Ten-room suburban home. Three baths. Sun, sleeping and breakfast porches. Radium heating system (20 pounds) . . ."

To find this advertisement, look in the classified columns of any metropolitan newspaper five or six centuries hence. Our great-great-grandchildren fifteen times removed will be worrying about paying the rent on some such dwelling. Have you paid your "Radium Rent" will be a common slogan then.

Radium power, light and heat for apartment and home will seem as much of a commonplace to them as soft coal furnaces seem to us. In tomes of ancient history they will read stories of how their ancestors struggled thru the smoky winter of 1918, and they will marvel at our lack of understanding. Soft coal then will have a place only in museums.

Twenty pounds of radium gives off an amount of heat in six months equivalent to that secured by burning four and one-half tons of the best Pocahontas or anthracite coal. The ten-room house mentioned above would be adequately heated, however, on twenty pounds, because a radium heating plant would be *one hundred per cent efficient*. Even with hot water and hard coal from eighty to ninety per cent of the heat our plants generate goes up the chimney. A radium system would have no chimney. Every single heat unit would be conserved for the interior of the house and distributed by any ordinary medium, such as register, radiator or the like.

In addition to this, the radium system would have the splendid recommendation for

urday afternoon. Then there would be the greatest point of all. Once installed, this radium system *never would have to be replaced!* When one house began to disintegrate from old age, the mysterious metal could be taken out and installed in the system of a new house, and so on forever, unless some careless janitor took it out to clean and left it in the subway. Coal men and ash carters would pass into that same merciful oblivion which shelters stage-coach bandits and Indians on the war-path.

The reason why such a radium system would never have to be replaced is that radium is the one and only close approach to perpetual motion to be found on our globe. Look at a piece of radium one-thousandth the size of a pin point thru a *spintariscope*. This is an instrument consisting of a high-magnifying lens and an aluminum disc covered with zinc sulfid. When viewed in this manner millions of tiny arrows of fire are seen to be flying from the radium and impinging on the zinc sulfid with an explosion like that of a fire ball from a Roman candle.

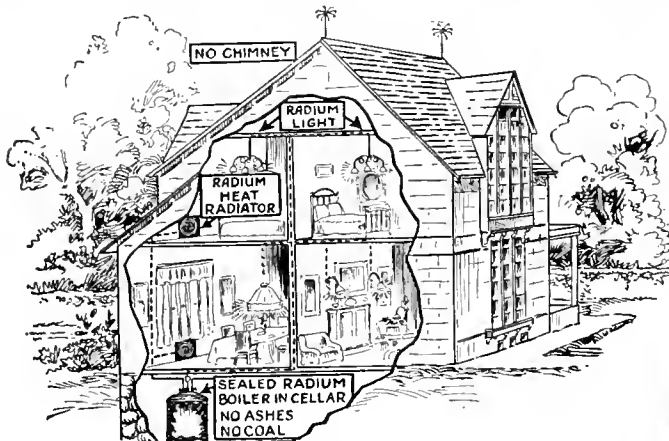
Tho each of the exploding projectiles of helium—radium somehow transforms itself into active atoms of this other element—looks nearly as large as the original divot of radium, you may glue your eye to the spintariscope for hours—centuries, if you live that long—and you never will see any diminution in the discharge or in the size of the radium piece.\* Scientists who have given the matter intensive study over long months and years say that they suspect radium of losing an infinitesimal part of its

ject unless a dynasty of scientific Methuselahs is established.

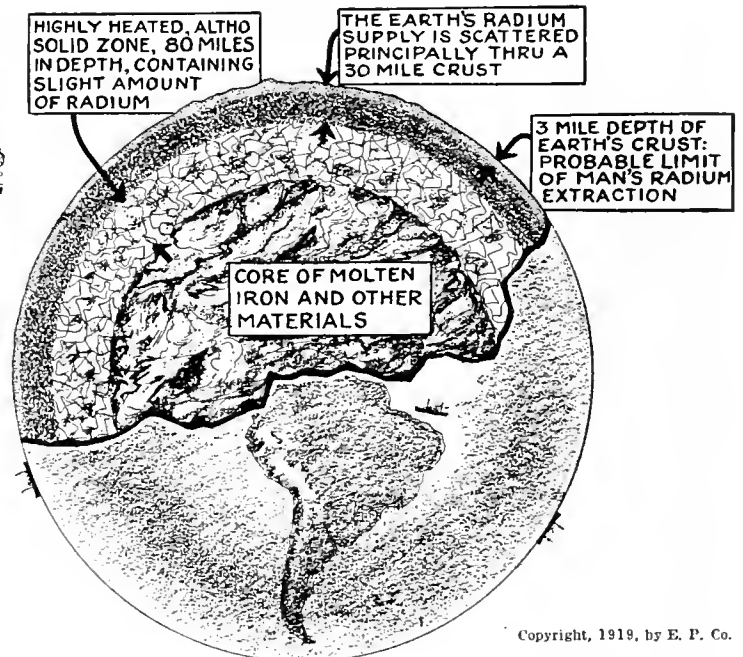
The one big obvious objection at present to the use of radium for heating plants lies in the scarcity and tremendous cost of the metal. One ounce only would cost, at the present market price, approximately \$40,000. The twenty pounds necessary for heating the ten-room house mentioned would retail at \$12,800,000, were such a quantity procurable. Figuring interest at six per cent, the cost of that radium heating system for a year—excluding the original investment, which would not appreciably deteriorate—would be in the neighborhood of \$768,000, or about 4,000 times the cost of coal heating today.

The only logical reason in the world for even allowing imagination to roam on this subject lies in the terrible and undisputed fact that *somewhere we are going to have to get heat if we are to live!*

So much space has been given in the last decade to learned dissertations on our rapidly decreasing supplies of coal and petroleum that it is useless to dwell on this. Suffice it to say that the last reports of competent authorities state baldly that we will surely be out of both *forever* at the conclusion of the present century, provided our present rate of consumption is neither raised or lowered. Since we have no assurance that the rate of increase of consumption will not keep on, we may bet safely that the year 1975 will see coal and oil so scarce that only millionaires can afford them. Coal then may be \$500 a ton, and crude oil \$25 a gallon. Alas for the "flivvers"! Imagine Mr. Autoist of that day



Radium Power, Light and Heat for Apartment and Dwelling Will Seem as Much of a Commonplace to Those of Future Generations as Soft Coal Furnaces Seem to Us. In Tomes of Ancient History They Will Read Stories of How Their Ancestors Struggled Thru the Smoky Winter of 1918, and They Will Marvel at Our Lack of Understanding. All Because of the Wonderful Power of "Radium" to Give Off Energy—Convertible Into Heat, Light, and Power, for a Practically Indefinite Period. At Any Rate for Thousands of Years. So the Principal Problem We Have to Solve Is—How to Find a Far Cheaper Way to Remove the Radium Than We Have at Present. And Why Should We Do This? Because, as Mr. Bronsdon Points Out, the Coal Supply of the World Is Fast Giving Out. On the Other Hand, Man Must Not Remove Too Much Radium from the Earth or the Earth May Freeze to Death.



Copyright, 1919, by E. P. Co.

that there would be no flues, traps or pipes to be cleaned, and no ashes would accumulate to make the householder angry on Sat-

actual weight in the course of a few eons, but that human beings are going to have trouble gathering accurate data on the sub-

going into the garage and asking for a new "can" of Radium for his "Radiobile." It can happen. (Continued on page 59)

\*This is not strictly the case, for the zinc sulfid spintariscope we have to-day, for while the radium will last for thousands of years, the zinc sulfid will give out in a relatively short time. However, there are undoubtedly other substances which would last much longer than zinc sulfid. Another variable factor, variable in the sense that we have not lived long enough with radium yet to tell exactly how long it will last before losing its power, is the total life of this marvelous substance. Scientists tell us that in 1,800 years radium loses one-half of its activity. In another 1,800 years one-half of the remainder will have disintegrated, etc., etc. So that on this assumption the radium will have totally disintegrated in 22,000 years.—Editor.



# How the French Located Submarines

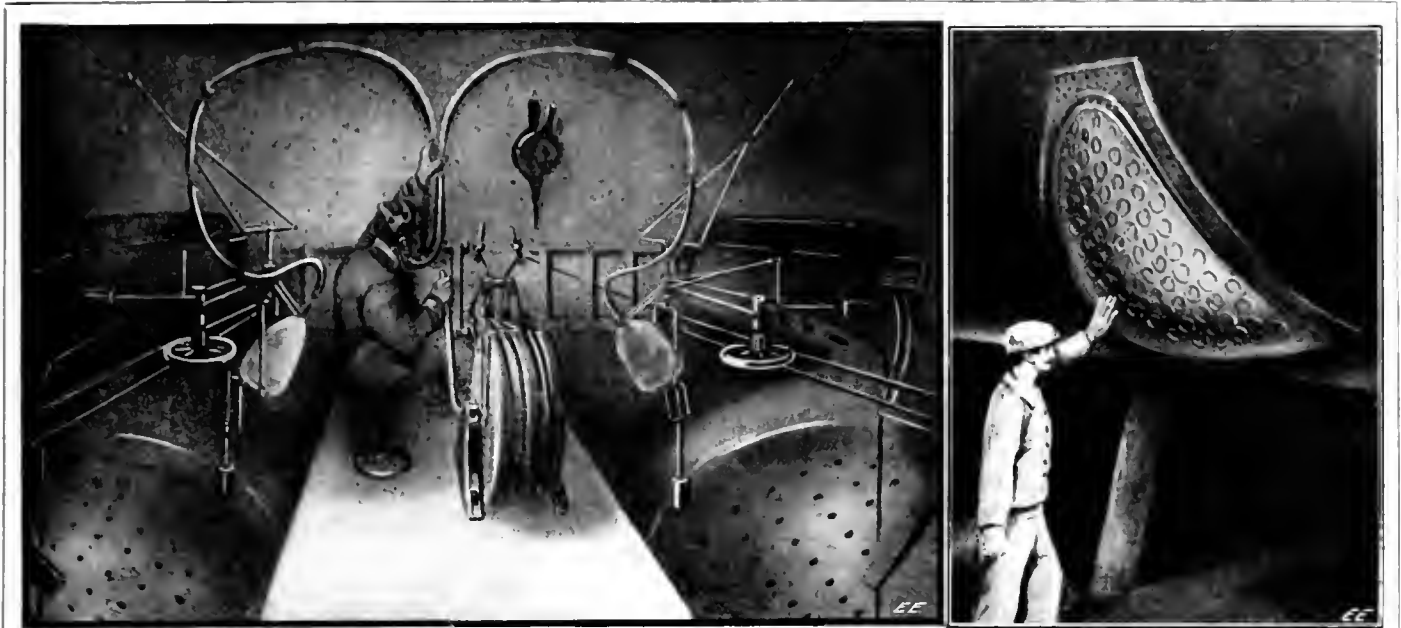
ONE by one the multitudinous scientific secrets of the great World War are finding their way to the public press, so that the student of science may at last have his appetite appeased in his quest of descriptive

depending upon the operating conditions and the size of the submarine.

The Walser Gear, whose construction has been kept secret during the war, is a directional apparatus for detecting and recording sounds heard thru water and thus locating

mized as the most improved type and most practicable.

The sounds are received thru a number of vibrating diaphragms fitted into holes pierced in a boss, or "blister" of sheet steel, which replaces a corresponding sec-



Photos International Film Service

The Walser Gear—a Type of Hydrophone Used for Submarine Listening. The Walser Gear, Whose Construction Had Been Kept Secret During the War, is a Directional Apparatus for Detecting and Recording Sounds Thru Water and Thus Locating the Presence or Approach of Enemy Ships. This Apparatus is the Invention of Lieut. Georges Walser, of the French Navy, and is Recognized as the Most Improved Type and Most Practicable. The Sounds are Received Thru a Number of Vibrating Plates Fitted Into Holes Pierced in a Boss, or "Blister" of Sheet Iron, Which Replaces a Corresponding Section of a Ship's Hull. The Observer Works in a Sound Proof Cabin Stretching Across the Whole Width of the Ship, and Wears a Listening-helmet, Attached to Two Trumpets. Into These Trumpets the Sounds are Focused By the Vibrating Plates Attached to the "Blister." Left:—Detecting the Presence of Enemy Ships On or Under the Surface of the Sea. An Observer Using the Walser Gear in a Special Cabin Fitted Up as a Listening Post. Right:—On the Hull of the "Henriette II", a French Warship Which is Using the Apparatus, Showing the Exterior of the Sound—Collecting Boss or "Blister".

matter on some of the master problems which have been worked out and solved by engineers and scientific workers connected with army and navy developments. Probably no one problem in the whole war drew more attention from laymen and scientists alike than did the one of accurately discovering and locating the whereabouts of the Kaiser's U-Boats. The United States Naval Advisory Board received thousands upon thousands of suggestions, all telling how very simple it was to ferret out and locate the position of an enemy submarine, just by placing a microphone or set of microphones in the hull of a vessel and connecting these up with a set of telephone receivers, so that the sound produced by the submarine propeller and motor would be picked up by the microphones and thus heard in the receivers. Various methods were described for taking certain definite and very precise measurements along these lines, so as to work out mathematically or otherwise the position of the lurking sub-sea fighter. Considerable success was obtained with similar arrangements by the navies of the different countries participating in the World War, but the Walser gear—a special type of hydrophone used particularly for listening to submarines under water was developed and successfully used by the French Navy and other allied vessels for accurately locating enemy submarines at distances of one mile to three miles or more,

the presence or approach of enemy ships. Many different devices for "listening" for enemy ships have been disclosed, but this apparatus, the invention of Lieut. Georges Walser, of the French Navy, is recog-

tion of a ship's hull. The observer works in a sound-proof cabin stretching across the whole width of the ship, and wears a listening helmet attached to two trumpets. Into these trumpets the sounds are focused by the vibrating diaphragms attached to the "blister."

Some of the disadvantages of the ordinary listening microphone arrangement for the detection of submarines are the following: Invariably the vessel on which they are mounted has to be stopt momentarily while a listening test is being made, in order that the ship's engines shall not drown out the sounds which the listening operator is endeavoring to pick up from the sea. It is interesting to mention in this connection, that some of the American listening devices of this type were so remarkably sensitive that even a small dynamotor used on the regular wireless apparatus on the vessel had to be mounted on springs, so that the extremely slight mechanical vibration set up by it would not interfere with the sounds picked up from the water on the submerged microphones fastened to the hull of the boat. Another fault found with the ordinary "hydrophone" is that the different sounds received simultaneously could not be distinguished very readily from one another, and even if but one sound was picked up, the direction from which the sound emanated was not very perfectly indicated.

Practically speaking then, one of the (Continued on page 82)

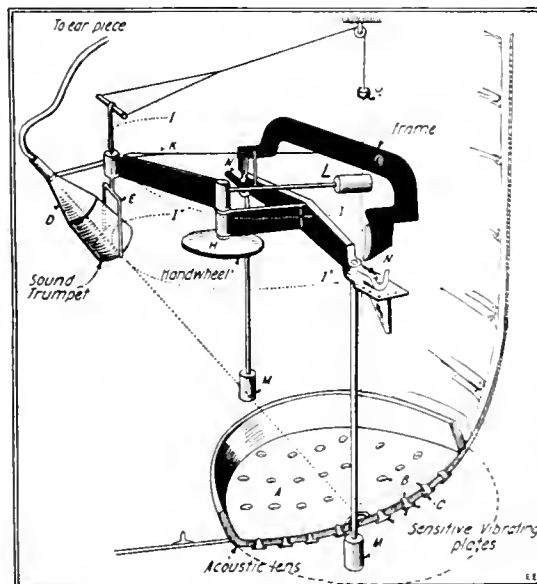
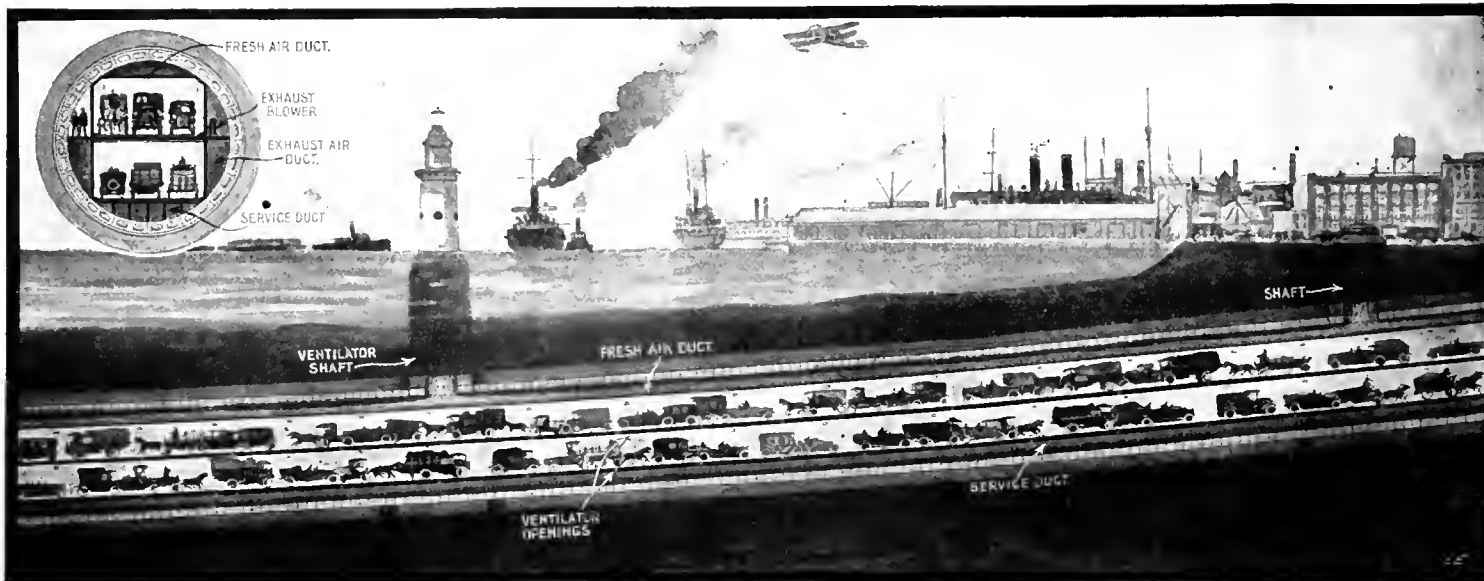


Diagram of One "Lens" of the Walser Submarine Detector and Locator, Showing the Carefully Worked Out Balancing Scheme for Supporting the Movable Sound Trumpet Over the Various Sound Focal Points.



The Accompanying Sectional View Shows Vividly How the New Vehicular Tunnel Under the Hudson River at New York City Will Look When Finished. There Seems to be No Question at Present as to the Possibility of Building This Tunnel, and the Only Remaining Details Are Engineering Considerations Such as Ventilation, Etc., Which Are Being Rapidly Solved by Some of the Crack Engineers of America, Including No Less a Personage Than General George W. Goethals, Builder of the Panama Canal, and Now Holding the Position of Consulting Engineer to the Interstate Bridge and Tunnel Commissions of New York and of New Jersey. Several Other Proposals Have Been Brought Forward for the Building of This Tunnel Under the Hudson River, But the Goethals Plan Seems to be the Most Feasible, and the One Most Likely to be Adopted. The Length of This Vehicular Tunnel Will be About 9,400 Feet from Portal to Portal, with a Distance of 5,500 Feet, or More Than a Mile Separating the Bulkhead Lines, if These Are Placed Back of the Shore Line. In View of the Fact that the Ventilation Problem is at Present One of the Most Important, and the One Responsible for the Most Discussion Among Tunnel Experts, We Have Several Suggestions in the Present Article and Illustrations Which Might, if Adopted, Help to Bring About the Early Adoption

THE bridging of the Hudson River, commonly known as the North River in New York City, is an engineering problem that has been before the people of the states of New York and New Jersey for probably more than thirty years. A bridge across this great water highway would no doubt have been constructed many years ago, if it had been found possible to raise sufficient funds to render this dream a living reality. Engineering experts have recently bestirred themselves with the thought of crossing the Hudson either by bridge or else by means of a tunnel, particularly a vehicular tunnel suitable for horse-drawn, electric and gasoline propelled vehicles. The bridge question seems to have been discarded practically altogether now, owing to its tremendous initial cost, which would be about \$72,000,000 at least, compared to the initial cost of \$12,000,000 for constructing a large tunnel under the Hudson on the newly revised plan proposed by General George W. Goethals, the well-known American engineer and builder of the Panama Canal. General Goethals has been appointed consulting engineer to the Interstate Bridge and Tunnel Commissions of New York and of New Jersey. There are many reasons why New York should have means of communication such as this, as its sister state supplies, either directly or indirectly, a very large portion of the food and other commodities for greater New York's population of 7,000,000, which is brought to the piers on the west side of the Hudson by numerous railroads. Right here there is a constant and prohibitive wastage of perishable food products, owing to the highly congested and inadequate terminal facilities afforded for their movement.

At the present time there is more or less agitation in the legislatures of both states between those friendly and unfriendly to the Hudson River project. So far the one great problem, according to some of the testimony being given, and which has seemed almost insurmountable, is the proper ventilation of this tube, especially where gasoline driven vehicles are to be permitted to exhaust devitiating gases into the air of the tunnel. But according to a very able engineering report on this project, given in the Journal of the Franklin Institute and prepared by Martin Schreiber, Chief Engi-

neer of the Public Service Railway Company of New Jersey, the ventilating problem of such a tunnel as proposed by General Goethals and other engineers can be readily taken care of, as actual laboratory tests have proven, and which have provided a satisfactory basis for calculating the results of such a long tunnel as that under the Hudson. Also to back up the argument for building the tunnel, there is precedence afforded by the fact that London, England, has built two vehicular tunnels under the Thames River, one 6,200 feet long, and the other 6,883 feet long.

The editors make several new tunnel suggestions, which are shown in the illustration accompanying this article, whereby the gigantic ventilating problem could be overcome to a large extent by controlling the kinds of traffic that should be allowed to pass thru the tube. First, the writer would suggest that the engineers contemplating the building of this tunnel consider a cable-way, one of which would be provided on each roadway, east and west, for the purpose of hauling gasoline operated vehicles thru the tunnel, *without their engines being operated*, thus doing away with the production of the objectionable carbon monoxid and other poisonous gases emanating from their exhaust. It would not be an impossible, or even impracticable matter, if such an electric motor-operated cable-way, similar to the old cable-car systems, were used to haul the gasoline vehicles thru the tunnel to Jersey or to New York. It could be arranged to have the owners purchase a standard cable grip, which could be fitted on to any gasoline vehicle at nominal cost.

Another proposal, made by Mr. H. Gernsback, is one employing a *moving roadway* of sufficient width to accommodate gasoline auto trucks, the roadway being operated by electric motors spaced at suitable intervals along its length.

Another proposal suggested by the writer would be to utilize a trolley wire over the

one line of traffic apportioned to gasoline vehicles on each roadway, and having the owners of these vehicles equip them with a trolley pole, but by the time the owners had installed an electric motor under the gasoline vehicles for use with it, it would probably be just as well for the tunnel operating engineers to ask the owners of such vehicles to invest in electric trucks for that particular traffic intended to go via the tunnel.

All of the tunnel proposals now under consideration agree on the location, which extends from Twelfth Street, Jersey City, to Canal Street, New York. The termini of the tunnel at both ends are located in the center of the trucking and freight districts. The New Jersey terminus is also happily located adjacent to the great freight yards of the principal railroads, and close to the main ferry lines, thus providing every chance for close co-operation. Besides, the great Lincoln and other much used vehicular highways lead to the location proposed for the Jersey City terminus.

The Hudson tubes as well as the Pennsylvania tunnels under the Hudson River, which are used for railway traffic exclusively, were driven by the well-known shield method. General Goethals, in his proposal for the new Hudson vehicular tunnel, has advocated the shield-driven double-deck single tube, as shown in the accompanying illustration. This tube is to have an internal diameter of 36 feet, with two 18-foot roadways, one super-imposed above the other, and a concrete floor between them. This proposal for the tunnel would permit of four lines of vehicles, two on each roadway, two of the faster moving type such as pleasure automobiles on the upper floor, and two of the slower moving vehicles, such as auto-trucks, on the lower floor.

Most of these under-river tubes have been constructed with cast-iron blocks built of segmental form, which were bolted together after being put in place, and which thus tended to resist any external hydrostatic

## Hudson River

By H. WINFIELD

Associate Member American



of the Tunnel Project. Among These Features Are the Following:—First, That a Ventilator Shaft be Placed a Comparatively Short Ways Out in the River at Either Approach, So as to Simplify the Ventilating Problem by Reducing the Length Between the Bulkheads. Second, That Gasoline Vehicles be "Hauled" Thru the Tunnels So as to Eliminate the Fouling of the Air by Obnoxious Exhaust Gases, Particularly Carbon Monoxid, by Means of a Moving Platform. Third, Haul Gasoline Vehicles Thru the Tunnel by a Cableway Similar to the Well-Known Cable Car System. Fourth, Cause the Gasoline Vehicles to be Fitted with a Trolley Pole and Electric Motor for the Purpose of passing Thru the Tunnel Without Discharging Obnoxious Gases. The Goethals Proposal Calls for a Concrete Block Tunnel, 42 Feet in Outside Diameter, with Two Road Levels, as Here Shown. One Roadway Will be for East-Bound Traffic, and the Other for West-Bound Traffic. Actual Laboratory Tests On a Short Length of Tunnel Have Shown That 750 H.P. Would be Required to Operate the Fresh Air and Exhaust Fans, with a Maximum Capacity of 360,000 Cubic Feet of Fresh Air Per Minute.

# Vehicular Tunnel

SECOR

Institute Electrical Engineers

pressure with great power, much in the same way that the stones of an archway tend to support the arch. The outside of these segmental steel tubes is covered over with a fairly thick coating of concrete. Here is where the Goethals proposal differs radically from former practise, and there is considerable discussion now taking place as to the feasibility and practicability of his proposed design, which is as follows:

General Goethals' proposition is that the tunnel be constructed of O'Rourke concrete blocks in segmental form. Outside of this tube a gravel packing is to be placed. Some experts seem to doubt whether such a tube would be thoroly water-proof, and also what would happen in case of an earthquake or other severe concussion, as when a powder boat or supply of explosives might happen to blow up in the harbor, as has occurred several times during the war, when the concrete tube might crack with an appalling loss of life.

Detailed plans have been drawn up by the New York State Bridge and Tunnel Commission, under the direction of Major General George W. Goethals and John F. O'Rourke, which provide for the driving of the tunnel by the use of a shield forty-two feet in diameter—the method most usual when dealing with soft material. The material under the Hudson River is a soft silt and sand overlaid by still softer material of sewage origin, which is almost fluid. These conditions are complicated by the presence of ledge rock which is occasionally encountered. In a shield having a diameter of twenty-five feet, there is a difference in pressure between the top and bottom of ten pounds per square foot. This makes it difficult to guard against blow-outs and other accidents caused by the difference in pressure at the top and bottom of the shield, tunnel experts consulted by the state commissions have pointed out.

The diameter of the shield used in driving the Hudson tunnel was 17 feet; that of

the Pennsylvania tunnel shields 23 feet 6 inches. The latter were the largest ever used under either the Hudson or the East rivers. The Rotherhithe tunnel, under the Thames River in England, was driven with a shield 30 feet in diameter thru clay mixt with shells, pebbles, loam, a much firmer material than that under the Hudson.

Of course, the traffic would have to be handled so that approximately half of the vehicles would move *eastward* and the other half *westward*. Once the tunnel is built, however, this becomes a problem for the traffic engineers of that year to solve. According to the Goethals plan, the fresh air duct is at the top of the tunnel, and fresh air is constantly pumped along this duct by means of powerful electrically-driven blowers and fans, while the foul air, including exhaust from the gasoline vehicles, is drawn out thru ducts at the bottom of the roadway. Besides, there are additional ventilating and foul air ducts at either side of the tunnel, walled off from the roadways.

To find out exactly what would happen in a section of such a tunnel with a number of gasoline vehicles operating their engines therein, a test building, corresponding in cross-section to the proposed tunnels and measuring 125 feet in length, was constructed at Newark, N. J. Eight automobiles were operated in this building, which could be shut off air-tight and fresh air pumped in at the top and the exhaust pumped out at the bottom, or vice versa. A number of elaborate tests of various kinds were carefully made by experts, including Professor Gellert Alleman, of Swarthmore, Pa., and Dr. H. Jermain Creighton, of Swarthmore College. From a very elaborate and convincing analysis on the various gases present in the tube after the automobiles had been operated for a period of forty minutes, Prof. Alleman reported that when all doors were closed and the ventilators opened, after the engines of eight

cars had been *running light* for forty minutes, the condition of the atmosphere was almost normal, so far as physiological action was concerned, and the amount of carbon monoxide content not dangerous. This calculation was further supported by the fact that eighteen persons who remained in the tunnel during the test for a continuous period of forty minutes experienced no unpleasant sensations from breathing the air. The contaminated air in this particular test showed .075 per cent. carbon monoxid, and 6 per cent. carbon dioxide, which proved that the per cent. of carbon monoxid was so small as to be negligible. With the data thus obtained, it was calculated that air supply fans with a maximum capacity of 360,000 cubic feet of fresh air per minute, and exhaust fans having 20 per cent. more capacity, would be required to ventilate the tunnel. The total amount of horse-power computed for operating these fans was 750 H.P. The length of the proposed tunnel under the Hudson, from portal to portal, would be approximately 9,400 feet, with a distance of about one mile, or somewhat over 5,000 feet between the bulkhead lines.

As aforementioned, London has built two vehicular tunnels under the Thames, one 6,200 feet long, the other 6,883 feet. Public interest in tunnels for New York was aroused about thirty years ago by Austin Corbin, who proposed tubes under both the Hudson and East Rivers. Scientists charted the bottoms of the two rivers and reported that tunnel construction was feasible. Perhaps it might have been undertaken at that time but for Mr. Corbin's death. Twenty years later William G. McAdoo undertook this work. President Cassatt, of the Pennsylvania, persuaded his directors to authorize the construction of tubes under the Hudson, also under Manhattan Island, extending under the East River to Long Island.

The total underwater section of the tube will be about 13/5 miles, and it is conservatively estimated that it will have a daily capacity of approximately 100,000 vehicles. Statistics compiled from data of 1917 show that during that year 4,800 vehicles crossed over the five ferry lines between New York and New Jersey in the vicinity of the proposed tunnel every day. The material thru which the trench must be dug is soft silt and mud.



COMING INVENTIONS

# THE THOUGHT RECORDER

By H. GERNSBACK

When the writer first conceived the idea of the thought recorder, he asked three prominent scientists regarding their views on recording thoughts electrically. The letters are reproduced herewith excerpted. It will be noted that Nikola Tesla disagrees with the writer as to thought transmission at all, but his letter nevertheless will give considerable food for thought to many readers.

Dr. Lee de Forest, inventor of the audion, is not too sure about thought transmission.

Dr. Greenleaf Whittier Pickard, the inventor of the silicon and pericon detector, as well as many other wireless specialties, has several interesting ideas, and his letter will certainly prove a revelation, particularly to those interested in radio.

**I**N studying the evolution of the human specie we must go back to the time when man proper, as we know him, had not as yet arrived on this planet.

Our great biologists have irrefutable evidence that everything in Nature works on a slow, laborious plan, one specie being developed slowly into another from the smallest animalculae up to present man. When man was still in the what we may call animal stage, i.e., when he was not "thinking," as that term is understood, he was wholly guided by instinct. His "thoughts," if so they may be called, were probably on a much lower plane than thoughts of the average dog. The chances are that the present day dog probably "thinks" much better than prehistoric man. We also find that thought and language go hand in hand. Crudely speaking, prehistoric man had no better language than any highly developed animal, such as a dog, cat or a horse.

Thru thousands of years of evolution, however, instinct developed into crude thought, and finally there came a time when prehistoric man really began to think, as we know the term. That was the time when he began to utter his thoughts by means of his voice. At first only a few crude words were formulated, and probably consisted of not much more than the gibberish of a chimpanzee. Little by little organized thought arrived, and words, trans-

### THREE FAMOUS SCIENTISTS' VIEWS ON THOUGHT TRANSMISSION

Altho I am clinging to ideals, my conception of the universe is, I fear, grossly materialistic. As stated in some of my published articles, I have satisfied myself thru careful observation carried on for many years that we are simply automata acting in obedience to external influences, without power or initiative. The brain is not an accumulator as commonly held in philosophy, and contains no records whatever of a phonographic or photographic kind. In other words, there is no stored knowledge or memory as usually conceived, our minds are blanks. The brain has merely the quality to respond, becoming more and more susceptible as the impressions are often repeated, this resulting in memory.

There is a possibility, however, which I have indicated years ago, that we may finally succeed in not only reading thoughts accurately, but reproducing faithfully every mental image. It can be done thru the analysis of the retina, which is instrumental in conveying impressions to the nerve centers and, in my opinion, is also capable of serving as an indicator of the mental processes taking place within. Evidently, when an object is seen, consciousness of the external form can only be due to the fact that those cones and rods of the retina which are covered by the image are affected differently from the rest, and it is a speculation not too hazardous to assume that visualization is accompanied by a reflex action on the retina which might be detected by suitable instruments. In this way it might also be possible to project the reflex image on a screen, and with further refinement, resorting to the principle involved in moving pictures, the continuous play of thoughts might be rendered visible, recorded and at will reproduced.

Nikola Tesla.

Your article should be an interesting one, particularly as to the audion suggestion. The audion, however, seems to have a certain wavelength limitation, so that unless the waves to be recorded lie between about  $3 \times 10^{10}$  cm. and  $3 \times 10^2$  cm., they are not apt to be "picked up."

A more likely range to search would be from  $3 \times 10^2$  cm. down to  $3 \times 10^{10}$  cm., that is, down to the harder Gamma rays, or to even shorter wavelengths, starting with the shorter Hertzian waves. Here the audion would be useless, save as a second stage in the detection, i.e., as an amplifier for some other form of detector.

Greenleaf W. Pickard.

While I have little doubt that there is such a thing in nature as transference of thought from one brain to another, I am not aware that sufficient data has ever been gathered on such a highly abstruse subject to permit forming any definite opinion.

Lee De Forest.

lated into speech kept pace with the advancing thought of man. As the human race kept advancing at a slow pace, its thinking qualities increased little by little, and the senses correspondingly became more sharpened.

This is especially true of the human thinking machinery which perhaps has advanced more rapidly than the senses. Thus we find that certain senses have even been retarded, such as, for instance, sight, smell and hearing. When man lived his wild life it was very necessary for these senses to be much sharper than they are at present; hence our poor hearing, bad sight and very much poorer smell. On the other hand, as the battle for existence becomes more and more acute, and as moreover the battle is not as much physical as mental, it follows that the mind and its thinking machinery should naturally become more and more developed, which, in fact, it does. We may safely say that within the next hundred thousand years—which is only a small span of time in man's evolution—the human mind will be an entirely different sort of apparatus than it is today. Man's mental power will be infinitely greater than what it is at present. Already we have indications that man's thoughts, or the effects therefrom, do not necessarily have to remain within his skull, but that they actually radiate from the latter in a very imperfect manner. As the human race advances, there is no doubt that thought transference proper will become an accomplished fact. It has already been shown experimentally by Di Brazza, as well as Charpentier, that concentrated thinking will produce certain external effects, as for instance, a slight fluorescence on a zinc sulfid screen, or a suitably excited X-ray screen. This would tend to prove that thoughts are of an electrical nature, having probably a very short wave length. As most electrical effects in space are depend-

(Continued on page 84)



The Thought Recorder is an Instrument Recording Thoughts Directly by Electrical Means, On a Moving Paper Tape. Our Illustration Shows What a Future Business Office Will Look Like When the Invention, Which as Yet Only Exists in the Imagination, Has Been Perfected. By Pushing the Button A, the Tape is Started and Stopped Automatically So That Only Thoughts That Are Wanted Are Recorded.

# Paris Letter

By JACQUES BOYER

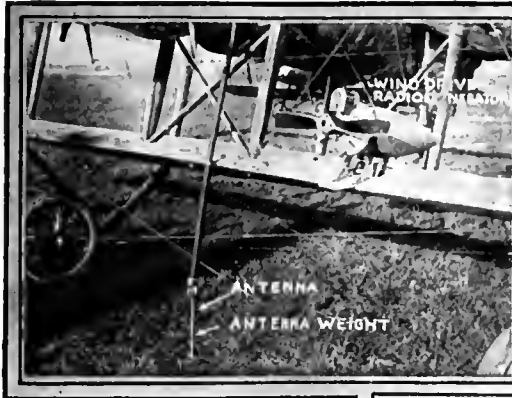
Paris Correspondent of the ELECTRICAL EXPERIMENTER

## Airplane-Radio.

Paris, February, 1919.

**T**HE war having ended thru the conclusion of the armistice, the military censor now allows the publication of information concerning various technical matters of the French Army. In this and in the following monthly

French airplane radio generator of the wind driven type and antenna employed. The dynamo is fitted with a small air blade which spins it rapidly. The antenna and weight are lowered from a reel on the cockpit. Similar schemes are in use on American Airplanes. Fig. 1.



## Signaling Tanks.

The "baby" Renault tanks now well known in the United States, played an important rôle in pushing back the Huns. They had not a little to do with the Allied victory and were constructed by the French engineer, Louis Renault. This well-known French technician created many different models, some of which carried cannon and



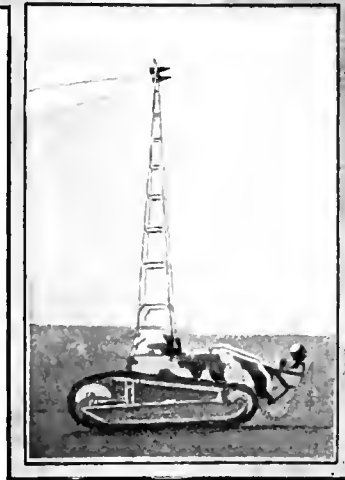
The "Radio-stereoscope" is the latest in French X-ray apparatus. By its means it now becomes possible to rapidly locate bullets or fractures—owing to the perspective of vision thus afforded. The X-ray plates are illuminated from behind, while the physician views them thru the special coordinating instrument shown. Fig. 3.

letters, we will unfold thru the ELECTRICAL EXPERIMENTER the latest European technical developments as they come to our attention.

Particularly during the war, the censorship has been so rigid that many important inventions have never been even mentioned in the technical press. We shall be glad to describe these monthly for the benefit of EXPERIMENTER readers.

The accompanying photographs show the latest system of radio-telegraphy installed on French Airplanes during the war. Fig. 1 shows what is called the "radio-telegraph dynamo" on a Farman airplane.

All the French combat machines were equipt with this or similar apparatus. Between 25 and 150 kilometers could be covered by means of this apparatus weighing some thirty odd kilograms. For receiving the wireless waves the aviators of course used the audion, and by use of sound-proof helmets, it was possible to receive the orders clearly, notwithstanding the terrific noise of the airplane motor. The small dynamo shown in Fig. 1 is operated by means of a small air propeller, and this motor works entirely independent from the power plant of the airplane. As long as the airplane is in motion the propeller will turn due to the rush of the air, and thus even if the engine becomes stalled, the aviator can still use his wireless, for the plane while volplaning down furnishes enough energy to drive the small auxiliary dynamo. The wireless antenna trails behind the airplane thru the steel tube as seen in Fig. 1, at the end of which there is a small pulley. At the free end of the antenna wire there is a weight of two or three kilograms (4 to 6 pounds) which tends to keep the antenna more or less taut. The wire stays of the airplane themselves form the "ground" for the wireless system. All aviators in the air were constantly in touch with each other, and in order that one airplane should not be mistaken for another one, different wave lengths were used for each. Not only this, but other tricks as for instance, sending at a different intensity, was often resorted to by certain aviators in order that the ground station would know from which plane the signals emanated.



The "Baby" Renault Tanks Played an Important Rôle in Pushing Back the Huns. Some of These Tanks Carried Cannon and Machine Guns. The "Tank Projecteur" Here Shown Was Effectively Used for Signaling Purposes. Fig. 2.

machine guns, while others merely carried ammunition. One of the strangest ones constructed by him is the "tank projecteur" (signaling tank). It is shown in the accompanying photograph, Fig. 2. This tank is built along the lines of the "baby" tank,

The war has brought forth a great many surprises, many of which for military reasons have remained secret, and many will continue a secret for some time to come. Our readers no doubt are very much interested in many of the war devices brought out during the war by our European Allies. We have therefore made arrangements with our Paris correspondent, Mr. Jacques Boyer to send us an article each month on hitherto unpublished information. The first article of the series appears on this page.—Editor.

but in the back we find on an inclined steel truss a little dynamo driven by the machinery of the tank. Two "signaling projectors" are mounted at the top of a light

metallic mast, the four lower legs of which are mounted on a revolving cupola which makes it possible for the mast to be immediately revolved in any direction. The top of the mast is 7½ meters from the ground. The two searchlights are arranged in such a manner that they can send out two independent light shafts, or the two shafts can be converted into a single shaft of light. In

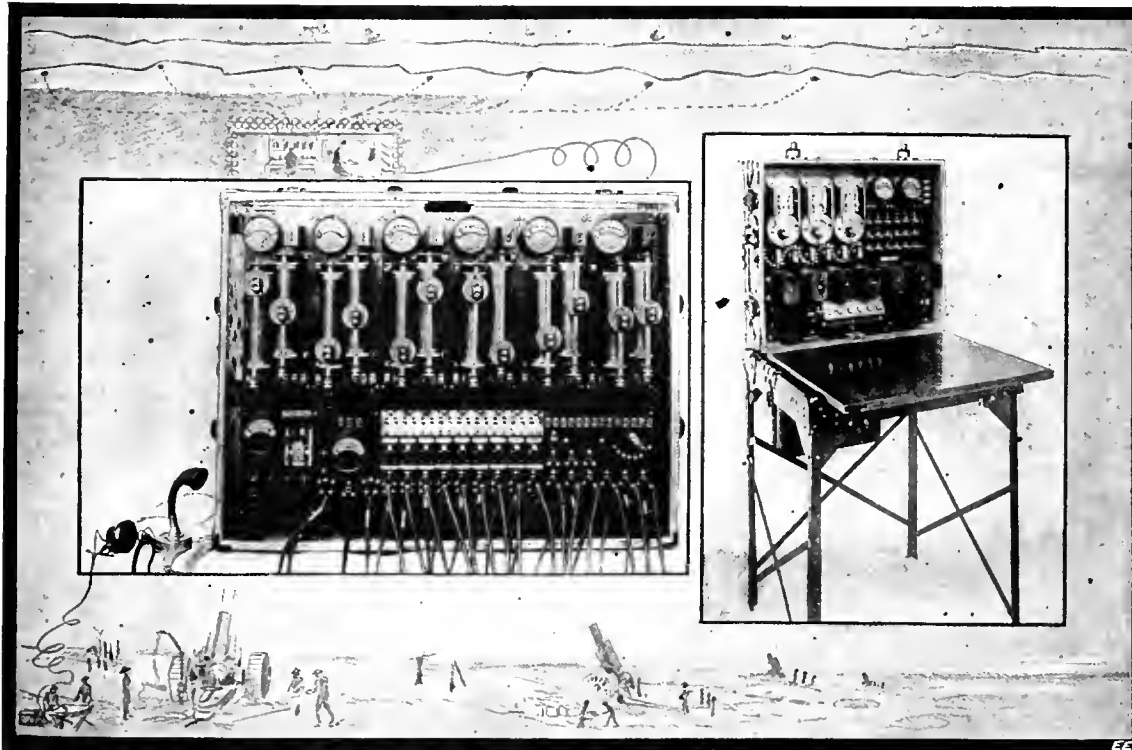
the inside of the tank we find our usual Morse telegraphers, operating a key which controls the light shafts. By means of this arrangement, the ordinary Morse or Continental Code can be sent out by breaking up the light shaft into "dots and dashes" the same as is done in the usual method of signaling with lights. Mr. Renault has incorporated several refinements into the search lights, one of which is an iris obturator whereby the volume of the light can be increased or decreased at will.

## Radio-stereoscope.

This apparatus has been developed by the French engineer, M. Nemirovsky, the X-ray specialist of Paris. It has given wonderful results to the French military physicians, and it now becomes possible to locate metallic or other foreign pieces in the human body in a manner not possible before. The ordinary X-ray photograph shows only the foreign body, but it is impossible to tell how deep the penetration is, and often the physician cannot tell if a bullet is in front or in back of a certain organ. In other words, he does not know just how deep the bullet is embodied. Everyone who has looked thru the ordinary stereoscope will readily understand how objects "stand out" and how they reveal their exact location to the human eye.

It is this principle which is made use of by M. Nemirovsky, who has also greatly simplified the radio-stereoscope technique. Our illustration, Fig. 3, shows the method. Two X-ray pictures taken at one time by super-imposing two plates and afterward developing them are placed side by side in an arrangement termed a "negatoscope." The plates are illuminated from behind by means of an electric lamp. The physician then regulates the radio-stereoscope by means of a thumb screw as shown, until he sees the bones, and all other parts as well. The foreign body then stands out in plain relief. The physician now examines the plates carefully and he obtains a clear mental picture which subsequently gives him an exact idea as to just how deep the foreign body is emplaced. If necessary during the operation, he can frequently inspect the negatives stereoscopically in order to guide himself should this be necessary.

# Locating Enemy Guns by Flash and Sound



Switchboards Used for Flash or Sound Spotting of Enemy Artillery. Photo at Left Shows a Type B-T Sound Ranging Set Such as Used by the United States Army Signal Corps During the War. Many of These Switchboards Were Successfully Used at the Front. It is Slightly Larger Than the Smaller Model and Requires a Little More Time to Set Up, But on the Other Hand it Combines Many More Telephone Circuits. A Single Section Has Located as High as 117 Guns of Enemy Batteries in 24 Hours. The Right Hand Photo Shows a Small Portable Switchboard, Known as a Flash Ranging Set. This Signal Board is Used in Conjunction With an Observation Telescope for Locating the Flash of Enemy Guns and General Activities at the Extreme Front, and is Suitable for Night or Day Service.

THE accompanying photographs show respectively two of the war's newer developments, which even the veterans of the Spanish-American War were not familiar with. For one thing, of course, "flash ranging" and "sound ranging," as they are called, are really two military developments which were brought about by the fact that vastly greater numbers of guns were used in the great world war than were ever even dreamed of before.

Let us first consider the "flash spotter." The flash spotter usually takes up his location in the vicinity of front line trenches, or in a shell hole from which he can effectively use an observation telescope for minutely observing and locating in what direction the flash of an enemy gun occurs. The electrical switchboard shown herewith forms a part of the communication link with the artillery and general intelligence headquarters, so that the position of the enemy guns can be quickly made known, and either shelled at once by counter-battery fire by the artillerists, or else the location is accurately plotted on large maps for future consideration, depending upon the activity of the enemy gun or guns at the moment.

The flash spotter, if he happens to be located in a listening post or shell hole, or in fact in any other forward location, invariably has with him his trusty portable telephone connected by wire to the nearest communicating depot, where we find one of the small portable switchboards here shown. These switchboards are fitted with the proper regulating instruments for creating the best working conditions on the various circuits, and make provision for connecting and disconnecting a large number of circuits, in some cases, about 30 or 40 lines running out to various flash ranging observation stations, or in other cases as many as 100 or more lines. The work of the flash spotter is finished for any particular case when his observations, as to the angle in which the flash was observed, and a similar or different angle measured by a co-observer somewhere down the line, have reached the engineers. These experts, by means of special slide rules and tables, quickly solve the distance of the enemy gun and its definite location geographically by the informa-

tion afforded thru the observation data submitted by two or more flash ranging observers. In other words, it is *triangulation*, which mathematical quantity has been raised to the nth power by Uncle Sam's artillery experts.

The work of the "sound ranging" experts in locating enemy guns, both large and small, is somewhat different from that of

the flash ranging corps. One of the switchboards used in connection with the sound ranging of enemy guns is illustrated herewith. Hundreds of these switchboards were successfully used at the front during the progress of the war. A single section of sound-ranging equipment located as high as 117 guns of enemy batteries in 24 hours. (Continued on page 68)

## World's Largest Generator

The accompanying illustration shows one of the largest water-wheel type generators ever built, and its gigantic dimensions may be judged by comparison with the figure of the man standing beside it. This is one of several water-wheel generators built for the Keokuk electric generating station of the Mississippi River Power Company. This mastodonic generator has 52 poles and delivers a current at 11,000 volts potential. This is a high voltage for a generator to produce, owing to the strains on the revolving windings, etc. Much higher voltages are frequently used for the transmission line, and voltages of 50,000 to 75,000 are common for such transmission, these extra high potentials being obtained by means of stationary transformers in the power station where the generators are located.

The large field or stator frame here shown forms the stationary part of the generator, and the rotating member which is also of gigantic size and mounted on a steel shaft several feet in diameter, is put in place and lined up with high accuracy when the stator frame of the generator is put in place and bolted to its foundation. These large machines are invariably built in sections which can be bolted together after they have reached the site of their installation.

The transformer comprises a laminated sheet iron core on which there are two windings or series of windings, one of which forms a low voltage primary which is connected with the generator, driven by a water-wheel or other source of primary power; while the second set of windings form a high voltage or secondary circuit, in which any desired potential current is in-

duced by induction, the primary and secondary windings being linked magnetically by means of the iron core. Transmission lines are in use at the present day with potentials of 150,000 volts and higher.—Photo Courtesy G. E. Co.



Note the Relative Size of the Man Compared to the Huge Stator of the Largest Water-Wheel Type Generator Ever Built. It Develops a Current of 11,000 Volts.



# Novel Electric Talking Sign

**T**HE accompanying illustrations, Figs. 1, 2 and 3, show the design, construction and method of operation of an electric bulletin board, operated by a typewriter, which is said to be the latest achievement in the electric sign industry.

This new illuminated sign called the *Electrograph* has been erected on the Dispatch Building in Columbus, Ohio, and flashes the latest news, fresh from the press wires, and advertising bulletins for local and national concerns.

It may be stated that this Illuminated Sign has two sides, each side holding sixty monograms, arranged in three rows. Each monogram contains a clever arrangement of twenty-one lights, combinations of which form any letter or numeral and a few other characters, each one measuring two by three feet.

The photograph Fig. 1 shows the operating room. The typewriter method of operation distinguishes this device from others of similar character. A standard machine is used and contacts are made by striking the keys just as they would be struck in ordinary typing. An extra platen, bearing silver plugs, over which a stylus rides, selects the monograms automatically as the writing proceeds, thus throwing the letters in their proper places on the sign. The letters remain in place until the bulletin is completed and may be held any length of

time; it is then released by pressing a single key.

It is of interest to note that a unit releasing device enables the operator to strike any one letter out and replace it with another without interfering with the other

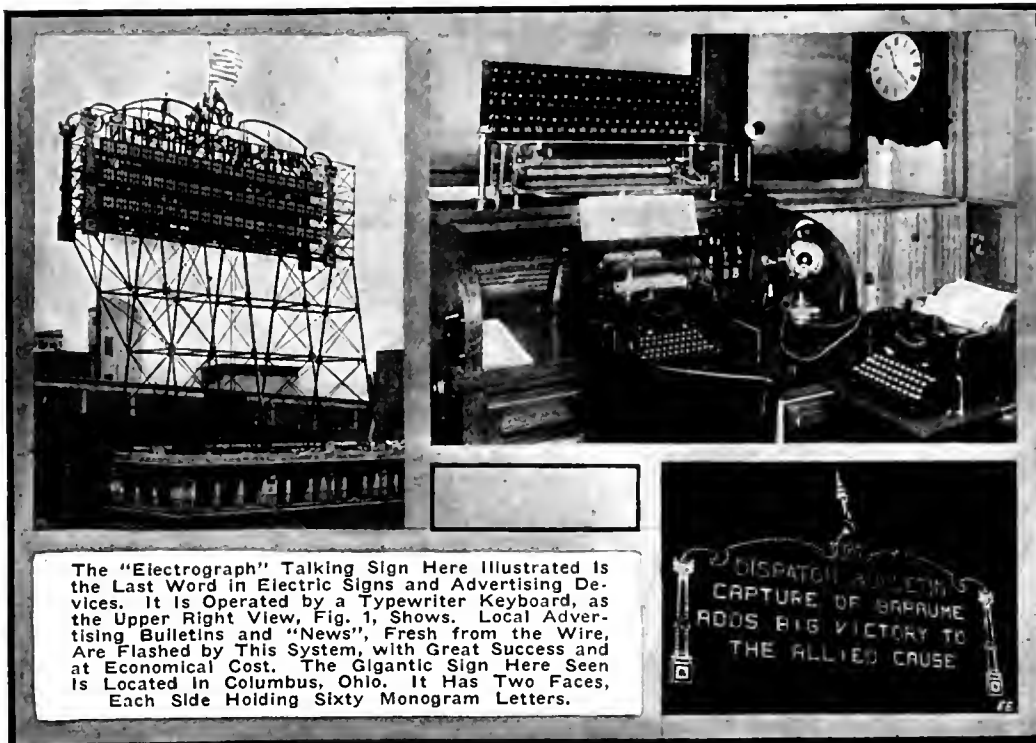
and the letter "K" is struck, "K" will appear in the monogram and green light No. 3 will burn. If it does not burn, the operator knows that the "K" failed to appear in the monogram and he strikes it again. When the operator writes a bulletin, the

typewriter keys write on paper in the usual manner. This gives a complete record of everything that appears on the board. The record is used in checking advertising.

It is claimed that an ordinary bulletin may be written in ten seconds. It usually is left burning ten or more seconds after being completed. This indicates the amount of advertising and news that may be flashed in an evening.

Mr. Alton D. Spencer, of the *Evening Dispatch*, points out that the news feature gives the electrograph an advertising pull not possible with

ordinary electric signs. Latest news from the peace table fronts is bound to attract attention, and while the crowds watch for news, they read the advertisements. On election night the electrograph is the center of attraction, as the returns are flashed more promptly than is possible by any other means. This service, of course, increases the value of the sign to the advertisers and gets more results from them than they could get from a sign hanging in front of their places of business and at less cost.—  
*By Frank C. Perkins.*



The "Electrograph" Talking Sign Here Illustrated is the Last Word in Electric Signs and Advertising Devices. It is Operated by a Typewriter Keyboard, as the Upper Right View, Fig. 1, Shows. Local Advertising Bulletins and "News", Fresh from the Wire, are Flashed by This System, with Great Success and at Economical Cost. The Gigantic Sign Here Seen is Located in Columbus, Ohio. It Has Two Faces, Each Side Holding Sixty Monogram Letters.

letters. Thus, if an error is made, it may be promptly corrected. The operator cannot see the sign as he works and so a pilot board has been provided directly in front of him, consisting of sixty green light bulbs, corresponding to the sixty monograms on either face of the board. When a letter is struck, with the platen set at any given position, the letter appears in the corresponding monogram and automatically lights the corresponding green light.

For illustration, it will be seen that if the platen is set with the stylus on No. 3 plug

## Relieving the Car Crush

By Sidney Gernsback

**H**AVE you ever seen a Subway crowd being herded into a car? Of course you have, if you are living in "little old New York." If not, thank the Lord and turn to the next page. You are not interested! Not at all! And then again you may get a notion to visit that "Burgh" one day; well, read on, it may interest you after all!

Let us go back to that Subway crowd on a rainy Monday morning between 8 and 9 A. M. and let us try to board a car at Times Square. There our train stops, packed brimful with its rain-smelling, sneezing and coughing cargo. You think there is not room for as much as another umbrella in the car you have selected. But behold the convulsory jerking and pushing going on in the middle

of the car. Our well trained eye reads these signs, like an Indian would read footprints on the warpath: These spasmodic movements, this pushing, twitching and thrusting

can mean only one thing: somebody wants to get off that train! And if somebody wants to get off, a half dozen other bodies want to get on, and usually do, too.



The Cure for the "Subway Crush".—There Are Three Doors on Each Subway Car: Two on Each End and One, About the Same Size as the Front and End Door Combined, in the Center. Let the Outgoing Passengers Use the End Doors Only, and the Incoming Travelers the Center Doors Only, as the Diagram Indicates.

Acting on this well established principle we push and get pushed toward the open car door. A melodious voice from the end of the car sings out: "Let 'em get off! Let 'em get off!" And behind you a gentleman wearing the snug uniform of a Subway gladiator

pushes on: "Step lively!" And right here it is where Kipling is wrong about that east and west business "who never shall meet!" Take it from an old Subway traveler: they do meet! They not only meet! They clash and they col-  
*(Continued on page 56)*

# My Inventions

By Nikola Tesla

## IV. The Discovery of the Tesla Coil and Transformer

**F**OR a while I gave myself up entirely to the intense enjoyment of picturing machines and devising new forms. It was a mental state of happiness about as complete as I have ever known in life. Ideas came in an uninterrupted stream and the only difficulty I had was to hold them fast.

The pieces of apparatus I conceived were to me absolutely real and tangible in every detail, even to the minutest marks and signs of wear. I delighted in imagining the motors constantly running, for in this way they presented to the mind's eye a more fascinating sight. When natural inclination develops into a passionate desire, one advances towards his goal in seven-league boots. In less than two months I evolved virtually all the types of motors and modifications of the system which are now identified with my name. It was, perhaps, providential that the necessities of existence commanded a temporary halt to this consuming activity of the mind. I came to Budapest prompted by a premature report concerning the telephone enterprise and, as irony of fate willed it, I had to accept a position as draftsman in the Central Telegraph Office of the Hungarian Government at a salary which I deem it my privilege not to disclose! Fortunately, I soon won the interest of the Inspector-in-Chief and was thereafter employed on calculations, designs and estimates in connection with new installations, until the Telephone Exchange was started, when I took charge of the same. The knowledge and practical experience I gained in the course of this work was most valuable and the employment gave me ample opportunities for the exercise of my inventive faculties. I made several improvements in the Central Station apparatus and perfected a telephone repeater or amplifier which was never patented or publicly described but would be creditable to me even today. In recognition of my efficient assistance the organizer of the undertaking, Mr. Puskas, upon disposing of his business in Budapest, offered me a position in Paris which I gladly accepted.

I never can forget the deep impression that magic city produced on my mind. For several days after my arrival I roamed thru the streets in utter bewilderment of the new spectacle. The attractions were many and irresistible, but, alas, the income was spent as soon as received. When Mr. Puskas asked me how I was getting along in the new sphere, I described the situation accurately in the statement that "the last twenty-nine days of the month are the toughest!" I led a rather strenuous life in what would now be termed "Rooseveltian fashion." Every morning, regardless of weather, I would go from the Boulevard St. Marcel, where I resided, to a bathing house on the Seine, plunge into the water, loop the circuit twenty-seven times and then walk an hour to reach Ivry, where the Company's factory was located. There I would have a wood-chopper's breakfast at half-past seven o'clock and then eagerly await the lunch hour, in the meanwhile cracking hard nuts for the Manager of the Works, Mr. Charles Batchellor, who was an intimate friend and assistant of Edison. Here I was thrown in contact with a few Americans who fairly fell in love with me because of my proficiency in—billiards. To these men I explained my invention and one of them, Mr. D. Cunningham, Foreman of the Mechanical Department, offered to form a stock company. The proposal seemed to me comical in the extreme. I did not have the faintest conception of what that meant except that it was an American way of doing things. Nothing came of it, however, and during the next few months I had to travel from one to another place in France and Germany to cure the ills of the power plants. On my return to Paris I submitted to one of the administrators of the Company, Mr. Rau, a plan for improving their dynamos and was given an opportunity. My success was complete and the delighted directors accorded me the privilege of developing automatic regulators which were much desired. Shortly after there was some trouble with the lighting plant which has been installed at the new rail-

road.

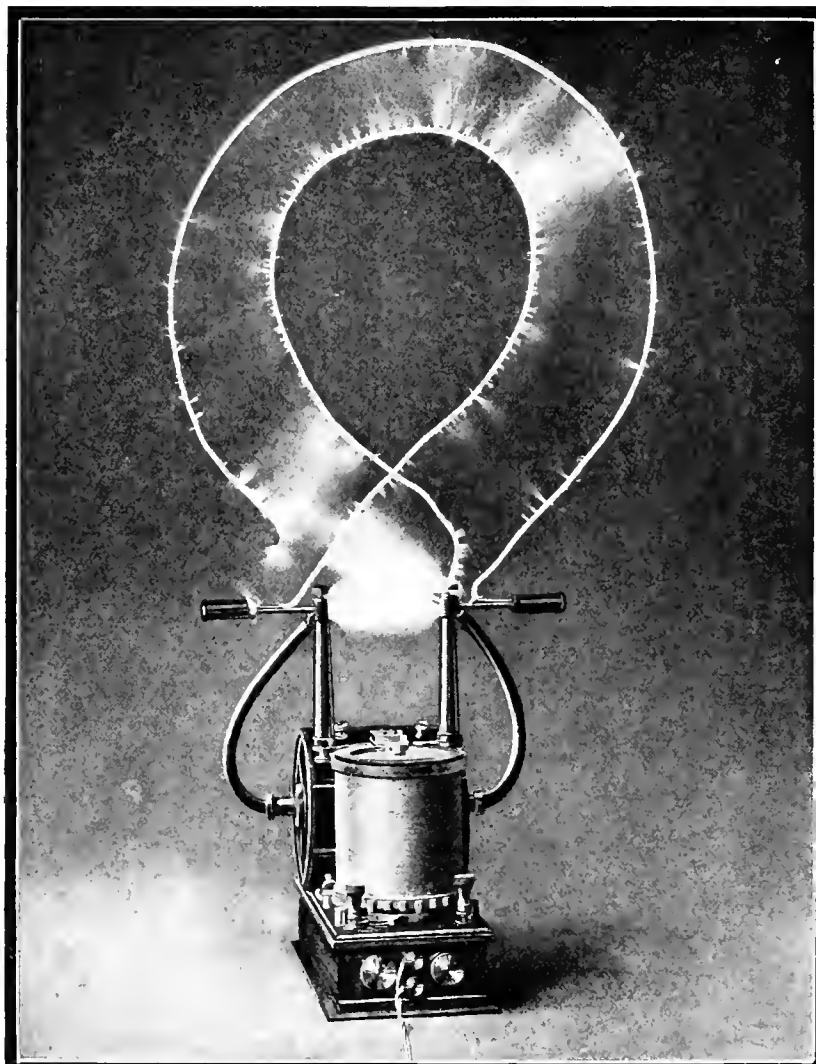


Fig. 1—Tesla Oscillation Transformer (Tesla Coil) Presented by Lord Kelvin Before the British Association in August, 1897. This Small and Compact Instrument, Only 8 Inches High, Developed Two Square Feet of Streamers With Twenty-Five Watts From the 110 Volt D. C. Supply Circuit. The Instrument Contains a Tesla Primary and Secondary, Condenser, and a Circuit Controller.

Copyright, 1919, by E. P. Co. All rights reserved

Mr. Tesla's articles started in our February issue

road station in Strassburg, Alsace. The wiring was defective and on the occasion of the opening ceremonies a large part of a wall was blown out thru a short-circuit right in the presence of old Emperor William I. The German Government refused to take the plant and the French Company was facing a serious loss. On account of my knowledge of the German language and past experience, I was entrusted with the difficult task of straightening out matters and early in 1883 I went to Strassburg on that mission.

#### The First Induction Motor Is Built.

Some of the incidents in that city have left an indelible record on my memory. By a curious coincidence, a number of men who subsequently achieved fame, lived there about that time. In later life I used to say, "There were bacteria of greatness in that old town. Others caught the disease but I escaped!" The practical work, correspondence, and conferences with officials kept me preoccupied day and night, but as soon as I was able to manage I undertook the construction of a simple motor in a mechanical shop opposite the railroad station, having brought with me from Paris some material for that purpose. The consummation of the experiment was, however, delayed until the summer of that year when I finally had the satisfaction of seeing rotation effected by alternating currents of different phase, and without sliding contacts or commutator, as I had conceived a year before. It was an exquisite pleasure but not to compare with the delirium of joy following the first revelation.

Among my new friends was the former Mayor of the city, Mr. Bauzin, whom I had already in a measure acquainted with this and other inventions of mine and whose support I endeavored to enlist. He was sincerely devoted to me and put my project before several wealthy persons but, to my mortification, found no response. He wanted to help me in every possible way

and the approach of the first of July, 1919, happens to remind me of a form of "assistance" I received from that charming man, which was not financial but none the less appreciated. In 1870, when the Germans invaded the country, Mr. Bauzin had buried a good sized allotment of St. Estèphe of 1801 and he came to the

conclusion that he knew no worthier person than myself to consume that precious beverage. This, I may say, is one of the unforgettable incidents to which I have referred. My friend urged me to return to Paris as soon as possible and seek support there. This I was anxious to do but my work and negotiations were protracted owing to all sorts of petty obstacles I encountered so that at times the situation seemed hopeless.



Fig. 2—This illustrates tests with spark discharges from a ball of forty centimeters radius in Tesla's Wireless Plant erected at Colorado Springs in 1899. The ball is connected to the free end of a grounded resonant circuit seventeen meters in diameter. The disruptive potential of a ball, is, according to Tesla, in volts approximately  $V = 75,400 r$  ( $r$  being in centimeters). That is, in this case  $75,400 \times 40 = 3,016,000$  volts. The gigantic Tesla coil which produced these bolts of Thor was capable of furnishing a current of 1,100 amperes in the high tension secondary. The primary coil had a diameter of 51 feet! This Tesla coil produced discharges which were the nearest approach to lightning ever made by man.

*THE proverbial trials and tribulations known to every inventor were not spared Tesla, the world's greatest inventor of all times. In this article we see him, arrived at young manhood, struggling along in a cold world. Already his fame has spread far and wide and his genius is recognized. But converting genius and fame into dollars and cents is quite a different matter, and the world is full of unappreciative and unscrupulous men. Tesla, the idealist, cared little for money and thus was promptly taken advantage of. But let Tesla himself tell you in his own inimitable style. It is a wonderful story.*

*In this month's installment Tesla also tells us how he made one of his most important as well as sensational discoveries—the Tesla Coil. Few inventions have caused such a sensation as this one which culminated in the only man-made lightning ever produced. The Tesla coil has so many uses and has been built in so many styles that it would take a catalog to list them all. From the spectacular high frequency stunts on the stage down to the "violet" ray machine in your home; all are Tesla coils in one form or another. Wireless without the Tesla Coil would not be possible today. Without an oscillation transformer, spark gap and condenser—which is a Tesla Coil—the sending station would be crippled.*

*But it is for industrial purposes where the Tesla Coil will shine brightest in the future. The production of ozone, the extraction of nitrogen from the air in huge quantities—all are children of Tesla's fertile brain. His coil is the key to them all.*

EDITOR.

morning. Everybody brushed up, I put on my gloves and when Funke came with his retinue he was ceremoniously received. After two hours' deliberation he suddenly exclaimed: "I must be going," and pointing to a place on the ceiling, he ordered me to get the

(Continued on page 64)

#### German "Efficiency".

Just to give an idea of German thoroughness and "efficiency," I may mention here a rather funny experience. An incandescent lamp of 10 c.p. was to be placed in a hallway and upon selecting the proper location I ordered the *monteur* to run the wires. After working for a while he concluded that the engineer had to be consulted and this was done. The latter made several objections but ultimately agreed that the lamp should be placed two inches from the spot I had assigned, whereupon the work proceeded. Then the engineer became worried and told me that Inspector Averdeck should be notified. That important person called, investigated, debated, and decided that the lamp should be shifted back two inches, which was the place I had marked. It was not long, however, before Averdeck got cold feet himself and advised me that he had informed *Ober-Inspector* Hieronimus of the matter and that I should await his decision. It was several days before the *Ober-Inspector* was able to free himself of other pressing duties but at last he arrived and a two-

hour debate followed, when he decided to move the lamp two inches farther. My hopes that this was the final act were shattered when the *Ober-Inspector* returned and said to me: "*Regierungs-rath* Funke is so particular that I would not dare to give an order for placing this lamp without his explicit approval." Accordingly arrangements for a visit from that great man were made. We started cleaning up and polishing early in the



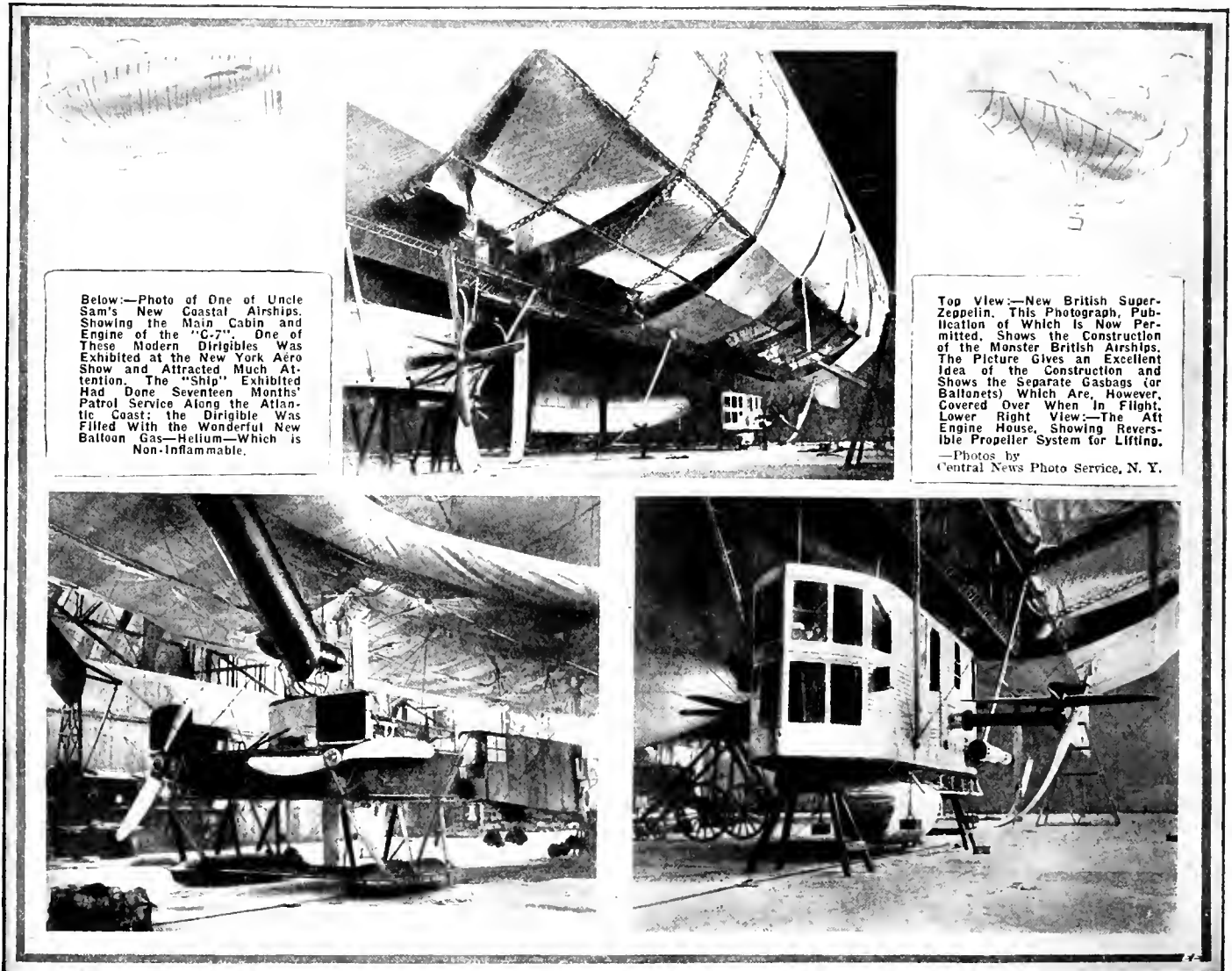
# The New York Aéro Show

**T**HE aeronautical exposition which was held jointly in Madison Square Garden and the 69th Regiment Armory, New York City, March 1st to 15th, was the most successful aéro show and exposition ever held in the United States. Many remarkable exhibits were shown, including large bombing 'planes, small high-speed pleasure and scouting 'planes, besides a gigantic naval sea plane.

of the stations at the Madison Square Garden or 69th Regiment Armory could be established with the flying 'planes or dirigibles, and in turn wireless telephonic speech was transmitted from the aircraft to the respective land stations. The effect on the public was startling, as while most of them had undoubtedly read of the wireless telephone, they did not have the slightest idea as to what the apparatus used for the purpose

wonderful indeed, to stand in the crowd before the radio exhibit, and hear this conversation flitting back and forth between the operator in front of you and a second operator flying thru the air at a speed of 80 to 100 miles an hour.

One day a captive propaganda balloon broke from its moorings over the Sixty-ninth Regiment Armory and shot into the clouds, spilling leaflets, its anchorage dang-



Below:—Photo of One of Uncle Sam's New Coastal Airships, Showing the Main Cabin and Engine of the "C-2". One of These Modern Dirigibles Was Exhibited at the New York Aéro Show and Attracted Much Attention. The "Ship" Exhibited Had Done Seventeen Months' Patrol Service Along the Atlantic Coast; the Dirigible Was Filled With the Wonderful New Balloon Gas—Helium—Which is Non-Inflammable.

Top View:—New British Super-Zeppelin. This Photograph, Publication of Which is Now Permitted, Shows the Construction of the Monster British Airships. The Picture Gives an Excellent Idea of the Construction and Shows the Separate Gasbags (or Balloons) Which Are, However, Covered Over When in Flight. Lower Right View:—The Aft Engine House, Showing Reversible Propeller System for Lifting. —Photos by Central News Photo Service, N. Y.

and a powerful Caproni tri-plane. A captured German 'plane of the Albatross type was also exhibited. There were also shown a number of gas type, or lighter-than-air aircraft, such as solo balloons, blimps, a naval dirigible which had seen seventeen months' service on coast patrol work, etc. The "gas bags" were filled with the new balloon gas—Helium. The individual exhibits included many interesting auxiliary appurtenances in the flying world, such as rapid-fire photographic cameras, aircraft machine guns, measuring instruments for indicating the velocity of the 'plane thru the air, et cetera, and a host of other new and highly novel devices.

Radio-telephony was demonstrated by the Army Radio Corps of the Air Division in a very popular and interesting way. During the course of the exposition, various types of aircraft flew over the city, equip't with wireless telephone and telegraph installations, so that communication from either

looked like, or how it worked, and many of them had a twisted notion that it had something to do with *telegraphy* somehow or other. However, Uncle Sam's radio experts, as soon as they got the sets up and working, soon showed the visitors how the wireless telephone worked. The roof operator, who is stationed at that point so that he could readily observe the approach of aircraft, would start calling the airplane or dirigible as soon as it came to view, somewhat in this fashion: "Hello airplane! Hello airplane! Hello airplane!" After a few moments' pause, and when the operator had manipulated the tuning of the apparatus to the right point and gotten his Audion detector and amplifiers adjusted to the proper strength, the voice of the pilot on the airplane, hovering in the air several hundred feet above the aéro show, could be heard calling, thru a large Audion amplifier—"Hello land station! I get you all right now, land station!" It was really very

ling. Up to approximately 3,000 feet it sailed, where it exploded in a burst of brown smoke, falling upon a roof in the neighborhood of Fifth Avenue. Came the wireless comment from an airplane aloft:

"Did you see that? It burst about a thousand feet under us—ought to make good stuff for the reporters. By the way, are any down there?"

"Yes," broke in a newspaper man standing near the land wireless set, "and will you spell your observer's name for the reporters?"

"Yes—it's Sergeant S-a-u-v-e-g-e-a-u. He had a date to come to New York this afternoon, and altho he's come he can't fill his date very well, unless he comes down and lands on the crankshaft. Anything else?"

"No, thanks," said the reporter as he hung up on the first *interview* by wireless telephony yet recorded.

The radio apparatus exhibited, including that in the exhibit of the United States

Navy, was that of the vacuum bulb or Audion type. The range of the wireless telephone airplane apparatus for transmitting and receiving speech signals varies, of course, with the size of the transmitting set, the length of the aerials used on the airplane and several other factors. It is interesting to note at this point that only recently Secretary of the Navy Daniels carried on a wireless telephone conversation on March 11th with an airplane flying over the Potomac River at a distance of 150 miles. In this two-way wireless telephone conversation with the Secretary of the Navy, who was located at Washington, he used his ordinary desk telephone, which was connected up to the wireless transmitting set in another building. A recent report states that radio-telegraphic communication from earth to plane has been carried on over a distance of 200 miles.

The form of antenna used on aircraft during the war has been invariably that employing a quick-acting reel, on which the phosfor bronze stranded antenna cable was wound upon or released from, according to the desires of the pilot. However, in the newer aerial systems as applied to the airplane, not one, but two aerials are utilized, and no reels are employed. Each wire is about 100 feet long, with a two-pound lead weight at the end, and flies out from either extreme of the wings. These wires, contrary to popular conception, are said not to interfere with the maneuvering of the plane at all. One of the officers at the radio exhibit explained that the planes can rise and land with these wires outstretched without any trouble. One of the wires forms the aerial, while the other forms a counterpoise ground capacity. The tuning and detecting apparatus are connected between them in the cockpit.

In looking over the wireless equipment on the various planes, one was struck by the wide-spread adoption of the wind-driven wireless dynamo, and even the gigantic for-

eign bombing planes, including the Handley-Page, were fitted with a wind-driven radio generator. This small dynamo is usually mounted just to one side of the fuselage or cockpit, and is rigidly secured to the wing. As the airplane speeds thru the air, the propeller on the small dynamo is rapidly spun, and the necessary current

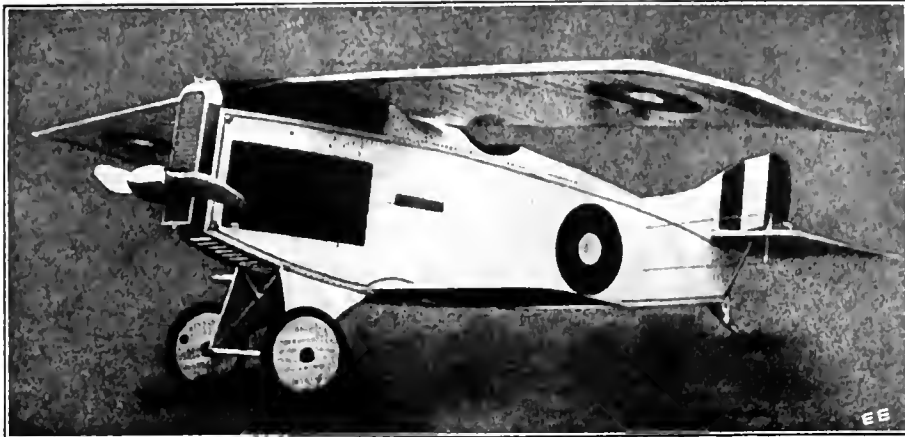
the aviator's breast, and in the front of which there is a metal plate containing three small holes about the size of a needle. The voice waves of the airplane operator impinge directly against this plate, and readily pass thru the small openings in it, thus vibrating the diaphragm of the microphone, while the violent swirling noises set up by the airplane engine pass by it without affecting the diaphragm thus protected.

Here are some of the outstanding electrical and other features which appealed to the visitor of the aero show, in looking over the airplanes of all designs, both large and small. On one of the planes one found red and green signal lights, which were placed respectively on the extreme outer ends of the lower wing. Another novelty was the electric searchlight of small size, mounted over the cockpit so as to be rapidly manipulated by the pilot or his assistant, for the purpose of making landings at

night or helping to locate the enemy in a night attack. Many interesting exhibits were on hand of the various magneto ignition systems. A beautiful model was shown of a spark phase-angle indicator, which roused great interest among the spectators, as the sparks staggered around the edge of a rapidly revolving two-foot black disc, which was covered over with sheet glass. Of course, there were electric lights in the aviators' quarters, or cockpit, besides many other electrical and allied features of great interest, such as signaling systems between the pilot and the observer, provision for supplying current to the electrically-heated aviator's clothes, which the aviators always wear on long distance trips, or in night flying when it is particularly cold.

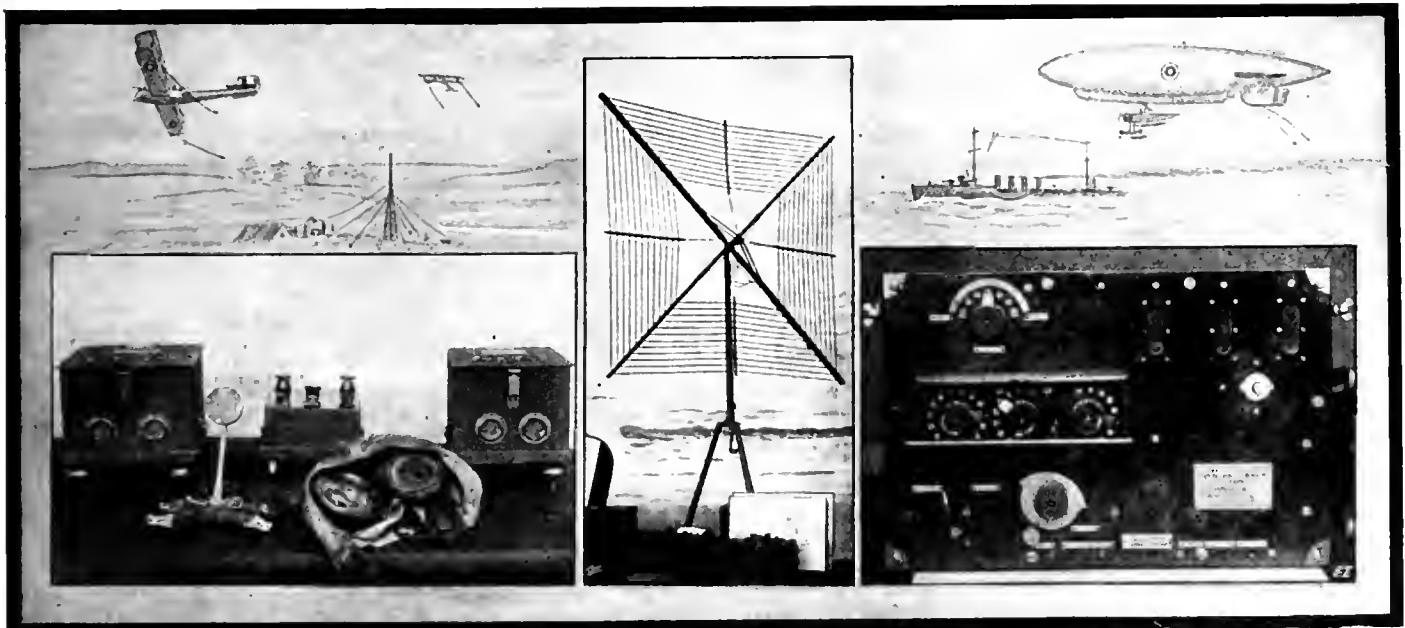
Other exhibits included luminous radium dial measuring instruments and gages, electro-pneumatic and other forms of aerial photographic apparatus, some of which operated at very high speed, as can be read-

(Continued on page 60)



The Fastest Airplane Exhibited At the Aero Show In New York—The "Christmas Bullet"—Rated Speed 200 Miles Per Hour. Test Showed 185 M.P.H. To Be Used as "Taxiplane" to Deliver Dispatches to Vessels One Day Out At Sea.

thus produced for operating the radio telephone or telegraph instruments. Whenever an airplane or dirigible was in radio telephonic communication with the station at the show, the most frequent question heard among the audience was: "Why is it that the terrific noise of the airplane engine is not heard above the comparatively weak voice of the pilot?" The explanation is simple when you know how it is done. The explanation for the non-transmission of the airplane engine exhaust noises is as follows: Many weary weeks were spent in special research on this particular problem by experts of the concerns who developed the radio telephone during the war, under great pressure, but thanks to their keen perception of the principles involved in successfully telephoning by radio from a moving vehicle in the air, in proximity to a terrific noise such as produced by the airplane, these engineers had the forethought to finally devise a special sound detecting instrument or microphone, which is strapt to



Photos by International Film Service

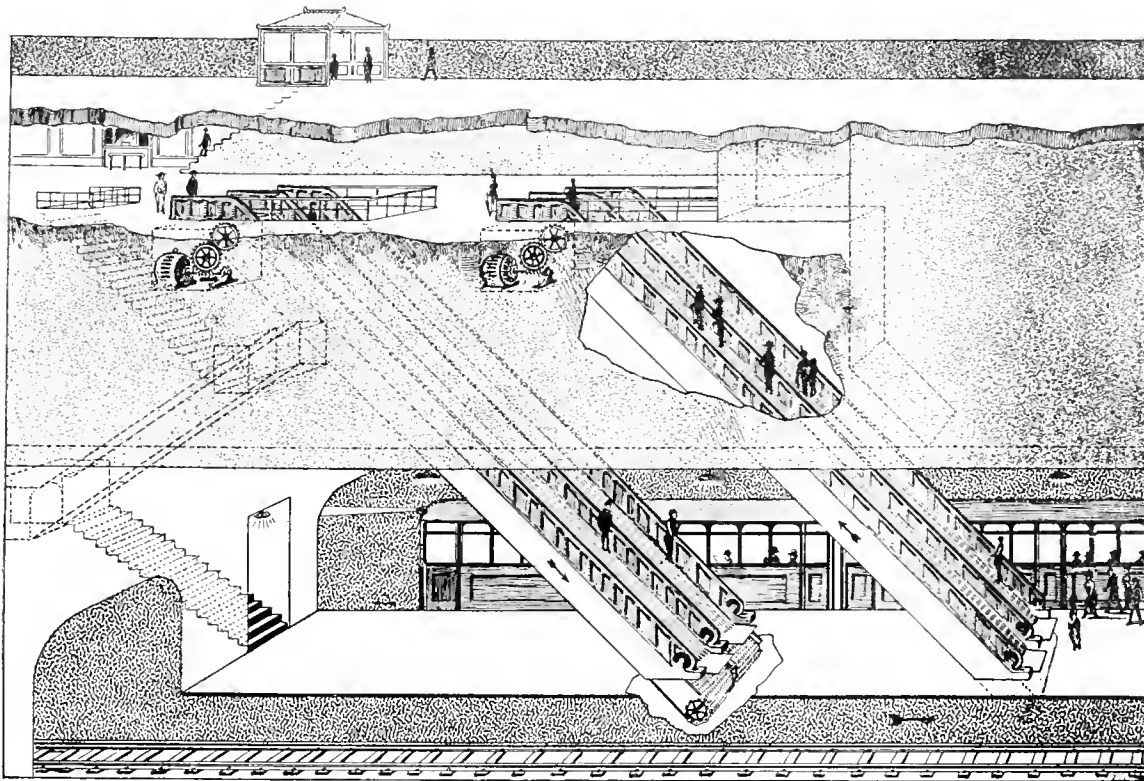
Airplane Radio at the "Aero Show." Left:—A Short Range Wireless Telephone Set, Transmitting and Receiving, Used on Airplanes. Center:—A Radio Direction Finder, Used for Locating Direction of Transmitting Stations. Right:—The Airplane "Land Station" Wireless Telephone Set, Transmitting and Receiving, One of the Many Exhibitions of the Special Feature at the Aero Show Held in New York City. The Management of the Show Arranged for Demonstrations and Exhibitions of the Many Developments of Aerial Communication Recently Adopted by the U. S. Government.

# Monster Escalator for New York Subway

THE New York subway system has incorporated in its various ramifications some of the most novel engineering

accompanying illustration shows a sectional view of this subway innovation, which promises to make this station one of the

in the morning when the traffic thins down, until it is about half uptown and half downtown, then two parallel escalators can be upward and the other two downward. If the traffic is quite light, it will be up to the station master to cut out two of the escalators and block them off, running one of the remaining pair upward and the other downward. As the crowd slowly changes and becomes a strong uptown-bound traffic, toward the latter part of the afternoon, then all of the escalators will be run downward.



An Innovation in Escalators is to be Tried Out at the Park Place Station of the Seventh Avenue Subway in New York City. Four Escalators Will be Available, Any Or All of Which May be Operated Either Up Or Down, Depending Upon the Direction of Traffic, Which Is Mostly Eastward in the Morning and Westward at Night.

features possess by any similar transportation system in the world. Moving platforms have been suggested and tried in various New York transportation systems, and moving stairways or escalators are not unknown to the metropolis' subway and elevated railroad traveling public by any means. But one of the most interesting and highest lift escalators is now being built at the Park Place and Broadway station of the 7th Avenue Subway, New York City. The

highest speed stations of its kind in the world.

The four escalators to be finally installed will be *reversible*, and several ways of operating these electric motor-driven moving stairways will be available. In the morning when this downtown station of the great metropolis is flooded with office-bound passengers, then if necessary all four of the escalators may run *upward* to carry the traffic to the street. After about 10 o'clock

where north-bound traffic might necessitate operating all of the escalators downward, then passengers arriving on southbound trains would have to gain access up these stairways to the street. It would probably be more expedient to operate three of the escalators downward and one upward, a problem which the traffic engineers will have to determine by careful check over a considerable period of time, after the escalators have been in operation for a while.

## Lightning of All Kinds

Lightning photos are more or less common, and a great number of them have been published in the various issues of this Journal from time to time, but one of the most astonishing lightning pictures ever recorded by the camera, is that shown in the accompanying view, which incorporates every form of lightning, such as bead, forked, chain and ribbon, so-called heat or flash, and ball lightning. This picture is extremely interesting to all photographers, who have attempted to obtain good photos of lightning discharges. It is quite a trick to photograph lightning in just the way you would like to have it appear on a finished picture.

In some cases, and as is the usual practice, excellent lightning pictures are obtained by waiting for a dark period just after a flash, and then opening the camera shutter, which has previously been set for a time exposure. As soon as the next flash of lightning occurs, the shutter is at once closed, and the plate then developed. This sounds simple, but as Shakespeare said, "There is many a slip twixt the cup and the lip," and one humorous instance comes to mind of an ambitious lightning photographer, who sud-

(Continued on page 56)



In this Remarkable Photo Lightning of Many Kinds—Chain, Bead, Forked and Ribbon Varieties—Are Shown. A Photo Hard to Beat.



## British Submarine Detector



The Views Herewith Show the "Hydrophone" Or Super-Sensitive Sound Detector Used by the British Navy in Clearing the Seas of U-Boats. The Left Hand Photo Shows the Device Being Demonstrated in a Museum, Where a Model "Sub" Lies in a Tank of Water. View at Right Shows a Close-Up of Microphone.

The invention was used extensively and successfully by the British Navy during the war. Wires lead to various stations on the ship, at which listeners are posted. By this means a steady watch is kept and the approach of every under-sea craft is heralded. One of the photos shows a model submarine in an experimental tank, showing the hydrophone in the tank, while the man with the receivers listens to the sounds from the propeller which warn of the approaching submarine.

Practically all of the British ships were equip with the device, and it is acknowledged that many ships were saved by means of the instrument, which is somewhat like a dictagraph, i.e., a super-sensitive telephone transmitter connected with a low resistance telephone receiver. The sound detecting microphone is placed in a submerged part of the hull.

## Electric Violin-Virtuoso a Marvel

One of the most wonderful musical instruments ever perfected is the electrically played violin-virtuoso shown herewith. Musicians said it could never be done—but it has been accomplished at last, with a range of action almost, if not, indeed, actually, miraculous.

The control of both speed and pressure of the bows of the self playing violin is said to be perfect. Regardless of how fast or slow the tempo the proper ratio of pressure is consistently maintained. This is accomplished by means of a small electric motor possessing a speed of from 200 to 6,000 (and any intermediate rate) revolutions per minute, and so constructed that the amount of pressure applied to the bows is automatically and accurately regulated by the speed. Thus even the softest notes are clear and sweet, while the loud are



The Electrically Played Violin is Truly a Wonder of Modern Science—It Was Long Predicted That Such a Device Could Not Be Built. But It Has—and Sixty Magnetically Operated Fingers Do the Work—and Play Better Than Most Human Violinists. Four magnets Operate the Bows.

rich and sonorous. Furthermore, one by one, there has been added to the Violano-Virtuoso various devices for producing not only the staccato, but the arpeggio, portamento, pizzicato, shake, trill and all other musical variants peculiar to violin playing.

Sixty "fingers" perform the action. As the contact cylinder carrying the paper (fed by a secondary cylinder) revolves, and the perforations in the music roll pass given points, contact is made with one or more of the brushes and an electric current flows to finger magnets resting over the finger board. Each of these magnets attracts an armature connected with a finger operating rod acting upon the violin strings. The same current also acts simultaneously on the bow action magnets. Another magnet produces the "staccato" while the tremolo

(Continued on page 56)

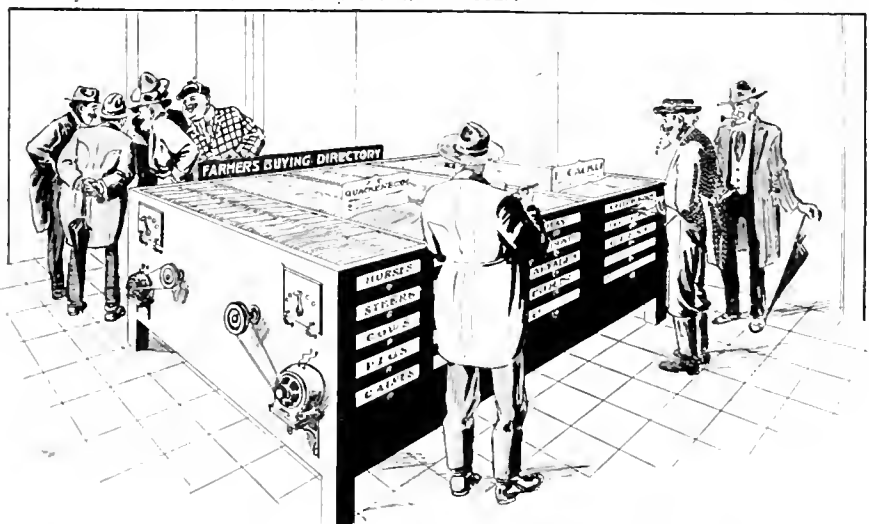
## Push a Button--Get a Pig

The Federal Agricultural Agent up in Litchfield, Conn., being frequently called upon to help farmers find things they needed and having no definite means of knowing where they were to be had except for gossip heard on his rounds, conceived the idea of an agricultural survey. Now, if you want to locate a supply of seed corn or oats, a grain binder, a pure-bred bull, or some young pigs, in any community in five counties in that State, all you have to do is to walk into the office of the State Librarian at Hartford, run a series of cards thru an electric sorting machine, and, Presto! you have the information.

It may sound a little like the story of Aladdin's lamp, but it is only big business applied to farm affairs under war stress. The Council of Defense took up this plan and offered to back the farm bureaus to the limit in every county in the State. Five of the eight counties began surveys early in March, 1918. Forty questions, under the headings of area, crops harvested in 1917, crops planted to be harvested in 1918, live stock on hand, machinery on hand, and employes, were included in the survey, and a corps of volunteer farmer census enumerators got busy. When the survey was completed the farm bureaus had a stack of cards containing minute information as to the

resources and needs of every farm. An electric sorting machine was installed in the State Library, and any fact disclosed by the survey can be made available by throw-

ing on an electric switch. The survey has been invaluable by helping Connecticut to mobilize her agricultural forces for peace needs.



Push a Button—Get a Pig! Sounds Incredible, Does It Not? Yet Up in Connecticut They Have Such an Electric System in Operation. You Don't Exactly Get the Pig Or Cow by Pushing the Button, But You Do Obtain Data as to Where You Can Buy Them.

# Putting It Over on Fritz

By K. K. SAMMERIN

## Tricks and Odd Slants of Warfare that Puzzled the Hun

THE immediate ancestor of the "Mills" hand grenade was the "jam tin." This was an awkward and unreliable species of bomb, shaped like a canned soup receptacle, with a six- or eight-inch projecting fuse intended to burn four seconds. Sometimes it fulfilled expectations exactly, but more often the fuse was temperamental. It went off before the time was up, or sputtered long enough, after dropping in the German trench, to allow one of the enemy to pick it up and toss it back. Because, early in the fall of 1915 when this crude weapon flourished, bombs of any kind were so scarce that the soldiers often made their own, few opportunities for dosing the enemy with his own pills were overlooked.

The last day upon which Fritz monkeyed with "fizzers" from the Allied trenches with any degree of self-confidence was November 12th, 1915. That occasion taught him that even a "dud" jam tin has its lively moments.

For several weeks preceding the date mentioned a French ordnance engineer had been experimenting with what he termed "instantaneous fuse." This was made up, wound in waxed thread, just like the ordinary fuse used in jam tins. The essential and important difference between the two

Over a sixty-kilometer front in the Verdun sector the bombers were assembled and coached in the use of this new weapon. Simultaneously at seven in the evening "parties" started out for the German wire. Stopping here, each of the four hundred bombers participating delivered himself of four regular "jam tin" grenades and four of the "imitations" before scurrying back.

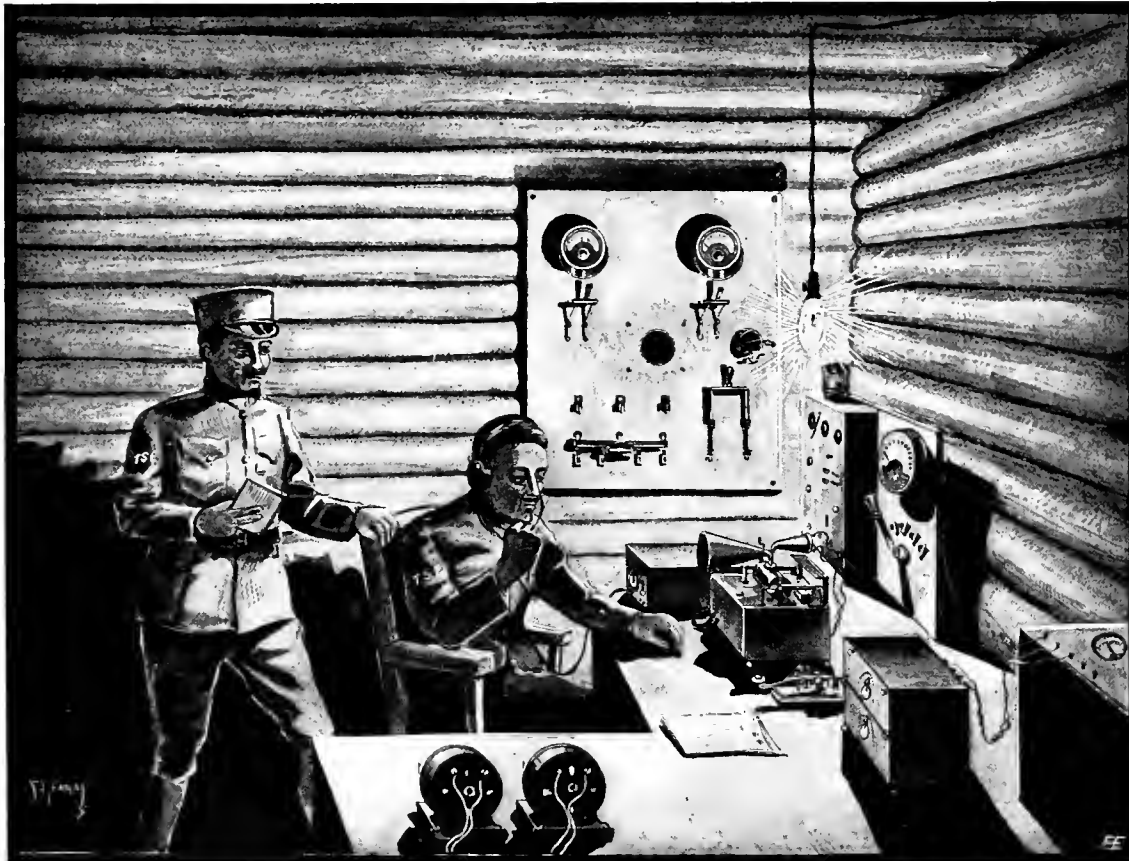
Fritz noted one striking feature of the engagement. Many of the Allied missiles landed "dud"; this probably was due to the extraordinary inefficiency of the French ordnance department, concerning which the German privates had been told so much. All along the line German defenders picked up the imitation duds and lighted their fuses, intending to bomb the bombers with French ammunition.

The havoc that resulted was appalling! Each grenade, of course, exploded the instant it was lighted. Because a raid was in progress, anyway, each individual accident received no attention at the moment. If Fritz saw Heiney go up in smoke while handling a French bomb, he thought simply

exploding in the confined lane of a trench will kill three and wound six soldiers, it is fairly safe to assume that this simple trick cost the Germans at least *five thousand men in killed and wounded!* From that day forward it was official practise in the German lines to let French bombs severely alone.

Another point at which Allied wits bested German scheming was at forecasting retreats by the enemy. To civilians, well-posted with data on the occasional exploits of airplane observers, this does not sound sensational in the least, but doubtless to the Huns themselves the manner in which the Allied forces knew of the last retreat in the Soissons-Reims sector in time to take full advantage of it seemed little less than miraculous. No matter what air-men may say about the photographs they took, or the observations made by telescope from a plane, this latter scheme could only tell of a retreat actually under way—too late for much action by the Allies. On the other hand, the method described here not only would tell for certain, two weeks in advance of the first troop or supply train movement, *but would mark off the exact line to be abandoned, and tell the depth to which the Germans intended to relinquish their hold!*

This was done simply by listening in on the unintelligible gibberish of German trench wireless with Allied instruments. Ordinarily, of course, three-fourths of the signaling done in the front trenches is done



He Thought He Detected Something That Sounded Just a Little Like a Message! He Wound the Phonograph and Turned its Speed Indicator Down So That the Record Revolved Only a Few Times a Minute. Then He Applied the Needle Again. Aha! There Was Something There!

by means of telephone, orders being sent thru one central station by wire to all parts of the sector.

Towards the end of the war, however, the Germans began to run out of wire and telephone instruments.

They could not replace them because of a lack of the materials. Therefore they began to plan on saving every instrument and foot of wire when a retreat was to be made. They took out the stations gradually, and as they removed them they set up trench wireless instead. The Allies, after finding out this plan, simply watched the appearance of wireless sets where phone stations had been; when the wireless began to predominate it was certain that ten days or two weeks would

(Continued on page 77)

varieties lay in the fact that while straight fuse fizzed off at the rate of *one and one-half inches a second*, the instantaneous variety burned *twenty-six feet a second!*

Without giving the fact much publicity, several thousand jam tins identical in appearance with the stock variety were made up. In every way but one these were the same; the six-inch fuse was instantaneous, and was made with the end charred a trifle, to look as if the bomb had been lighted and had gone "dud" after being thrown.

that Heiney had been too careless—tough luck for Heiney, but *he* would never get caught that way. A second later another trick bomb would send him to join his Hun Comrade.

For several minutes after the bombers reached their sheltered trench the explosions continued across No Man's Land. It was estimated at the time that a full thousand of the grenades exploded in the hands of German soldiers before anyone found out the secret. Since the average bomb

# Cold Light

By ROGERS D. RUSK, M. A.

**C**OLD light is one of the wonders of the modern age. Light without heat seems like a contradiction, nevertheless it is a scientific fact. Since the discovery of the electrical

dioxid. The heat which this light produces is almost negligible.

Cold light is a term used to indicate luminous radiation *without* heat radiation, and that means maximum efficiency, i.e., a colder and a colder source. The old fashioned kerosene lamp wastes 36.4 calories of heat per second for every candle-power of light produced. The gas mantle wastes 11, and the tungsten lamp but from 1. to 2. calories.

Considering electric lights only, the heat loss in tungsten lamps has been reduced by the introduction of gases such as nitrogen into the bulb, but arc lights have made a greater development. The invention of the enclosed arc reduced the heat loss without reducing the illumination. Then the invention of the flaming arc increased the illumination without increasing the temperature of the arc. The latter is the most interesting development because part of the light from the flaming arc is *cold light*, from the chemicals in the flame which are ionized by the electric current. The cold light from these ions plus the light from the incandescent carbons makes the flaming arc nearly *three hundred per cent* more efficient than the ordinary incandescent lamp.

The first flaming arc appeared in 1900, known as the Bremer arc, and using carbons impregnated with several chemical salts. Later Steinmetz and Whitney used the rare metals titanium and chromium in their arcs and produced a still more efficient light. About the same time the *mercury vapor* light was invented, which gave a brilliant bluish white light from the mercury ions in the arc. Later still is the discovery by two scientists, Franck and Hertz, that an electric current of only 4 volts, when past thru *cold iodine vapor*, produces a faint light of definite color. When the voltage is raised to twelve, another color is obtained. This is *true cold light*, produced directly from the molecules as they are ionized by the current. How this is possible, and how light and heat may be produced independently of each other, will now be shown.

What the actual source of a light wave is has been one of the mysteries of science since the beginning of history. The discovery by Maxwell, Hertz and others that light is an electro-magnetic vibration, caused scientists to look for the electric charges which produce these waves. When the electron was discovered it was thought that the solution had been found, but there

was still one great drawback. Scientists said that as the electron revolved about its axis in the molecule it produced light waves just like a paddle wheel in a body of water. But as all molecules of all substances con-

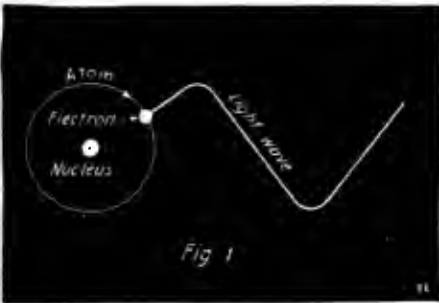


Diagram illustrating the Old Theory of Light Produced by Electricity. In This Explanation the Electron is Considered as Continuously Producing Light Waves by Its Rotation. The Newer Theory of Light and Heat Waves is Shown at Fig. 2.

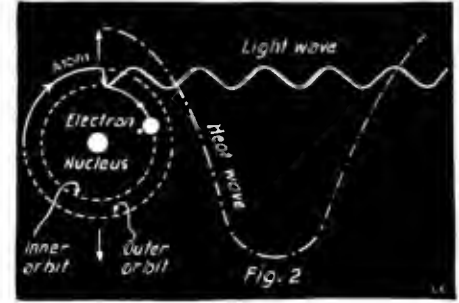
nature of light, the possibility of transforming electricity directly into light, without the production of heat, has been a tempting goal. For centuries, scientists dreamed of solving the mystery of the *fire-fly* and the *Aurora Borealis*, but dreamed in vain. They saw light without heat produced in Nature, but could not produce it themselves.

Today the discovery that light may be produced without heat, by means of electrical ionization, seems to be the key to the situation, and we can only wonder where it may lead us. At the present time over 96 per cent of all the energy used in the fifty million incandescent lamps in the United States, instead of being turned into light, is *wasted in the form of heat!* Moreover the astonishing production of light without heat by ionization has given us a new view of the relation between light and electricity and the great problem of the origin of light.

It used to be thought that light could only be produced by incandescence, that is, thru heating of a solid body to white heat. Strange as it may seem, the candle and the kerosene lamp are really incandescent lights. The light they give off is due to white-hot particles of carbon liberated in the combustion process. Even the light from an arc lamp is mainly due to the crater in the positive carbon being heated to incandescence.

The fact that heat is not the only factor which effects the production of light can be easily seen in two ways. First, salts of sodium, potassium and lithium may be thrown in the same flame at exactly the same temperature, but the first gives off a bright yellow light, the second a violet, and the third a deep red. Second, light is produced by an electric spark in a partial vacuum, such as a Geissler tube, *with little or no heat at all.* In both of these cases the light *must* be produced by the breaking up of the molecules, of the solid or gas, into electrically charged particles, or ions, in a manner to be explained later.

The idea of using cold light for illuminating purposes seems to have first occurred to Nikola Tesla. Very early in his career he suggested that the effects produced in Geissler tubes might be utilized in that way. Not until recent years, however, did his suggestion bear fruit in the shape of the now famous Moore *vacuum tube* light, invented by McFarland Moore, which produces a fine soft light from a glass tube thirty to forty feet long, filled with carbon



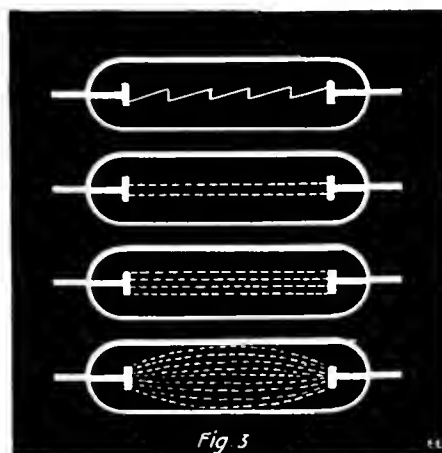
The New Theory of Light and Heat Waves, Which Says that Light is Produced Intermittently. Here Light is Produced by the Electron Jumping from One Orbit to Another, as the Circular Orbital Paths Indicate.

tain electrons which are constantly in motion, then all substances should give off light all the time. This was ridiculous, as everything in the world and the whole universe would be of a dazzling brightness like the sun.

The discoveries of today are changing this idea completely. One of the world's greatest physicists, Planck, says electrons cannot give off light waves continuously, but emit definite quantities at intervals. This theory he calls the *quanta theory*, and another physicist, Bohr, says the time the light is given off is when the motion of the electron is suddenly changed from its normal continuous motion, by its jumping from one atom to another, or from one orbit to another about the same atom. This is a very simple theory, but it is often the simplest theory which best explains the facts. When trillions of trillions of electrons are doing this at the same time, the light is to all purposes continuous. These theories have received added confirmation from work done recently by Prof. Millikan of Chicago University, who gained fame by his original measurements of the electron itself.

The principle of the new theory can be easily explained by an illustration. If a ball is whirled in a circle on the end of a string, the pull on the string is steady and continuous as long as the ball whirls with the same speed. However, if the ball is suddenly stopt or hit by something which makes it change its course, a jerk or a wave will be felt in the string. Now an electron does the same thing, only the jerk or wave is sent out in all directions by the electro-magnetic field about the electron. This jerk or wave is the little quantity which Planck calls a "quanta". The familiar way in which an electron is pictured as continuously producing light waves, by its rotation, is shown in Fig. 1, but this is wrong according to the above theory. What really must happen is shown in Fig. 2, where the two circles represent different orbits and the full line represents the path of the electron jumping from one orbit to another and at the same time emitting a quantity of radiation or *light*. The way in which electricity or some other agency causes this disturbance of the electron is not fully understood.

The most remarkable thing about it all is that heat and light waves may be produced independently. A heat wave is produced by the vibration of the whole molecule or atom as shown by the big arrows and dotted wave line in Fig. 2. And under



How "Cold Light" May be Obtained by Exhausting an Ordinary Glass Tube. When Air is Pumped Out of a Tube in Which There is an Electric Spark Discharge, a Stage is Reached Where the Whole Tube is Filled with a Soft Luminous glow—Cold Light.

(Continued on page 73)



# Popular Astronomy

## Astronomical Distances

By ISABEL M. LEWIS  
of the U. S. Naval Observatory

THE immensity and grandeur of the scale upon which the visible universe is fashioned lies almost beyond human comprehension. To visualize the vast extent of our own solar system which is but a single unit in the system of the stars we may have recourse to earthly standards of measurements, such as the mile. But when we desire to express in terms of units that can be grasped by our imagination, the distances of the stars that lie far, far beyond, we find that all ordinary standards of measurement become utterly inadequate for our purpose. For the measurement of celestial distances within the solar system the unit employed is either the familiar mile or kilometer or the "astronomical unit," which is the mean distance from the earth to the sun (ninety-two million nine hundred thousand miles in round numbers).

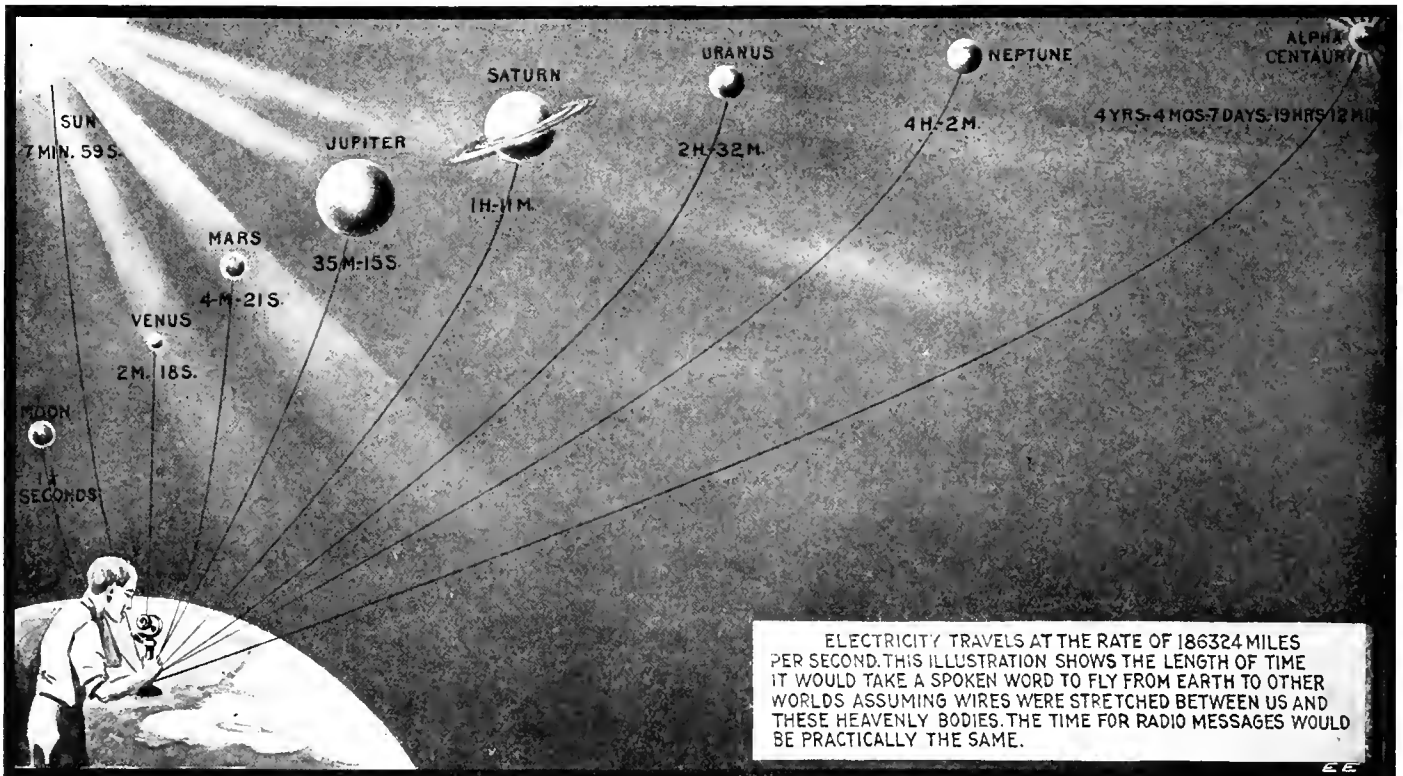
the earth to the sun, "the astronomical unit," would subtend an angle equal to one second of arc. This angle is spoken of as the parallax of the star. The larger the parallax; that is, the larger the angle that the astronomical unit or radius of the earth's orbit subtends, viewed from the star, the nearer the star is to us. The fact that there is no known star within one parsec, or three and twenty-six hundredths light years, of the sun shows the immensity of the scale of the universe of stars.

Before considering the distances of the stars and the extent of the sidereal system of which our sun and his satellites form a part, let us undertake to express the distance of the sun, moon and planets from the earth and the extent of the solar system in terms with which we are familiar.

The nearest to the earth of all celestial bodies is its satellite, the moon. So near

unslacked at two hundred miles an hour. An airplane traveling at this rate would circumnavigate the earth in a little over five days and would reach the moon in seven weeks. A trip to the sun, however, would require fifty-three years.

After traveling for fourteen and a fraction years we would pass the orbit of Venus and eighteen years later the orbit of Mercury. If we preferred to travel outward from the earth in the direction of Mars and the outer planets instead of toward the sun, more than twenty-seven years would elapse before the orbit of Mars would be crossed. An airplane journey to Jupiter would be a matter of more than two hundred years, to Saturn four hundred and fifty years, to Uranus nearly one thousand years and to Neptune about one thousand five hundred years. To cross the solar system on the diameter of Neptune's orbit would be a



Next Time When You Are Impatient and Fretting Because "Central" Keeps You Waiting Ten Seconds for a Connection, Imagine That Your Best Girl is on Neptune. You say "Hello" and It Takes Exactly 4 Hours and 2 Minutes for "Hello" to Get Up to Neptune, and Then You Have to Wait 4 Hours More to Give Your Sweetheart a Chance to Say "Hello" in Return. While If She Were on Alpha Centauri, It Would Take Your Voice Over Four Years to Get to Her and an Equal Time for Her Voice to Get Back, Altho You Know That Electricity Travels at the Rate of 186,324 Miles a Second.

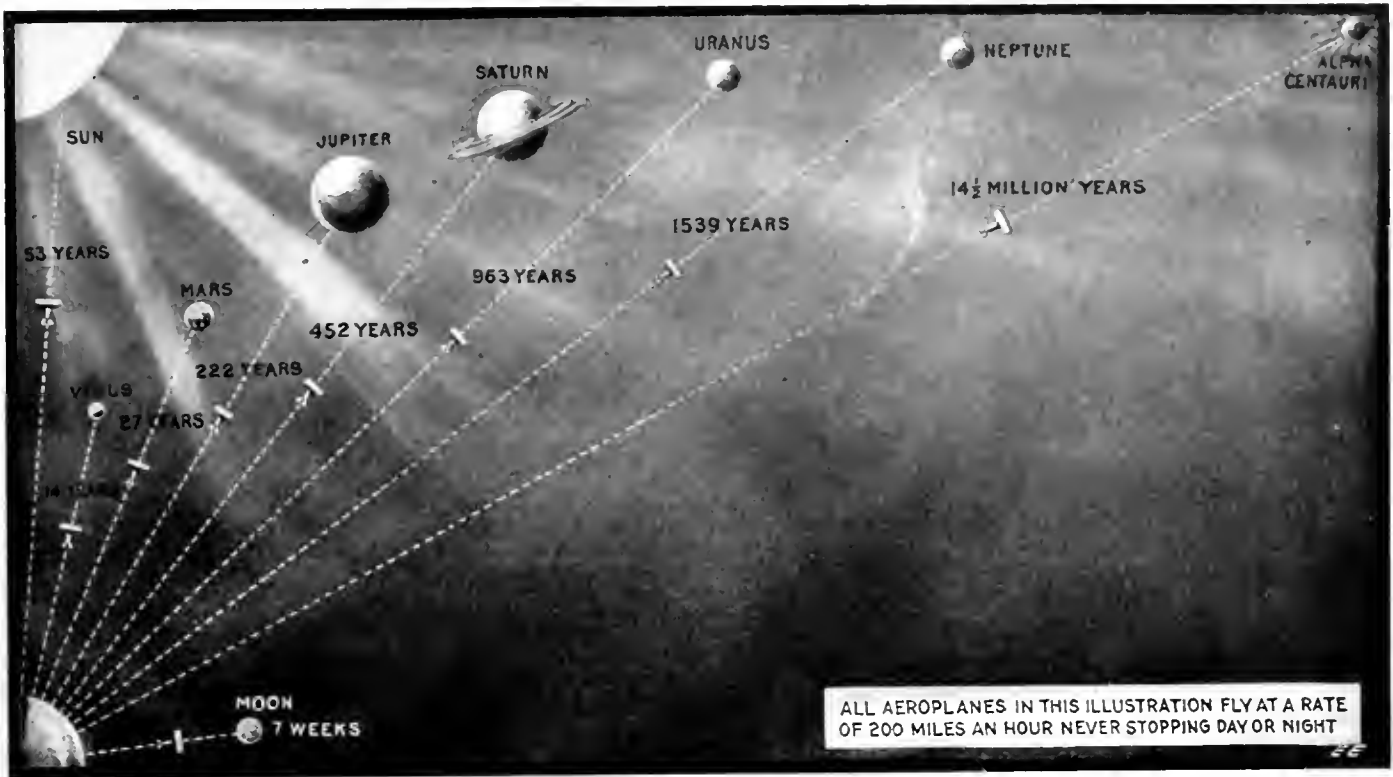
The unit of measurement employed for distances beyond the solar system is either the light year or more recently the parsec which appears to be rapidly replacing the light year among astronomers. A "light year" is the distance that light, with its finite but almost unimaginable velocity of one hundred and eighty-six thousand miles per second, travels in a year. It is equal in round numbers to sixty-three thousand times the distance from the earth to the sun or approximately six thousand billions of miles. The parsec is equal to three and twenty-six hundredths (3.26) light years, and it is approximately two hundred thousand times the distance from the earth to the sun. It is "the distance of a star with the parallax of a second," a fact which its name conveys to us. In other words, at the distance of one parsec the distance from

is the moon that if we should make on some great plain a model of the solar system in which the astronomical unit, the distance from earth to sun, would be four hundred feet, the distance between earth and moon would be only one foot. On the same scale the most distant planet Neptune would be two and one-quarter miles away. In round numbers the moon is distant from us sixty times the distance from the earth's center to its surface or two hundred and forty thousand miles and thru our great telescopes we see it as it would appear at a distance of one hundred miles.

Granted that it were possible to escape the earth's gravitational bonds and to travel by our swiftest means of conveyance, the airplane, thru interplanetary space, let us consider how long it would take us to reach the moon, sun and planets if our speed were

journey of more than three thousand years. The sun's attraction reaches far beyond Neptune's orbit, however. There are comets belonging to the solar system compelled by the sun's attraction to accompany him on his travels thru space that return periodically to the immediate vicinity of the sun from regions far beyond the orbit of Neptune and there is also the possibility that one or more undiscovered planets may travel around the sun in orbits exterior to Neptune's orbit.

Measured in terms of familiar units, such as are employed for the measurement of distances on our own planet, the extent of the solar system is tremendously great. Seen from Neptune, the sun presents no appreciable disk. It is in this sense star-like to the Neptunians, but seen from Neptune the stars appear no more brilliant and



The Fastest Vehicle Known to Man is the Airplane. Supposing There Was Air Instead of a Vacuum Between the Earth and the Other Heavenly Bodies, It Would Take an Airplane a Very Considerable Time to Reach These Bodies. Even to the Moon, the Nearest of All Heavenly Bodies, Only 236,000 Miles Distant, Seven Weeks Would Be Consumed in Reaching It By Airplane. To Reach Neptune, It Would Take 1359 Years. Such Are the Immense Distances of the Universe.

therefore no nearer than they do to us.

To Neptune the sun, tho star-like in form, supplies a very appreciable quantity of light and heat (one nine hundredth of the amount the earth receives) while the amount of light and heat that Neptune receives from the nearest stars is entirely inappreciable. When our airplane reaches Neptune after a journey of one thousand five hundred years, it is, as it were, just clearing the ground for its flight to the stars. To cover the intervening space to the nearest star, traveled by light in four and a third years, an airplane would require *fourteen and a half million years*. In that time the solar system itself would be in some far distant part of the universe, for it is speeding onward thru space at the rate of twelve miles a second or about four astronomical units a year.

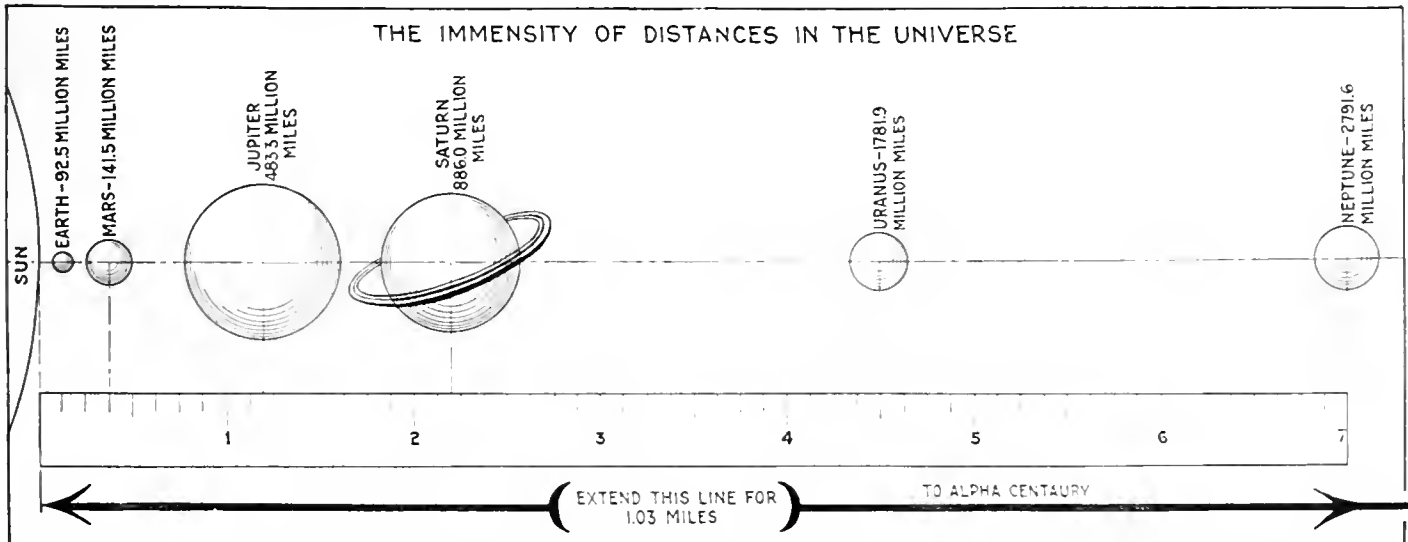
Changing now our unit of measurement that we may express interstellar distances in comprehensible numbers, we prepare to

travel from the earth to the stars with the velocity of light.

At this speed, one hundred and eighty-six thousand miles per second, we circumnavigate our globe in one-seventh of a second, reach the moon in one and a fourth seconds and the sun in eight minutes. In a little over four hours we pass the orbit of Neptune and are started on our journey to the stars penetrating further and further into interstellar space. For a year we travel and reach not a single star tho we are speeding ever onward with the velocity of light. We have now covered the distance of one light year which means the waves of light from the sun we have left behind must travel for a year before they reach us. We continue our journey and find ourselves next at a distance of one parsec from the sun. We have traveled a distance of approximately three and a quarter light years, and were it possible to see the earth as well as the sun at this distance, the two would

appear to be but one second of arc apart, a distance that requires the most careful adjustment and manipulation of the telescope to measure accurately. We are still one light year distant from Alpha Centauri, the nearest of the bright stars. A few of the stars may now appear somewhat brighter than they appear to us on earth, but the majority of the stars appear just as we see them here on earth and the forms of the constellations remain practically unchanged in appearance, for we are only beginning our journey thru the sidereal universe and our position in the universe has only shifted in a slight degree. If we should continue our journey to the immediate vicinity of Alpha Centauri, we would find that it is not like our own sun, a single star, but is a binary star consisting of two suns in revolution around their common center of gravity. The distance of this binary system from the solar system has been measured.

(Continued on page 54)



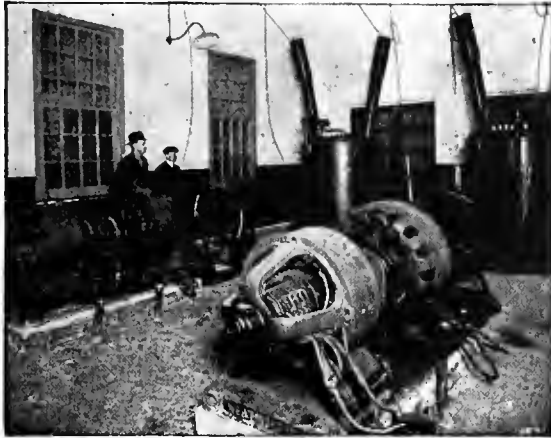
In This Illustration, We Are Trying to Convey to the Reader an Idea of the Enormous, Unthinkable Distances of the Universe. If the Distance from the Sun to Neptune, Which in Reality is 2,791 Million Miles, is Represented by Seven Inches On This Scale, Then the Distance from the Sun to the Nearest Star, Alpha Centauri, Would Be Slightly Over One Mile. Note How Near the Earth is to the Sun, Altho 92 Million Miles Away from It. In Order to Show the Earth Without It Touching the Sun, It Was Necessary in This Drawing to Make the Earth Smaller Than Mars. In Reality Mars is Smaller Than the Earth. The Other Planets Are Shown in Their Correct Proportions.

# Reclaiming Metal Dust From Flue Gases

**I**N refineries of different types there is always a possibility of some valuable by-products, waste, etc., being lost by gases ascending the flue. This is particularly true in the metal treating field. Here

the particles carried by the gases become electrified and are projected against the walls of the tubes. These tubes are grounded and thus the particles drop into hoppers below. Mechanical rectifiers convert the

It is stated that over 90 per cent of the flue dust can be removed and that the value of the copper, zinc and other metals recovered will within a short time pay for the treating equipment.



This Power Plant Delivers 100,000 Volts and .5 Ampere, Direct Current, for Precipitating the Solid Particles in Flue Gases, Such as in the Metal Refining Field, Thus Saving as Much as 90 Per Cent of the Flue Dust.

low voltage alternating current into direct current.

An interesting application of this process was recently made in a copper refinery. In this particular installation there is another noteworthy fact and that is the size of the generating and transforming unit used.

The treater tubes containing the high tension electrodes and thru which the flue gases pass are arranged in six groups. The electrodes are suspended at the top from a rack which provides ample insulation, and are connected with the high tension direct-current line at the bottom. The gases from the furnaces



Interior of High Tension, Direct Current, Electrode Chamber Inside of Flue Tube Measuring 13 Feet in Diameter. The Electrodes Are Suspended Chains Which Carry the Charge When in Use.

it has been found possible to save solid and liquid particles from the flue gases by an electrical process. This consists in passing the gases thru tubes in which are suspended insulated chains charged with high voltage direct current. In passing thru the tube

pass thru pipes 13 feet in diameter, a "Y" with valves being provided so that the gases can be made to go either thru the treater or directly to the stack as desired. See figure herewith.

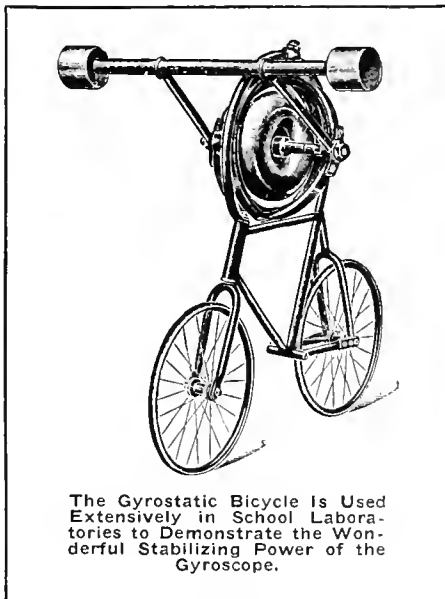
The transformers are of 40 kva. capacity, 200 volts low tension and 100,000 volts high tension. To the motor-generator shafts are coupled the commutating rectifiers for transforming the high-tension alternating current into direct current.

## A Gyrostatic Bicycle

The accompanying illustration shows a novel gyrostatic bicycle model built by a London scientific instrument maker, and this machine will maintain its equilibrium for a considerable period of time. Many of us most probably have seen the street fakir shouting loud and longly about the wonderful possibilities of the toy gyroscope,

bicycle, or other device on which the spinning gyro is mounted. To demonstrate the principle of the gyroscope—which is based upon the fact that a spinning or rotating mass tends to preserve its plane of rotation—all one has to do is to jack up the rear wheel of a bicycle, and by turning the pedals, cause this wheel to spin rapidly. Now hold the bicycle off the ground a short distance, and endeavor to turn the complete bicycle sidewise. You will experience a surprisingly strong counter-turning effect, which tends to keep the bicycle in its upright plane as long as the wheel spins at a fair rate of speed. Many of these gyros are electrically driven; also it is well to keep in mind the fact that even an ordinary bicycle exerts some gyrostatic effort, and this has much to do with the success of the rider in maintaining his upright position while spinning along on two wheels mounted in tandem, that is, one behind the other. You have probably noticed, if you have ever ridden a bicycle that the faster you go, the easier it is to maintain your balance. The increasing gyrostatic effect as the rotational speed of the wheels increased was the reason.

ducing mechanism. The cams and levers which operate the arms and head are thoroly concealed inside the body.



The Gyrostatic Bicycle Is Used Extensively in School Laboratories to Demonstrate the Wonderful Stabilizing Power of the Gyroscope.

### A HARD DRINKER OF SOFT DRINKS.

This little girl is a soft drink demonstrator and she sits in show windows all day long pouring drink after drink of some delicious beverage into the glass and raising it to her lips and draining it with the greatest ease.



Drink Hearty, Little Girl. It's Only Some of Willie Bryan's Famous Grape Juice. An Electric Motor Solves the Mystery of This Silent and Ever-Drinking Demonstrator.

and the apparatus here shown duplicates the many startling maneuvers that the little twenty-five-cent toy gyro performs. When a gyroscope balance wheel is spun rapidly, and providing the rim of the wheel is sufficiently heavy to give it a good momentum, it will be found very difficult to shift the

She seems to like the beverage, for after each drink she nods her head a couple of times with a happy smile which seems to say, "My, that was good"; then she pours down another one.

The figure is made life size of papier maché and mounted on a tabourette, which contains the electric motor and speed re-



# Try These On Your Auto

## ELECTRIC CIGAR LIGHTER FOR THE AUTO.



Ever Try to Light a Cigar While Driving an Auto? This Electric Cigar Lighter Does the Trick Better Than Matches and Does Not "Blow Out".

At last—a perfect electric cigar lighter. It should prove a boon to motorists. It is handy and convenient—a always within reach. The burner tip is made of heavy wire and will last indefinitely. Burner tip is protected by a cap not shown in cut. This neat and efficient cigar lighter is equipped with 5½ foot cord, which automatically re-winds. The lighter is easily attached to the battery in the car and costs practically nothing to operate.

## NEW MAGNETO IMPULSE STARTER.

One of the many reasons why the magneto is so firmly established as the supreme ignition system is the fact that it does not depend upon any other unit or units for its electrical output and distribution of current.

The magneto transforms mechanical energy into electrical energy. The moment the shaft of a magneto-equipped engine revolves, the magneto begins to generate electrical energy for ignition; and, following requirements, the higher the rate at which it is driven the more intense are the sparks.

To facilitate starting when necessary, the magneto here shown can be supplied, with an impulse starter, which automatically "speeds up" the magneto armature at the exact moment of firing the initial gas charge or charges, thus providing at even low speeds the full electrical capacity of the magneto.

In a word, the impulse starter or coupling is a mechanical device for the purpose of obtaining positive and efficient starting, without the aid of batteries or a battery system of ignition.

The impulse starter is located between the magneto drive and the armature; when the engine is cranked or barred over, the armature is held stationary, while energy is being stored up by the compression of a series of springs. At a predetermined moment the springs are released and the armature is given a partial revolution at high speed. In this way, intense sparks are provided, and the engine given its starting impulse.

As soon as the engine commences its regular operation, or attains a speed of about 120 r.p.m., the impulse starter is auto-



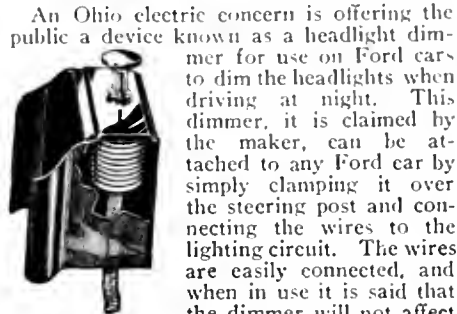
By Storing Up Energy in a Special Spring Coupling Device, It Becomes Possible to Spin This Magneto at Starting, and Provide a Hot Spark.

matically disengaged, the "starter" transmitting the driving energy to the magneto as a flexible coupling.

The control of the "starter" is by means of a lever mounted on a shaft projecting from the front of the housing. The lever is so constructed that it can either be operated by hand or thru the medium of a control connection.

The impulse starter is not an attachment, but is provided only as a part of this new magneto.

## HEADLIGHT DIMMER

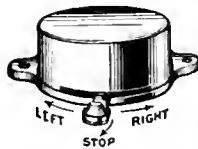


Here is a Simple Electric Headlight Dimmer, Something Every Car Requires by Law. It Answers to the Call of Fords.

An Ohio electric concern is offering the public a device known as a headlight dimmer for use on Ford cars to dim the headlights when driving at night. This dimmer, it is claimed by the maker, can be attached to any Ford car by simply clamping it over the steering post and connecting the wires to the lighting circuit. The wires are easily connected, and when in use it is said that the dimmer will not affect the ignition or lighting system in a detrimental way. The control is made possible by means of a push and pull switch and a barrel type resistance. It is pointed out that it makes possible the use of a brighter light than can be secured thru the use of dimming lenses, yet at the same times makes it convenient to dim the lights according to requirements of traffic laws.

## EFFECTIVE AUTO SIGNAL.

In this new electric auto signal there is only one signal box, which is placed on the



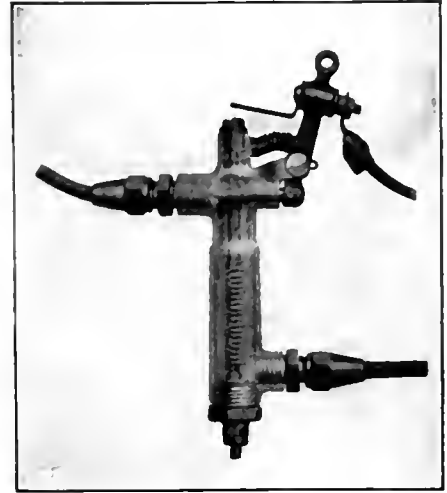
A Logical Design In Electric Auto Signals, Which Can Be Seen from Front or Rear. It is Controlled from the Driver's Seat by Means of a 3-Way Switch.



left rear fender (or body or panel in the case of commercial vehicles and trucks). This shows both from the front and rear, and is visible day and night. The left rear fender is the logical place for the signal, as it is seen by all cars following from the rear, or cars approaching from the front, as well as by the traffic policeman, who is always to the left of cars approaching him.

The signal is controlled from left, right, or stop by a plainly marked, single handle, three-way switch attached to the steering column immediately below the steering wheel, or in a place most accessible to the person driving. It is easily attached, and there are no moving parts to get out of order. A tell-tale buzzer indicates that the signal is functioning. A very slight amount of current from the lighting system of the car or dry cells is consumed. The signal is easily installed on the car by any mechanic.

## ELECTRICALLY HEATED PRIMER FOR QUICK STARTING OF AUTOS.



This Electrically Heated Primer Will Save Much Useless Cussing and Start Your Auto Engine in a Jiffy. The Fuel is Heated, Mixed With Air and Vaporized, Then Sucked Into the Engine. A Simple and Positive Device.

The autoist usually thinks of a primer as a means of pumping fuel into the cylinders quickly. The master primer here shown is not a pump in any sense of the word. The fuel is first heated boiling hot, vaporized by heat and mixed with air. Then drawn into the cylinders by suction of the motor. The suction draws only the quantity needed. Liquid gasoline will not explode. It must be vaporized. It must have air mixed with it to make it explosive.

Liquid fuel in large quantities carbonizes the engine. With the throttle of the carburetor closed, the master primer acts as an auxiliary carburetor—supplies the motor with what it needs in any kind of weather—heated vapor. The heating coil draws 20 amperes, about the same as the horn. Without it you may turn a balky engine over a hundred times.

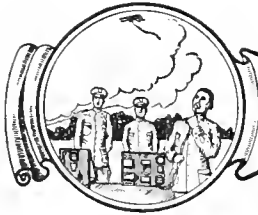
To operate the primer all one need do is just pull a button on the dash. The same operation as choking the carburetor. Pulling the button makes electrical contact and opens the outlet valve of the primer. When car starts let go of button; the contact is broken and valve shuts off automatically.

## NEW MAGNETIZER FOR REMAGNETIZING FORD MAGNETOS.

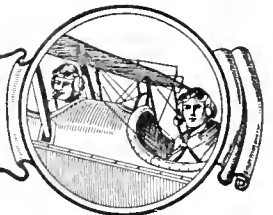
The Ford engine will display a great deal more "pep" if the magnets on the magneto are kept charged. We all know these magnets will lose their magnetism, which naturally reduces the energy displayed by the engine. The magnetizer is constructed in such a way that these magnets can be charged without taking the engine apart. All that is necessary is to take off the transmission cover. The magnets can then be charged, requiring only three or four seconds to each magnet. This is done by connecting the magnetizer to a well charged 6 or 12-volt battery or a sufficient number of dry cells in series.



Ford Owners Will Hail With Delight This New Magneto Magnetizer.



# RADIO DEPARTMENT

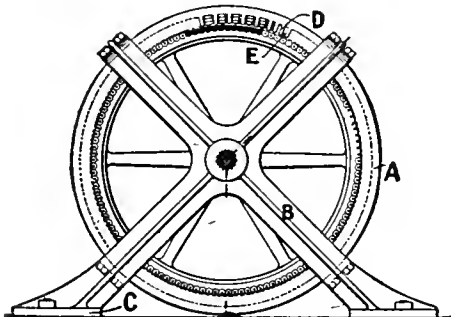


## The True Wireless

By NIKOLA TESLA

Written Exclusively for The Electrical Experimenter

**E**VER since the announcement of Maxwell's electro-magnetic theory scientific investigators all the world over had been bent on its experimental verification. They were convinced that it would be done and lived in an atmosphere of eager expectancy, un-



Alternator of 10,000 Cycles p.s., Capacity 10 K.W., Which Was Employed by Tesla in His First Demonstrations of High Frequency Phenomena Before the American Institute of Electrical Engineers at Columbia College, May 20, 1891. Fig. 1.

usually favorable to the reception of any evidence to this end. No wonder then that the publication of Dr. Heinrich Hertz's results caused a thrill as had scarcely ever been experienced before. At that time I was in the midst of pressing work in connection with the commercial introduction of my system of power transmission, but, nevertheless, caught the fire of enthusiasm and fairly burned with desire to behold the miracle with my own eyes. Accordingly, as soon as I had freed myself of these imperative duties and resumed research work in my laboratory on Grand Street, New York, I began, parallel with high frequency alternators, the construction of several forms of apparatus with the object of exploring the field opened up by Dr. Hertz. Recognizing the limitations of the devices he had employed, I concentrated my attention on the production of a powerful induction coil but made no notable progress until a happy inspiration led me to the invention of the oscillation transformer. In the latter part of 1891 I was already so far advanced in the development of this new principle that I had at my disposal means vastly superior

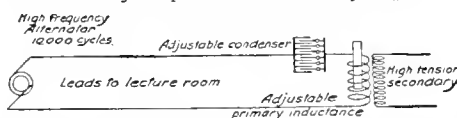


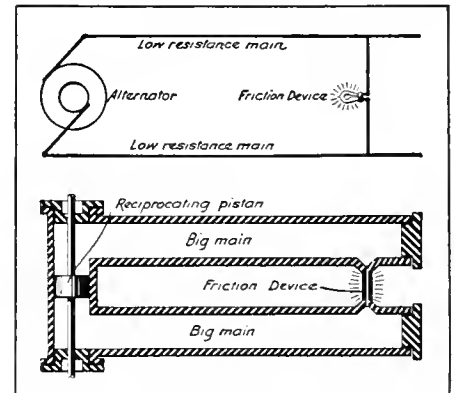
Diagram Illustrating the Circuit Connections and Tuning Devices Employed by Tesla in His Experimental Demonstrations Before the American Institute of Electrical Engineers With the High Frequency Alternator Shown in Fig. 1. Fig. 2.

to those of the German physicist. All my previous efforts with Ruhmkorff coils had left me unconvinced, and in order to settle my doubts I went over the whole ground once more, very carefully, with these im-

proved appliances. Similar phenomena were noted, greatly magnified in intensity, but they were susceptible of a different and more plausible explanation. I considered this so important that in 1892 I went to Bonn, Germany, to confer with Dr. Hertz in regard to my observations. He seemed disappointed to such a degree that I regretted my trip and parted from him sorrowfully. During the succeeding years I made numerous experiments with the same object, but the results were uniformly negative. In 1900, however, after I had evolved a wireless transmitter which enabled me to obtain electro-magnetic activities of many millions of horse-power, I made a last desperate attempt to prove that the disturbances emanating from the oscillator were ether vibrations akin to those of light, but met again with utter failure. For more than eighteen years I have been reading treatises, reports of scientific transactions, and articles on Hertz-wave telegraphy, to keep myself informed, but they have always impress me like works of fiction.

The history of science shows that theories are perishable. With every new truth that is revealed we get a better understanding of Nature and our conceptions and views are modified. Dr. Hertz did not discover a new principle. He merely gave material support to a hypothesis which had

application of these radiations for the purpose was quite obvious. When Dr. Hertz was asked whether such a system would be of practical value, he did not think so, and he was correct in his forecast. The best that might have been expected was a method of communication similar to the

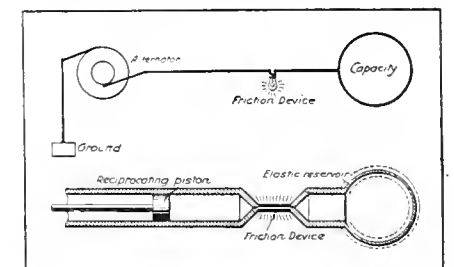


Electric Transmission Thru Two Wires and Hydraulic Analog. Fig. 3.

heliographic and subject to the same or even greater limitations.

In the spring of 1891 I gave my demonstrations with a high frequency machine before the American Institute of Electrical Engineers at Columbia College, which laid the foundation to a new and far more promising departure. Altho the laws of electrical resonance were well known at that time and my lamented friend, Dr. John Hopkinson, had even indicated their specific application to an alternator in the Proceedings of the Institute of Electrical Engineers, London, Nov. 13, 1889, nothing had been done towards the practical use of this knowledge and it is probable that those experiments of mine were the first public exhibition with resonant circuits, more particularly of high frequency. While the spontaneous success of my lecture was due to spectacular features, its chief import was in showing that

all kinds of devices could be operated thru a single wire without return. This



Electric Transmission Thru a Single Wire Hydraulic Analog. Fig. 4.

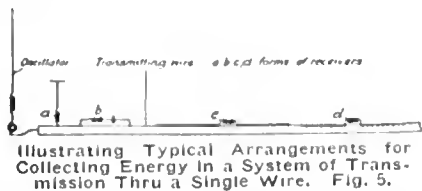
was the initial step in the evolution of my wireless system. The idea presented itself to me that it might be possible, under ob-

**I**N this remarkable and complete story of his discovery of the "True Wireless" and the principles upon which transmission and reception, even in the present day systems, are based, Dr. Nikola Tesla shows us that he is indeed the "Father of the Wireless." To him the Hertz wave theory is a delusion; it looks sound from certain angles, but the facts tend to prove that it is hollow and empty. He convinces us that the real Hertz waves are blotted out after they have traveled but a short distance from the sender. It follows, therefore, that the measured antenna current is no indication of the effect, because only a small part of it is effective at a distance. The limited activity of pure Hertz wave transmission and reception is here clearly explained, besides showing definitely that in spite of themselves, the radio engineers of today are employing the original Tesla tuned oscillatory system. He shows by examples with different forms of aërials that the signals picked up by the instruments must actually be induced by earth currents—not etheric space waves. Tesla also disproves the "Heaviside layer" theory from his personal observations and tests.

EDITOR.

been long ago formulated. It was a perfectly well-established fact that a circuit, traversed by a periodic current, emitted some kind of space waves, but we were in ignorance as to their character. He apparently gave an experimental proof that they were transversal vibrations in the ether. Most people look upon this as his great accomplishment. To my mind it seems that his immortal merit was not so much in this as in the focusing of the investigators' attention on the processes taking place in the ambient medium. The Hertz-wave theory, by its fascinating hold on the imagination, has stifled creative effort in the wireless art and retarded it for twenty-five years. But, on the other hand, it is impossible to over-estimate the beneficial effects of the powerful stimulus it has given in many directions.

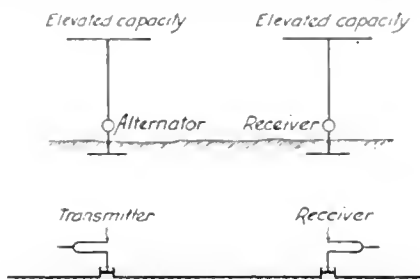
As regards signaling without wires, the



Illustrating Typical Arrangements for Collecting Energy in a System of Transmission Thru a Single Wire. Fig. 5.

servance of proper conditions of resonance, to transmit electric energy thru the earth, thus dispensing with all artificial conductors. Anyone who might wish to examine impartially the merit of that early suggestion must not view it in the light of present day science. I only need to say that as late as 1893, when I had prepared an elaborate chapter on my wireless system, dwelling on its various instrumentalities and future prospects, Mr. Joseph Wetzler and other friends of mine emphatically protested against its publication on the ground that such idle and far-fetched speculations would injure me in the opinion of conservative business men. So it came that only a small part of what I had intended to say was embodied in my address of that year before the Franklin Institute and National Electric Light Association under the chapter "On Electrical

number of radical improvements. Suitable high frequency generators and electrical oscillators had first to be produced. The energy of these had to be transformed in effective transmitters and collected at a distance in proper receivers. Such a system would be manifestly circumscribed in its usefulness if all extraneous interference were not prevented and exclusiveness secured. In time, however, I recognized that devices of this kind, to be most effective

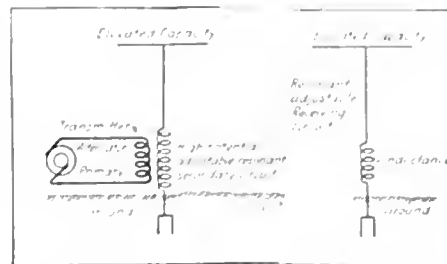


Transmission of Electrical Energy Thru the Earth as Illustrated in Tesla's Lectures Before the Franklin Institute and Electric Light Association in February and March, 1893, and Mechanical Analog of the Same. Fig. 7.

and efficient, should be designed with due regard to the physical properties of this planet and the electrical conditions obtaining on the same. I will briefly touch upon the salient advances as they were made in the gradual development of the system.

The high frequency alternator employed in my first demonstrations is illustrated in Fig. 1. It comprised a field ring, with 384 pole projections and a disc armature with coils wound in one single layer which were connected in various ways according to requirements. It was an excellent machine for experimental purposes, furnishing sinusoidal currents of from 10,000 to 20,000 cycles per second. The output was comparatively large, due to the fact that as much as 30 amperes per square millimeter could be past thru the coils without injury.

The diagram in Fig. 2 shows the circuit arrangements as used in my lecture. Resonant conditions were maintained by means



Tesla's System of Wireless Transmission Thru the Earth as Actually Exposed in His Lectures Before the Franklin Institute and Electric Light Association in February and March, 1893. Fig. 8.

of a condenser subdivided into small sections, the finer adjustments being effected by a movable iron core within an inductance coil. Loosely linked with the latter was a high tension secondary which was tuned to the primary.

The operation of devices thru a single wire without return was puzzling at first because of its novelty, but can be readily explained by suitable analogs. For this purpose reference is made to Figs. 3 and 4. In the former the low resistance electric conductors are represented by pipes of large

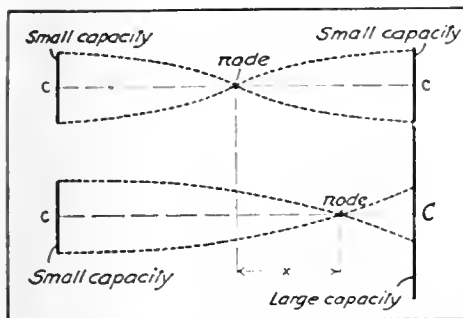
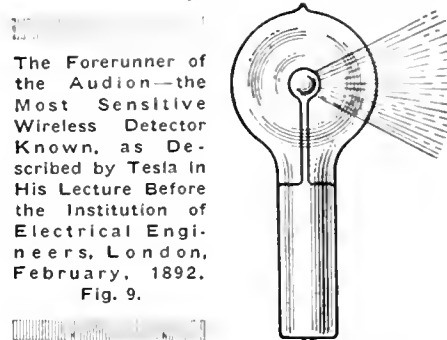


Diagram Elucidating Effect of Large Capacity on One End. Fig. 6.

Resonance." This little salvage from the wreck has earned me the title of "Father of the Wireless" from many well-disposed fellow workers, rather than the invention of scores of appliances which have brought wireless transmission within the reach of every young amateur and which, in a time not distant, will lead to undertakings overshadowing in magnitude and importance all past achievements of the engineer.

The popular impression is that my wireless work was begun in 1893, but as a matter of fact I spent the two preceding years in investigations, employing forms of apparatus, some of which were almost like those of today. It was clear to me from the very start that the successful consummation could only be brought about by a



The Forerunner of the Audion—the Most Sensitive Wireless Detector Known, as Described by Tesla in His Lecture Before the Institution of Electrical Engineers, London, February, 1892. Fig. 9.

section, the alternator by an oscillating piston and the filament of an incandescent lamp by a minute channel connecting the pipes. It will be clear from a glance at the diagram that very slight excursions of the piston would cause the fluid to rush with high velocity thru the small channel and that virtually all the energy of movement would be transformed into heat by friction, similarly to that of the electric current in the lamp filament.

The second diagram will now be self-explanatory. Corresponding to the terminal capacity of the electric system an elastic reservoir is employed which dispenses with the necessity of a return pipe. As the piston oscillates the bag expands and contracts, and the fluid is made to surge thru the restricted passage with great speed, this

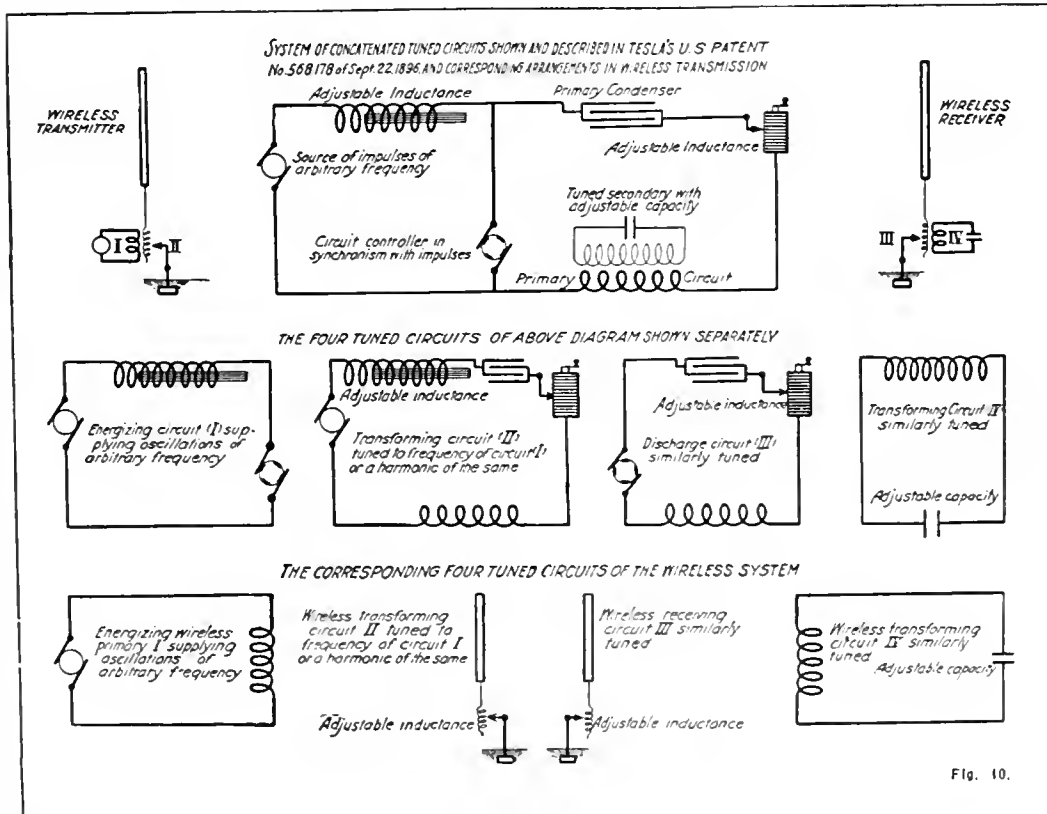


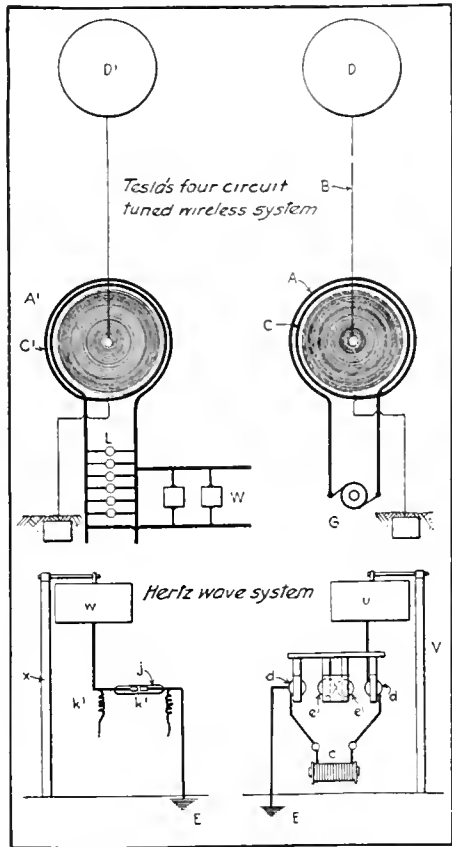
Fig. 10.

Tesla's System of Concatenated Tuned Circuits Shown and Described in U. S. Patent No. 568,178 of September 22, 1896, and Corresponding Arrangements in Wireless Transmission.



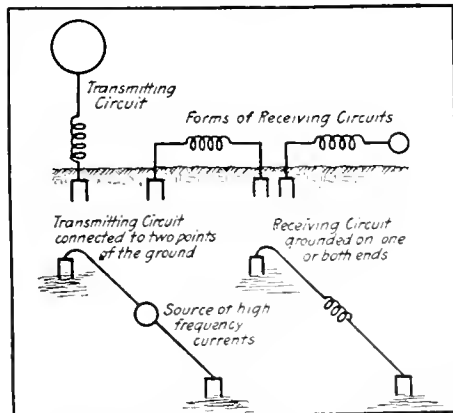
resulting in the generation of heat as in the incandescent lamp. Theoretically considered, the efficiency of conversion of energy should be the same in both cases.

Granted, then, that an economic system of power transmission thru a single wire is



Tesla's Four Circuit Tuned System Contrasted With the Contemporaneous Hertz-wave System. Fig. 11.

practicable, the question arises how to collect the energy in the receivers. With this object attention is called to Fig. 5, in which a conductor is shown excited by an oscillator joined to it at one end. Evidently, as the periodic impulses pass thru the wire, differences of potential will be created along the same as well as at right angles to it in the surrounding medium and either of these may be usefully applied. Thus at *a*, a circuit comprising an inductance and capacity is resonantly excited in the transverse, and at *b*, in the longitudinal sense. At *c*, energy is collected in a circuit parallel to the conductor but not in contact with it, and again at *d*, in a circuit which is partly sunk into the conductor and may be, or not, electrically connected to the same. It is important to keep these typical dispositions in mind, for however the distant ac-



Arrangements of Directive Circuits Described in Tesla's U. S. Patent No. 613,809 of November 8, 1898, on "Method of and Apparatus for Controlling Mechanism of Moving Vessels or Vehicles." Fig. 12.

tions of the oscillator might be modified thru the immense extent of the globe the principles involved are the same.

Consider now the effect of such a conductor of vast dimensions on a circuit exciting it. The upper diagram of Fig. 6 illustrates a familiar oscillating system comprising a straight rod of self-inductance  $2L$  with small terminal capacities  $c$  and a node in the center. In the lower diagram of the figure a large capacity  $C$  is attached to the rod at one end with the result of shifting the node to the right, thru a distance corresponding to self-inductance  $X$ . As both parts of the system on either side of the node vibrate at the same rate, we have evidently,  $(L + X)c = (L - X)C$  from

$$\text{which } X = L \frac{C - c}{C + c}$$

When the capacity  $C$  becomes commensurate to that of the earth,  $X$  approximates  $L$ , in other words, the node is close to the ground connection. The exact determination of its position is very important in the calculation of certain terrestrial electrical and geodetic data and I have devised special means with this purpose in view.

My original plan of transmitting energy without wires is shown in the upper diagram of Fig. 7, while the lower one illustrates its mechanical analog, first published in my article in the *Century Magazine* of June, 1900. An alternator, preferably of high tension, has one of its terminals connected to the ground and the other to an elevated capacity and impresses its oscillations upon the earth. At a distant point a receiving circuit, likewise connected to ground and to an elevated capacity, collects some of the energy and actuates a suitable device. I suggested a multiplication of such units in order to intensify the effects, an idea which may yet prove valuable. In the analog two tuning forks are provided, one at the sending and the other at the receiving station, each having attached to its lower prong a piston fitting in a cylinder. The two cylinders communicate with a large elastic reservoir filled with an incom-

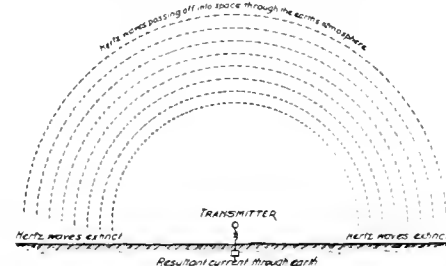


Diagram Exposing the Fallacy of the Gliding Wave Theory as Propounded in Wireless Text Books. Fig. 13.

pressible fluid. The vibrations transmitted to either of the tuning forks excite them by resonance and, thru electrical contacts or otherwise, bring about the desired result. This, I may say, was not a mere mechanical illustration, but a simple representation of my apparatus for submarine signaling, perfected by me in 1892, but not appreciated at that time, altho more efficient than the instruments now in use.

The electric diagram in Fig. 7, which was reproduced from my lecture, was meant only for the exposition of the principle. The arrangement, as I described it in detail, is shown in Fig. 8. In this case an alternator energizes the primary of a transformer, the high tension secondary of which is connected to the ground and an elevated capacity and tuned to the impressed oscillations. The receiving circuit consists of an inductance connected to the ground and to an elevated terminal without break and is resonantly responsive to the transmitted oscillations. A specific form of receiving device was not mentioned, but I had in mind to transform the received currents and thus make their volume and tension suitable for any purpose. This, in

substance, is the system of today and I am not aware of a single authenticated instance of successful transmission at considerable distance by different instrumentalities. It might, perhaps, not be clear to

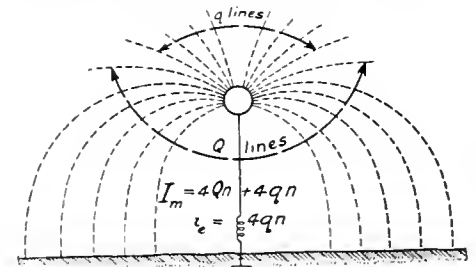


Fig. 14. Diagram Explaining the Relation Between the Effective and the Measured Current in the Antenna.

those who have perused my first description of these improvements that, besides making known new and efficient types of apparatus, I gave to the world a wireless system of potentialities far beyond anything before conceived. I made explicit

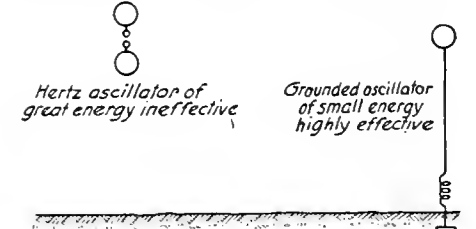


Fig. 15. Illustrating One of the General Evidences Against the Space Wave Transmission.

and repeated statements that I contemplated transmission, absolutely unlimited as to terrestrial distance and amount of energy. But, altho I have overcome all obstacles which seemed in the beginning unsurmountable and found elegant solutions of all the problems which confronted me, yet, even at this very day, the majority of experts are still blind to the possibilities which are within easy attainment.

My confidence that a signal could be easily flashed around the globe was strengthened thru the discovery of the "rotating brush," a wonderful phenomenon which I have fully described in my address before the Institution of Electrical Engineers, London, in 1892, and which is illustrated in Fig. 9. This is undoubtedly the most delicate wireless detector known, but for a long time it was hard to produce and to maintain in the sensitive state. These difficulties do not exist now and I am looking to valuable applications of this device, particularly in connection with the high-speed photographic method, which I suggested, in wireless, as well as in wire, transmission.

Possibly the most important advances during the following three or four years were my system of concatenated tuned circuits

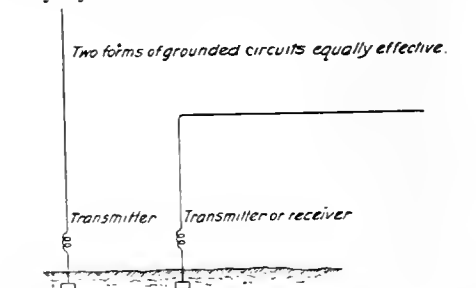


Fig. 16. Showing Unimportance of Relative Position of Transmitting and Receiving Antennae in Disproof of the Hertz-wave Theory.

and methods of regulation, now universally adopted. The intimate bearing of these inventions on the development of the wireless art will appear from Fig. 10, which illus-

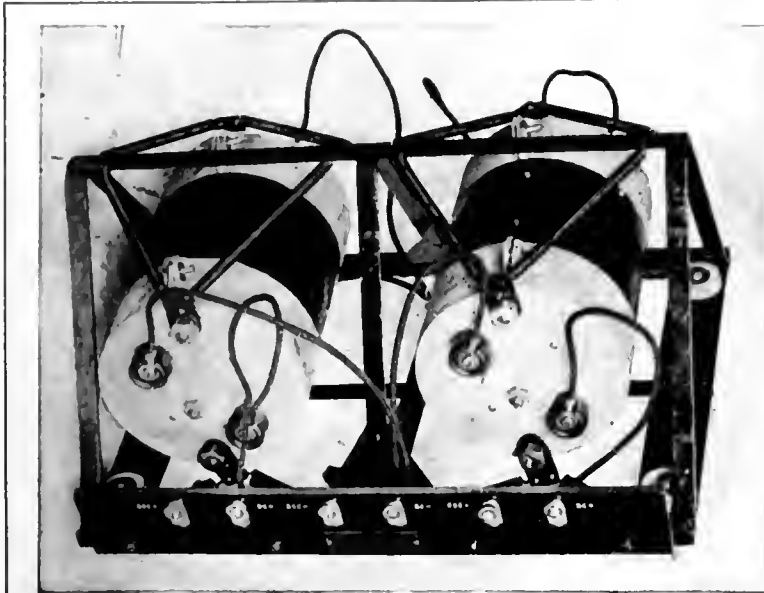
(Continued on page 61)

# Novel Generators

**I**MAGINE yourself wearing a set of head receivers and a telephone transmitter and listening to a voice saying, "I am right over R 7 and your shells are all bursting 'short.' Increase range 50 yards." That was the experience of American radio oper-

ators during the latter part of the war, for radio telephone sets were developed that enabled men on the ground to talk with airplanes flying over the enemy lines and aim the guns according to their directions. An essential feature of the radio telephone set is a small generator to deliver direct current at from 275 to 350 volts. For airplane use, these generators also delivered current at 25 volts. One is mounted on the

landing gear of each 'plane, so that the air "back-wash" of the propeller drives a small two-blade wooden fan on the generator shaft. Thus the generator rims whenever the 'plane is in motion, and also while it is on the ground with the engine running. originally mounted on a light metal frame carrying a voltmeter, fuses and terminals. Quite recently an aluminum carrying-case was developed which was watertight when closed. All the switches, fuses, etc., are mounted inside.



Above:—Spring Cradle Suspension of the Wireless Generators Used on U. S. Naval Submarine Chasers and Destroyers, to Eliminate the Transmission of the Humming Sound Produced by Their Operation, to the Steel Hull of the Vessel and Its Subsequent Interception by a Lurking U-boat. The Sub-sea Sound Detector Used by the German Submarines Was so Sensitive That This Precaution Was Necessary.

At Right:—Lower Right-hand View Shows the Wind-driven Airplane Radio Generator Developed During the War. Its Speed, of Course, Varies with the Velocity of the 'Plane and How Its Voltage Is Maintained Constant with Variable Speed is One of the Interesting Problems That Radio Engineers Had to Solve Before Anything Else Could Be Done.



Ground Officers of the U. S. Army Talking to Airplanes in Flight by Means of Wireless Telephone. The Range of Such Communication Has Recently Been Increased to 150 Miles by Official Test.



ators during the latter part of the war, for radio telephone sets were developed that enabled men on the ground to talk with airplanes flying over the enemy lines and aim the guns according to their directions.

An essential feature of the radio telephone set is a small generator to deliver direct current at from 275 to 350 volts. For airplane use, these generators also delivered current at 25 volts. One is mounted on the

Constant voltage with variable speed is secured by an ingenious arrangement of differential fields controlled by a two-element vacuum tube mounted in the stream-line housing of the generator.

At stations on the ground or on ship-board, power is taken from storage batteries, and here a small dynamotor, driven by 10-volt current, gives the required high voltage. In the field one of these sets was

A submarine chaser often lies motionless, waiting for a U-boat to stick its nose above the surface. So sensitive are the listening devices on the submarines that even the slight hum of one of these dynamotors, transmitted to the chaser hull, would betray its position. Hence the dynamotors furnished to the Navy are mounted in a cradle of coil springs as here illustrated. Photos courtesy Westinghouse E. & M. Co.

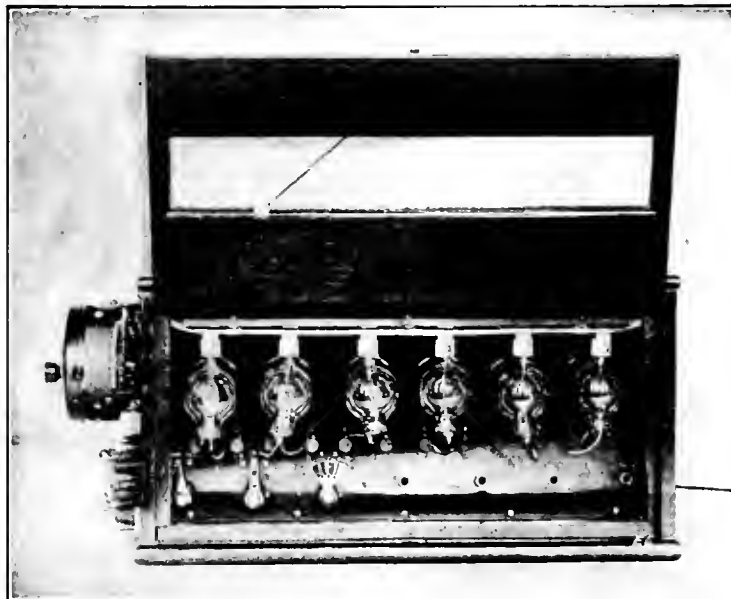
## Boosts Signals 1,000,000 Times

The six-step audion amplifier set here shown represents the latest development in amplifiers, and its intensifying qualities are enormously in excess of any similar apparatus produced heretofore. Under ordinary conditions, this set will amplify 1,000,000 times, so it is especially well adapted for use in connection with the reception of the very weak signals set up by the small portable transmitters used in modern warfare. As a matter of fact, the set has been designed strictly with an eye towards military field work, and similar purposes, and has already proved its efficiency along such lines. An entirely new departure in design is seen in the fact that only one "A" battery, and one "B" battery are employed. In addition, these batteries are practically free of adjustment, which greatly enhances the value of this set, and is a unique feature in amplifier construction.

In connection with the above apparatus, it may be mentioned that the success of the

French armies was in part due to the wonderful results achieved with such amplifiers

on the various battle-fronts. Amplifiers using as many as nine steps were employed with marked success in trench communication, aerial communication, and similar work.



The Most Powerful Vacuum Tube Amplifier Now Standardized and Built. It is a Six-stage Amplifier and Possesses an Amplifying Power of 1,000,000 Times. It Solved Many Knotty Problems During the War.

with marked success in trench communication, aerial communication, and similar work.

In the lower left-hand corner of the panel is mounted a simple two-way switch, by means of which the first bulb can be made either a detector for radio signals or the first-step amplifier for audio-frequency currents. When used as a detector, the connections from the tuner are made to the upper pair of external binding posts. When used as an amplifier, the connections from the detector (or the two-ground terminals, in case one is receiving conduction or induction currents thru the earth) are made to the lower pair of external binding posts. To the other pair of binding posts is connected the six-volt storage battery.

The telephone cord terminates in a plug, which can be plugged into the third, fourth, fifth or sixth jack cord to the degree of amplification which is desired.

## U. S. Adopts Multiplex Radio

THE recent announcement that the Government had decided to adopt the multiplex system of radio telegraphy and telephony, makes possible some entirely new methods of communication.

The multiplex radio system is a complex one. The multiplex system of ordinary telegraphy permits the sending and receiv-

ing of eight different messages on one wire at the same time. Thus it may be seen what a great advantage it holds over the old method of Morse telegraphy.

Radio messages are sent by the same method. The trans-Atlantic Radio Room in the Navy Department illustrated herewith is completely equipt with a multiplex

radio outfit. By this new system Secretary Daniels is able to keep in communication with several vessels out at sea at the same time. Likewise, President Wilson, on his voyage to France, was able to keep in immediate communication with Washington.

This photograph is the first to be released showing the trans-Atlantic Radio Operating Room of the Navy Department.

This is the receiving room of the radio station in the Navy Department. Four receiving machines constitute, with the four perforating machines, one complete unit of multiplex radio-telegraphy. As a result, four messages may be sent and four received over one antenna at the same time.



A Recent Photo Taken of the U. S. Navy Department's Trans-Atlantic Radio Operating Room. Multiplex Radio Signaling Is Now Carried on in Both Directions across the Ocean.

### RADIO LINKS 3,000 MILES BETWEEN OMSK AND LYONS.

Omsk, in which are centered the hopes for the rebuilding of a new Russia, after months of isolation, is now actively in wireless communication with the outside world. Hourly reports, containing a complete news service, are received in Omsk direct from the French wireless station at Lyons, France. Outgoing communication will be inaugurated soon.

From Omsk to Lyons is 3,000 miles on a direct air line over Bolshevik Russia and Central Europe. Omsk is about midway between the Atlantic and Pacific oceans.

### AN OMISSION.

We wish to state that credit for the photographs accompanying the article entitled "The City of Splendid Night" by Amos Stote, published in the January, 1919, issue, should have been given to the New York Edison Co.

## New French and American Audions

UNDOUBTEDLY the radio amateur and experimenter has often wondered what form of audion or vacuum detector and amplifier was being used both by the American and European armies. Thru the courtesy of Dr. Lee de Forest, we are enabled to show herewith the standard form of three-electrode audion in use by the French Army signal corps, as well as by the French Navy, and also the standard form of three-electrode audion in use by the United States Army Signal Corps.

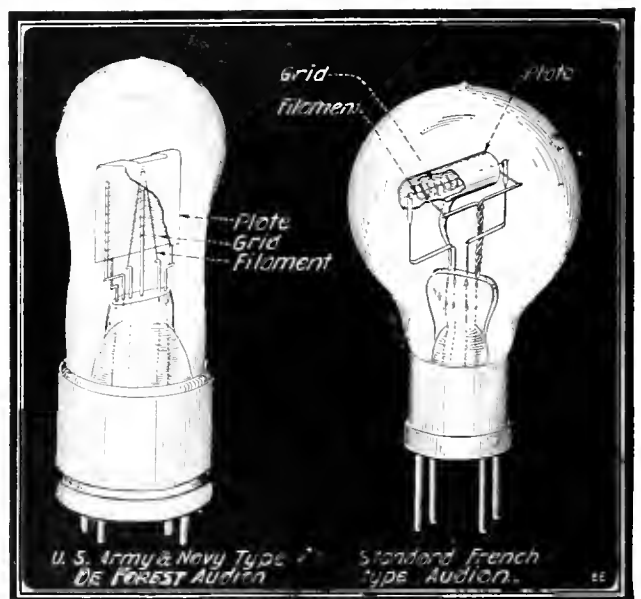
As we have heard but very little concerning the French and other European wireless apparatus for several years, owing to the war conditions existing, we find considerable interest in the French type of vacuum bulb detector and amplifier, and so we will consider it first.

As the illustration shows it comprises a spherical form of glass bulb, which is eventually pumped out to a very high degree of vacuum. One thing decidedly noticeable about both the French and American tubes, is the simplified and highly improved form of base which incorporates four contact pins, which form a juncture with four sockets in the bayonet-joint receptacle supporting the audion. Two of the contact pins lead to the incandescent filament, while the other two connect to the grid and the plate respectively. It is thus but a moment's work to snap a bulb out of its socket and replace it with another one.

The French audion is unique in its general design, as will be noted from the accompanying illustration, the filament being in the form of a fine straight wire passing thru the center of the grid, which takes the form of a helical coil of non-oxidizing wire. Outside of the helical grid, we find the wing or plate element, which is made in the form of a small cylinder or tube. Each of the three distinct elements comprising the audion are spaced about 3/32 inch apart. It

is stated on good authority that during the war the French Government manufactured five thousand of these audion bulbs every day, or almost two million of them in a year. This rate of audion production was carried on during the last two years of the war. The French bulb here shown is particularly interesting as being efficient and suitable in all three functions,—detector, amplifier and oscillator.

The Standard United States Army type of three-electrode audion here shown comprises filament, grid and plate, rigidly secured in place in the manner indicated. Particular attention has been given in this design to the manner of supporting the inverted "V" type filament as well as the grid and plate elements, so that as a matter of fact these rugged bulbs can be handled without any particular pains, and none of the electrode elements can move as they could in the older types. A still better construction is involved in a modified and improved form of audion being developed for the United States Signal Corps by Dr. de Forest. It will be seen how the plate member is bent into the shape of an inverted "U" and rigidly secured by two wire members securely molded or fused into the glass stem. The fine wire grid is securely mounted in place inside of the plate member on two upright wire legs as shown, and



At the Left—U. S. Army and Navy Type de Forest Audion. At Right—the Famous French Type of Three Electrode Audion. Five Thousand of Which Were Manufactured Every Day during the Last Year of the War. It Serves as Detector, Amplifier and Oscillator.

the top of the filament is anchored and supported by a third wire secured in the glass stem. There is still a slight chance for a little movement between the electrode elements in this detector, and in the improved form aforementioned and which is now being developed and perfected, the filament, grid and plate are still further strengthened, so that no matter how much the bulb is jarred or shaken, no variation whatsoever can occur in the spacing between any two of the three electrodes.

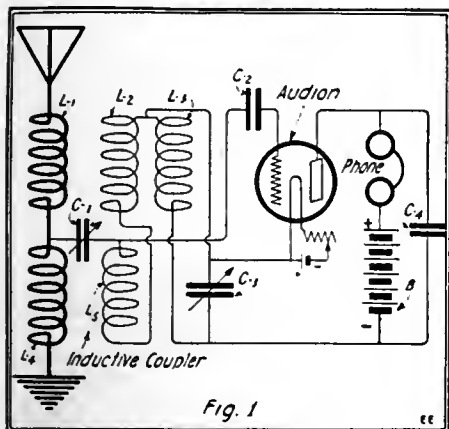


# New Regenerative Vacuum Tube Circuits

By SAMUEL D. COHEN

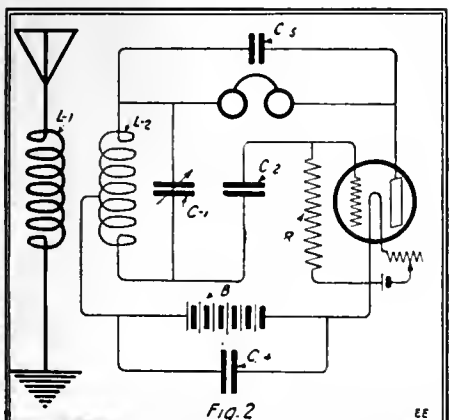
**D**URING the war the vacuum tube has gone into very extensive use in radio communication and other allied electrical fields. The regenerative circuits used until now have been found satisfactory. However, certain improvements were discovered and it is the privilege of the writer to give the results of some of these improvements that were made on regenerative vacuum tube circuits for the reception of long distance stations using long wave lengths.

One of the schemes tried by the writer was to couple the grid to the plate of the vacuum tube directly in the antenna system of the oscillating circuit, in order that heterodyne method of reception might be accomplished with maximum efficiency. For this work it was essential to construct a coupled magnetic system in order to accomplish the desired effects and the accompanying photograph shows a special type of inductive coupler utilized thruout these experiments. It will be noted from the

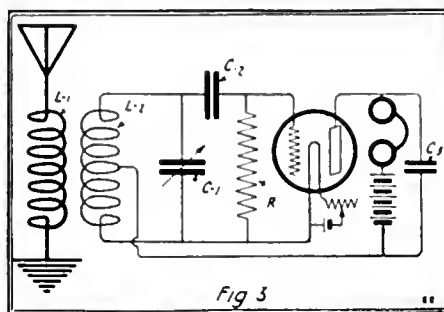


**Fig. 1**  
This New Audion Regenerative Circuit Utilizes a Five Coil Loose Coupler, Which is Described in Detail by the Author. By This Arrangement the Grid and Plate Circuits Are Coupled Magnetically. There Are Two Secondary Coils Which Form a Variometer.

photograph that the primary winding consists of two distinct coils wound on the same tube and in the same direction. The third coil which is swung on a pivoted arm as indicated moves into the magnetic field of one of these coils. The secondary of the coupler also consists of two coils, moving one inside of the other, thus comprising



**Fig. 2**  
In This Audion Circuit, the Plate and Grid Are Coupled Magnetically Thru Coil  $L_2$ , and the Central Tap Should Be Accurately Taken Off.



**Fig. 3**  
This Circuit for a Regenerative Vacuum Tube is Similar to That Given in Fig. 2, and Needs no Special Comment.

a variometer. The coupling of both of these coils can be changed at will, both within the main primary and outside of the primary. This was essential in order to eliminate the use of switches for the control of the inductance of the coils.

The coils were built with great care, in order to eliminate the undesirable oscillations produced within the coil circuits, due to the inherent distributed capacity of the coils.

A circuit giving remarkable results in amplifying received signals is that shown in Fig. 1. The main inductance  $L_1$  is the main primary connected in series with the small coil wound on the same tube  $L_2$ , which is thereafter connected to the ground as indicated.  $L_2$  and  $L_3$ , which comprises the secondary of the coupler are connected in a variometer manner as indicated. The joint point of these coils is connected to the filament terminal of the vacuum tube. The end of the coil is linked to the battery B. of the plate, while coil  $L_2$  is connected

### ROGERS UNDERGROUND ANTENNA

Since the publication of the Rogers underground antenna in our March issue we have been flooded with letters from amateurs all over the country who desire to have further information on this wonderful radio development. The standard question asked by most of these correspondents is, how large is the antenna, how to connect it, etc. In a few words, we might say that a satisfactory method is to use about 100 to 300 feet of ordinary standard automobile rubber cable, burying same in a 3-foot earth trench. The cable is then covered up entirely. One end is insulated, the other end goes to the instruments taking the place of the former aerial.

In our next issue we shall have a comprehensive article specially prepared for amateurs on the Rogers Underground System.—Editor.

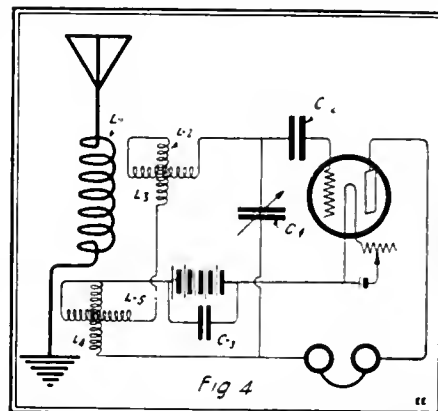
to the tertiary coil  $L_3$ , which coil is the one mounted on the moving arm as indicated on the right of the photograph. Coils  $L_3$  and  $L_4$  are coupled magnetically and electrostatically thru the condenser  $C_1$ . It will thus be seen from the diagram that the plate and grid are coupled thru the inductance  $L_3$  and which said inductance is coupled to the antenna system  $L_1$ . A critical adjustment is necessary between  $L_4$  and  $L_3$ , and between  $L_2$  and  $L_3$ , to give maximum radio frequency amplification in the circuit. Condenser  $C_2$  has a magnitude of the order of two microfarads and is used in general to permit the high frequency current to readily pass to the plate.

Another circuit is shown in Fig. 2, which gave excellent results. In this circuit, the plate and grid are coupled magnetically thru coil  $L_2$ . In this particular case, it is

very essential to note that the filament coil line should be tapt off exactly at the center of coil  $L_2$  in order to give best results. This is done in order to equalize the potentials between the grid and plate circuits. Coil  $L_2$  can be made as a variometer as will be shown later. Condenser  $C_1$  is a regular oscillatory secondary tuning condenser. The resistance R is a grid leak-resistance and its magnitude depends upon the operating characteristics of the tube.

A similar circuit to that of Fig. 2 is shown in Fig. 3, and needs no comment.

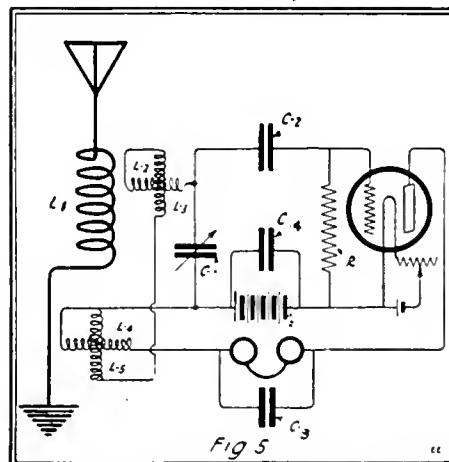
In Fig. 4 is shown another circuit for accomplishing the necessary results for regenerative effects for better efficiency. It will be noted that the inductances  $L_2$  and  $L_3$  comprise a variometer secondary coupled to the primary  $L_1$ . The inductance  $L_4$  is coupled magnetically to the antenna inductance  $L_1$  and to inductance  $L_5$ , which comprises another variometer of both  $L_4$  and  $L_5$ , coupled magnetically to the plate and wing circuit of the vacuum tube. Con-



**Fig. 4**  
Regenerative Audion Circuit Utilizing All Five Coils on the Loose Coupler. Variable Condenser  $C_1$  is Used to Tune the Complete Secondary Oscillatory Circuit in the Manner Indicated.

denser  $C_1$  is used to tune the complete secondary oscillatory circuit, which comprises the inductances  $L_2$ ,  $L_3$ ,  $L_4$ ,  $L_5$ . With this arrangement it is possible to receive wave lengths from different magnitudes ranging from 150 up to 4,000 meters. It is, of course, to be understood that to receive

(Continued on page 74)

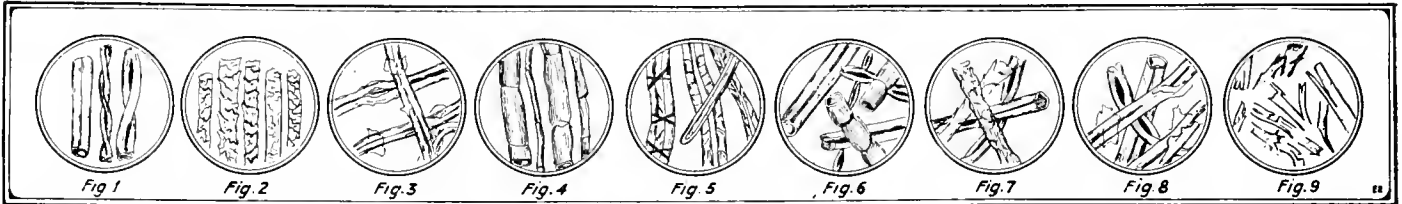


**Fig. 5**  
Another Regenerative Circuit Resembling Fig. 4. Here the Radio Frequency Bridging Condensers  $C_2$  and  $C_1$  are Used to Permit Radio Frequency Currents to Pass Freely to the Plate.

# Practical Chemical Experiments

## Testing of Wool, Cotton and Linen

By ALBERT W. WILSDON



The Two Long Illustrations on This Page Show How Various Textiles Such as Cotton, Silk, Linen, Etc., Look Under the Microscope. Microscopic Examination of Such Textiles is Considered One of the Best Methods of Determining Just What a Certain Fabric is Composed of. Microscopic Drawings of the Various Fabrics Shown in the Illustration Above are:—1—Cotton, 2—Wool, Various Kinds, 3—Silk, 4—Linen, 5—Hemp, 6—Cotton and Linen Mixed, 7—Cotton and Wool, 8—Cotton and Silk, 9—Shoddy, Made from New, Fine, Blue Worsted Clips.

**I**N order that the layman may be more familiar with methods of making quick and accurate tests of varied textiles, this article is written, and not with an object of a complete treatise on "Textile Testing," which work in its entirety may be written in several volumes.

A person buying a piece of material, let



Fig. 19. The Burning Test Applied to Various Cloth Materials to Determine Their Composition, Particularly the Presence of Wool. Vegetable Fibers May Be Readily Distinguished from Animal Fibers By Burning, Animal Fibers Such as Silk and Wool Giving Off the Smell of Burnt Horn. They Do Not Burn Like Vegetable Fibers, But Cease to Burn When Removed from the Flame. Vegetable Fibers Give Off a Slight Odor of Burnt Wood When Ignited, and They Burn Away Very Rapidly With a Flash, leaving No Hard Cinder, But a White or Gray Ash Only.

us say for a suit, does not want to feel that he is being imposed upon by having inferior substitutes sold him when he believes it is all wool. He must, therefore, have immediately available some means of testing.

Textiles may be separated into two main divisions, as we may call them. VEGET-

TABLE FIBERS, under which heading appear *Cotton, Flax, Hemp*, etc., and ANIMAL FIBERS, as *Wool and Silk*.

COTTON appears under the microscope as a wide band, generally twisted, as shown in Fig. 1. Chemically, cotton fiber, separated from all impurities, may be looked upon as pure Cellulose, similar in composition to the Cellulose in starch. Ordinary raw cotton is not pure Cellulose, containing as it does, various impurities such as wax, oil, coloring matter, water and about 1 per cent. of mineral matter.

The appearance of various kinds of WOOL under the microscope is shown in Fig. 2. Wool differs very considerably in chemical composition from Cotton and Flax. It consists of horny-matter (*Keratin*), Carbon, Hydrogen, Oxygen, Nitrogen and Sulfur. This composition is strikingly noticed when wool is burnt, accounting for the peculiar and disagreeable smell of *burning horn* which is given off. Boiling Caustic Soda or Potash solutions dissolve Wool, and if Acetic Acid in excess is added to the solution obtained Hydrogen Sulfid is given off.

SILK, under the microscope, exhibits no definite structure, but consists of cylindrical or flattened, sometimes helical, compact threads, having the appearance of a smooth cylinder without any contents. Fig. 3 depicts Silk as seen under the microscope. Chemically, Silk is composed of silk gelatine, silk fiber, with fat, coloring matter and mineral substances.

FLAX-LINEN fibers consist of chemically pure Cellulose, and are of regular thickness. The cells are built up in a regular manner, cylindrical in shape, having *nodes* arranged at regular intervals as shown in Fig. 4.

IN HEMP the cells are very irregular in form, and do not possess *nodes* as in the former case. The cell walls are not of such constant thickness as Flax, and the ends of the fibers are blunt, having thick walls, frequently branching laterally.

SHODDY is old woolen or worsted materials, torn to pieces by a machine having spiked rollers, which reduces them to fibers. They are then cleaned, and the fiber spun with a certain proportion of new wool.

Broadly, shoddy fibers are of two kinds,

namely—those obtained by mechanical disintegration alone from the clippings, and second, those fibers that are obtained from rags that have been carbonized. It thus becomes necessary to consider first the result of a purely mechanical operation, and in the latter case, combined chemical and mechanical operations. Naturally, we con-

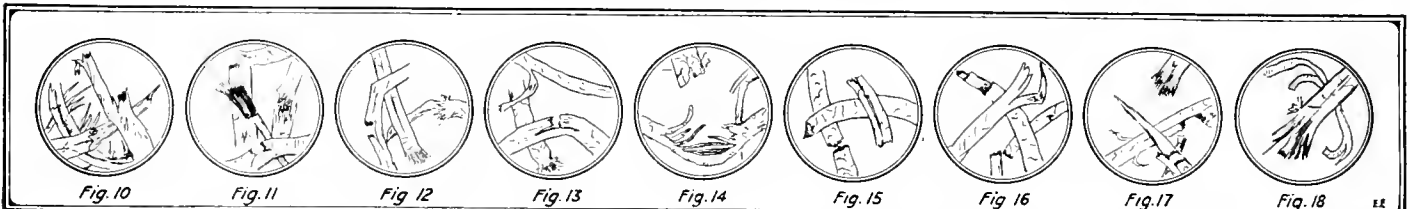


Fig. 20. This Shows Apparatus Arranged for the Accurate Testing of Cotton and Wool Content of Cloth, and One That is Used by Practically All Commercial Cloth Testers. One Glass Contains a Solution of Caustic Potash, or Caustic Soda, into Which is Immersed a Sample of the Wool to Be Tested. A Precipitate Indicates the Relative Amount of Cotton and Other Substances Present. Likewise When Cotton is Immersed in an Acid, a Precipitate Will Show the Relative Amount of Adulterants. See Also Fig. 7.

sider whether the chemical operation of carbonizing has in any way altered the fibers so that they might differ microscopically from those treated only mechanically.

Pure wool, when first sheared from the sheep, shows that the fibers are terminated at one end with a slightly rounded point, while the other end shows a more or less

(Continued on page 79)



Microscopic Appearance of Various Fabrics Under Microscope, Continued. 10—Shoddy, Made from New, Fine, Black Worsted Clips, 11—Shoddy, Made from Carbonized Brown Serge, 12—Shoddy, Made from Brown Serge That Has Been Carbonized and Subsequently Stript, 13—Fibers Made from Blue Serge That Had Been First Carbonized, Then Stript, and Afterward Dyed Green, 14—Shoddy, from the Same Batch as That Shown in Fig. 12, Except That It Has Been Dyed a Full Red, 15—Originally a Brown Serge That Had Been Carbonized, Then Stript, Afterward Dyed a Deep Orange, and Finally Garneted, 16—Shoddy, Made from Brown Serge Which Had Been Carbonized, Stript and Dyed Olive Shade, 17—Shoddy, Made from Various Knit Goods of Different Colors, 18—Shoddy, Made from Serges That Were Carbonized, Stript and Dyed a Deep Maroon.

# Experiments in Radio-Activity

By IVAN CRAWFORD

## PART III.

**I**N the last article ionization by a-rays was discust. The radiations of radium also possess the property of affecting photographic plates. This action of radio-active substances is essentially an ionizing property and the effect produced is



Arrangement of Plate and Uranium Salt in Taking Radiographs.

proportional to the ionizing power of the substance.

Both the a and b particles ionize the air thru which they pass; however, the a-particles do this to a larger extent. In fact the total number of ions per sec., due to the complete absorption of a-rays from one gram of radium, is  $2.56 \times 10^{10}$ , while the beta rays from the same amount of radium produce only  $9 \times 10^4$ . It will be seen from this that the a-rays would affect the plate to a much greater degree than the b-rays. This is only true when there is no obstruction between the substance and the plate. When a solid is interposed the effect is accomplished almost entirely by the b-rays on account of their greater penetrating power.

Geitel, and afterwards Becquerel and Mme. Curie showed that the b-rays were subject to magnetic deflection. The experiments conducted by Kaufmann and Becquerel have shown that the b-particles consist of negatively charged particles projected with an exceedingly high speed, indeed almost approaching that of light. These experiments also proved their mass was equal to that of the cathode particle in vacuum tube phenomena. Really, however, the b-particles are electrons ejected from radio-active substances at a considerably higher speed than that observed for the cathode particle.

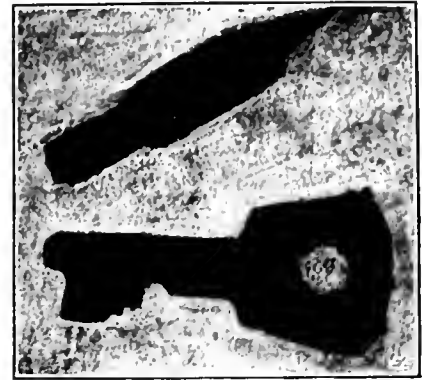
To show the effect of b-rays on photographic plates a very simple device suffices. The following experiment may be easily carried out. An ordinary photographic plate is wrapt in black paper; a few metal objects, such as coins, keys, etc., are then placed upon it and covered with a piece of radio-active ore. Any uranium or thorium salt may be used instead. The exposure should last several days. The action is much slower than X-rays and the results much less clearly defined. A plate with uranium salts on it is shown in Fig. 1. This lack of definition makes this method ill-adapted for practical radio-graphy. The salts of uranium and thorium have been found to give off the beta particles which affect the photographic plate. An interesting experiment is to take an incandescent gas mantle which contains thorium, and

spread it evenly over a photographic plate. After a long exposure the plate will be seen to be affected.

Niewenglowski has shown that phosphorescent calcium sulfid after being exposed to sun-light, assumes the power of emitting beta particles. These particles are extremely penetrating, and are capable of affecting photographic plates even thru comparatively thick sheets of intervening metal. This property, however, differs from ordinary radio-activity. The sun-light seems to cause a disintegration of the calcium atom, causing an emission of beta rays.

Much better radiographs may be obtained if the ionizing agent is the active portion from a spintharoscope. This is a wonderful little instrument and should be in the hands of every experimenter of radio-activity. Considering the great variety of experiments which may be performed with it, and the comparatively small sum for which it may be procured from several leading houses, the experimenter, if at all possible, should possess himself of one. It is, while being an extremely interesting and instructive apparatus, a very simple one. In its common form it somewhat resembles the eyepiece of a micro-

glued. Just above this screen and with its end about over the middle of it, a small watch hand is secured. To the extremity of this a small quantity of radium salt is



Radiograph of Key and Pen Point Taken with Radium Ore. Exposure Three Days.

fastened. In some spintharoscopes the arm which supports the active substance is removable, allowing it to be utilized in the making of radiographs. Those, however,

which are fitted with stationary arms or those in which the active substance is placed directly on the screen, may be employed by removing the lens portion and using the case alone. When using a spintharoscope for making radiographs the exposure need only last about two days. This is because of the much greater activity of the substances used in the construction of these instruments. If figures such as letters be cut from heavy lead foil or some metal sheet and interposed between the spintharoscope element and the plate, their shadow will be clearly discernible. Many interesting

photographs may be made in this manner. The author has found that it is impractical to attempt the construction of such an instrument as they are more cheaply bought. Of course there are many variations of the experiments just described which will not be given here as they will doubtless suggest themselves to the reader's mind.

Before closing this article it has been thought fitting, however, to describe several experiments with this remarkable little instrument—the spintharoscope. If the experimenter will take the spintharoscope into a dark room he will be able to see wonderful flashes of light resembling shooting stars. It is best for the observer to remain for several minutes in the dark before attempting his observations, so to allow the eyes to become accustomed to the darkness. Upon further observation a pulsating nebula of light surrounded by flashing meteors will be seen. This is caused by the fluorescence due to the ions from the disintegrating atom striking the zinc and sulfid screen. The spintharoscope clearly shows the constant shower of particles given off by radio-active substances without any sensible depreciation in their weight or power.

The spintharoscope may be used in another very interesting and instructive experiment. The earlier experimenters with

(Continued on page 68)



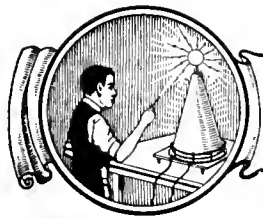
Method of Preparing Radium in Tubes For Use in Medical Work. The Three Small White Tubes Contain Radium Sulfate and Have Respectively 2,550 and 100 Milligrams of Radium Element Content. Beside them Are the Silver and Platinum Screens Used, Back of Which is the Brass Carrying Tube, Together with a Package Ready for Shipment.

scope. The distal lens is removed, and in its place is put a metal plate upon which a thin layer of phosphorescent zinc sulfid is

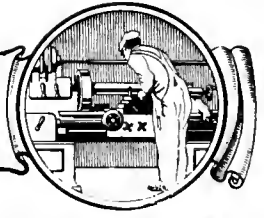


A Small Silica Capsule, Shown in Natural Size, Containing 1.764 Milligrams of Anhydrous Radium Barium Bromid, Having a Radium Element Content of 740 Milligrams. At the Present Market Price of \$120 Per Milligram, This Radium Shown in the Dish Has a Cash Value of \$88,800.





# THE CONSTRUCTOR



## The "Noiseless" Phonograph

By THOMAS REED

I WISH you knew Gladys Doolittle. No I don't, either. I've got no grudge against you. The Doolittles live in the next wing of my hotel, and as their parlor windows face mine I know all about the family, except who they are. "Gladys Doolittle," is only *one* name I call her—among others, yes, many others!

Gladys entertains a young man quite frequently. It isn't the same young man—I wish it was. She's "looking 'em over," and the specimens come on in a remarkably even procession, one at a time, some way she has it fixt. No fights, or jostling in the ante room; never any novelty like that.

Her entertainment is a stock sketch, always the same. From 8 to 9, the visitor engages in conversation with "Pa" Doolittle about what they've both read in the newspaper, while Gladys butts in occasionally with remarks on the sock she's trying to knit. Thus "Pa" samples him, and at the same time the victim makes up his mind whether he likes this better than the hall bedroom on the whole. About 9, he tries to pet the dog—one of these micro-dogs it is—and it bites him; the cake hound has to have his sample, too, I suppose. At 9:15, "Pa" retires. He's a nervous wreck or something, and needs the sleep; if he forgets he needs it, Gladys reminds him. Then, new scene: she turns off all the bulbs except the pink reading-lamp, chases the knitting off the davenport, and trails over and opens up the phonograph. The "vamping" is about to begin.

So far the performance has been confined to the home, but from this on it invades the neighborhood, and atrocities come hard and fast. Gladys uses "haunting" melodies in her vamping business, and as the vampees are always different, one haunter is all she needs at a time. When she first came it was "Memories," but that wore out on her, and ever since then it's been "Poor Butterfly." Does it haunt? Well, look: when Gladys laps her lily finger and gives that record the initial twirl, and old "But" soars out into the community with his ragtime triplets fluttering around him, we know too well it'll be an hour before the trusty insect will be allowed to fold his painted pinions and beat it back to the envelope. Does it haunt? Woof!

I'm slowly getting crazy from it. Perhaps you've noticed signs of it in my writings. What's that, somebody says—"What d'ye mean *slowly*?" Well, all right, you know the cause of it, anyway. I have an

idea I could sue Gladys or her father or somebody and get damages—if the jury should decide I was less valuable crazy than the way I was before. If anybody wants to buy my claim, I'll make an attractive price on it, for cash "or what have you?"

I suppose it isn't really Glad's fault that

been endangered by these instruments ever since the "Pup first heard His Master's Voice," and you know it.

It's a "Noiseless Phonograph" that's needed, and as usual I have to invent it—nobody else will waste the time. Sometimes I get almost discouraged raking around after the big inventors and clearing up the poisonous by-products they leave. Everything falls on Patsy Bolivar. However, here's your new phonograph, not only *inaudible* except to the persons who want to hear it, but one that you can make yourself with hardly any trouble. With this and the prohibition law in operation, I feel as tho the Home might straighten out and survive for several years.

This machine has become possible, in a practical sense, only lately, thru the invention of the Skinderviken transmitter-button, a complete transmitter in itself; and right here I sure won't object if Mr. Skinder makes one simoleon on his part of the rinktum, because he advertises in our "Mag." like a regular fellow, and will sell you a single button if you want it.

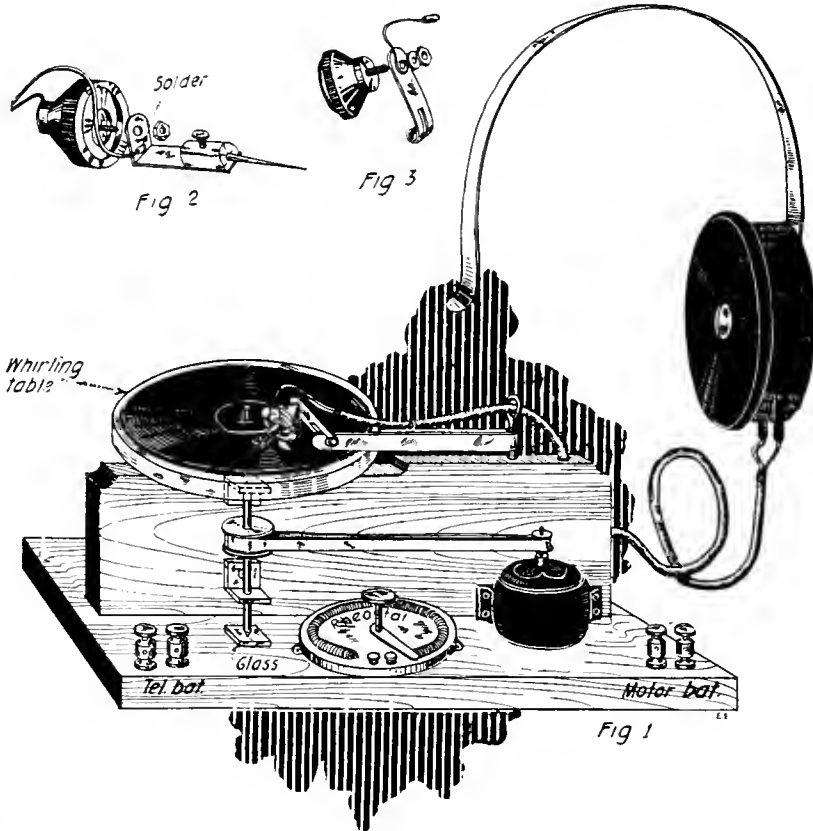
Fig. 1 shows the general layout. For the whirling table, take one of these round shallow tin pans they use for baking Washington-pie sections—or strata, I guess you'd call 'em. The Five and Ten'll have 'em. Take some pains to fix it true on the spindle.

The spindle runs in holes thru two brass elbows. At the lower end, to reduce friction, point it off and

have it bear on a piece of glass. As the transmitter-button is so much lighter than the ordinary reproducer, the pressure of the needle on the record will be negligible, so you won't need a governor. Your battery motor will run it evenly enough, and the speed is regulated by your rheostat.

Fig. 2 shows the method of attaching the needle to the front stem of the button. Fig. 3 shows the short arm for perpendicular play and method of attachment to the back stud of the button.

Of course it's understood you can connect up as many receivers as there are folks who want to listen. But say—if any fellow starts to laugh at you or me for our "silent phonograph," just remove the gentle little receivers altogether and hitch on a couple of audion amplifiers from your old wireless set, then sick "Poor Butterfly" on that critic, magnified up till he'll think the pretty creature is a night-flying airplane with a ton of bombs on its chest. Oh! Boy!



Well—Fellow Constructors—Here's the Original "Noiseless" Phonograph. First You'll Need One of Those Transmitter Buttons That's All the Rage Now-a-Days. You Stick a Needle Holder On Said Button, Rig Up a Pie Tin Turn-Table, Hook Up a Battery and 'Phone to the Button, and Let 'Er Go!

the instrument she's using in her "laboratory" operates on the neighbors as well. Phonographs are loud! all of 'em. The manufacturers took pains to make 'em so, out of an absolute misconception. They got the idea very early that several or more people would like to hear 'em at once. Why, even now, when they ought to know better, they publish those pictures showing the whole family sitting spellbound, mother dropping her sewing and Johnny his Meccano or volume of Browning, and all that.

The facts are just the other way. Johnny delights in the jangled jazz that nobody can follow but himself, that makes the baby cry and the others want to. If Little Sister starts the well-worn maxixe, and falls to dreaming of the slim-waisted lounge-lizard she's seen in the movies, mother fidgets and glances at her offspring with apprehension; and when Big Sister puts on the \$7.00 "operatic," father picks up his paper and stealthily makes for the kitchen. And so it goes. The Home has

# Automatic Bell-Ringing Attachment

By T. A. NEELIN

THE present diagram illustrates a simple home-made attachment for an ordinary eight-day clock, for the purpose of automatically ringing a bell or working a relay at certain fixed times. It was primarily designed for use in a small



The Clock Fitted with Automatic Electric Bell-Ringing Switch. This Arrangement Has Given Entire Satisfaction in a High School for Some time, and Provides 18 Rings Between 9 A. M. and 4 P. M.

high school where it was not thought desirable to purchase an expensive clock especially designed for that purpose. The clock in question has given entire satisfaction and rings at intervals of about 35 minutes with intermissions of three minutes between periods, making some 18 rings between 9:27 a. m. and 4 o'clock p. m. An attachment constructed according to the enclosed diagram should cause the bell to ring at the following times: 8:55, 9, 9:55, 10, 10:55, 11, 11:55 and 12 noon; 1:25,

1:30, 2:25, 2:30, 3:25, 3:30 and 4 p. m. The accompanying photograph shows the clock as it is in use at the present time.

### CONSTRUCTION

A wooden disc bounded by the inner and outer circles  $c^1$  and  $c^2$  was cut from white-wood and finished to about  $\frac{3}{8}$  of an inch in thickness. A copper strip of the form  $c^3$  was then cut and attached to the wood by means of a screw at  $s^1$  and a coating of shellac to hold it in place in the other parts. A narrow slit  $s^2$  just wide enough for insulation purposes, separates the ends of this strip. The screw  $s^1$  serves to connect the bare end of an insulated copper wire  $c^4$  to the copper strip  $c^3$ . This wire connects to one pole of the battery B as shown. Copper plates of the form  $c^5, c^6, c^7, c^8, c^9, c^{10}$  were next cut and in  $c^5, c^6, c^7, c^8, c^9, c^{10}$  holes just large enough to admit a  $\frac{3}{8}$  inch screw were bored. Corresponding holes were bored in the wood disc. The copper plates were then laid down in shellac and insulated from each other by narrow spaces as shown;  $c^5$  and  $c^6$  were connected by a wire attached by means of the screws  $s^3$  and  $s^4$ , and passing behind the wood disc;  $c^8$  and  $c^{11}$  were similarly connected. The dial was then removed from the clock and the disc inserted in its place. The hands were next prepared.

To the outer extremity of the hour hand was attached a little brush made of fine strands of copper wire obtained from a piece of "lamp cord" and bound tightly about the hand. The hand was then adjusted in place so as to press the brush evenly on the surface it past over. A small brass wheel  $w^1$ , say  $\frac{5}{16}$  of an inch in diameter rotates freely and smoothly on the pin which fixes it to a piece of wood as shown. Into the other end of this piece of wood the outer end of the minute hand was inserted. The object of the wood was to insulate the minute hand from the wheel. The minute hand was then curved upward in the middle to allow the whole to freely pass over the hour hand while at the same time the curved minute hand acts as a spring to hold the wheel firmly against the copper parts beneath. The minute hand was then

put in place;  $c^{12}$  is an insulated copper bell wire attached from the rear to the metal works of the clock, and continuing to the bell, or relay if a number of bells are to be worked at the same time, and thence to the battery B.

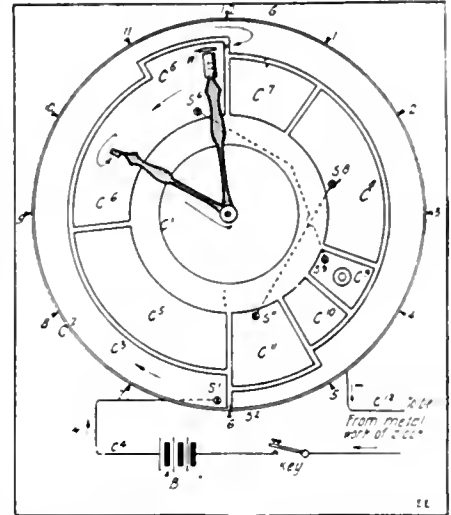
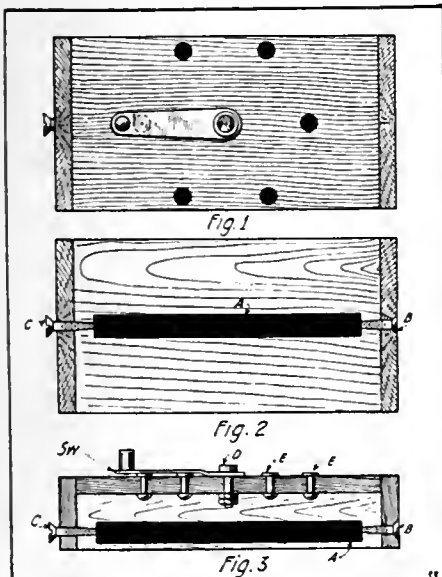


Diagram of Electrical Circuits and Contacts Fitted to Hands of Clock for Ringing One or More Bells at Different Hours.

### ACTION

From the battery B the current may be thought of as travelling thru the wire  $c^4$  to the copper plate  $c^3$ . As soon as the wheel  $w^1$  bridges the gap at G the current can then pass to  $c^5$ , thence thru the brush and hour hand, the works of the clock, thru the wire  $c^{12}$  completing the circuit and thus ringing the bell or working the relay. In a few seconds the circuit is broken again at "G" by the minute hand moving on, and the bell stops ringing. The wires shown by the dotted lines are necessary to get the current from the hour hand to the proper plates so that the bell may ring at the times indicated.

## A "Lead Pencil" Rheostat



The Lead-Pencil Rheostat. The Pencils, Without Rubber Erasers, Are Supported Between Wood Screws, as Shown, Proper Wire Connections Being Made Between the Switch-Points and Screws.

The accompanying drawing shows a lead pencil rheostat. The idea is new and very simple at the same time. The lead pencils used are in no way spoiled and can be taken out of the frame and used as if new.

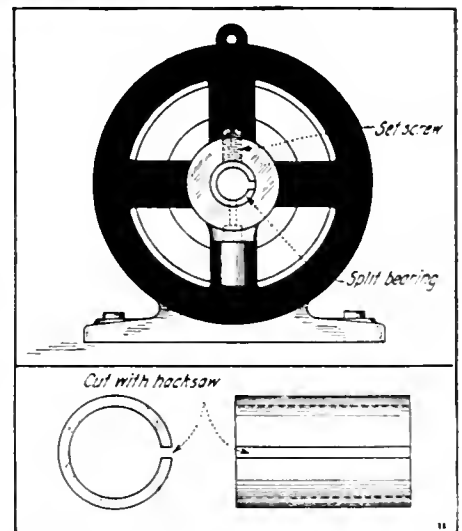
Fig. 2. A, is a pencil (a drawing pencil) which has the lead exposed at both ends. B is a screw which is flush with the wood, F, and makes connections with a wire not shown. C is another screw longer than B. D, E, E are the parts of a switch.

Fig. 3. It shows the switch side of rheostat. The pencil, A, is set between screws B and C. Screw C is screwed down until the both screws make good connections with the exposed lead in the ends of pencil. Connect wires with the screws, connect the wires in the right place on the switch. The number of pencils used and their length will determine the size of the rheostat. It is best to use good drawing pencils as their resistance is higher.

Contributed by JONAS GULLBERG.

### USE YOUR OLD MOTOR BEARINGS.

The accompanying sketch illustrates how the bearings of small motors can be easily used when badly worn. Remove bearing from motor and cut with hacksaw as shown in sketch, drill and tap bracket for set-



Why Not Use Your Old Motor Bearings? Cut a Slot in the Lining and Close It Up With a Set Screw.

screw and replace bearing; tighten set-screw until motor runs without vibrating.

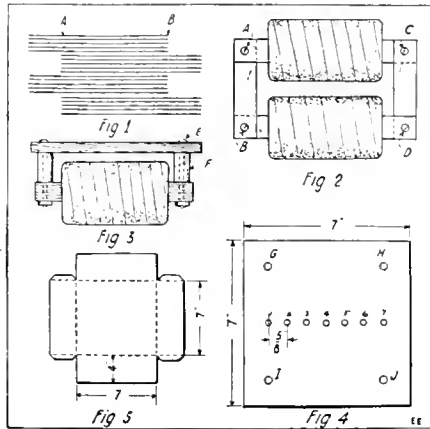
Contributed by HENRY L. BEIMEL.

**A HEAVY DUTY 110 VOLT, 60 CYCLE STEP-DOWN TRANSFORMER.**

BY RAY SEITZ

With this article I intend to fill the want of the experimenter for a good and efficient transformer.

The first step is to make the core. From a piece of black sheet iron cut enough



A 250-Watt Step-Down Transformer for Use in the Laboratory, in Cautery Work, and General Experimental Work.

strips 5" long 1 1/2" wide to make a pile 3" high and 3 1/4" long and 1 1/2" wide to make a pile 3" high. Now build four cores like those shown in Fig. 1, two from the the larger size and two from the small size strips. When you have done this clamp tightly in a vise and wrap well with three layers of good friction tape. On the long legs wind three layers No. 12 D. C. C. copper magnet wire, 30 turns to the layer, taking a tap off at each layer. The two legs will require 2 1/4 pounds of wire. Now wrap two layers of good friction tape over this and begin winding the primary which consists of 6 layers No. 22 S. C. C. magnet wire, 80 turns per layer, using a layer of paper between each layer of wire. This winding, the primary, will require 1 1/2 pounds of No. 22 S. C. C. magnet wire. After you have both of the legs wound wrap again with two layers of friction tape and paint the whole heavily with shellac and bake in an oven for three hours. Now put the four legs together and drill a hole in each corner to pass a 1/4" bolt A\*B\*C\*D—Fig. 2.

After the holes are drilled, the next thing to do is to solder the taps on with short pieces of No. 12 R. C. wire and brought to their proper binding posts. No. 1 comes from the beginning of secondary winding, No. 2 from first tap, No. 3 from second tap, No. 4 from end of winding on first leg, (end of winding on first leg and beginning of winding on second leg are joined together, and tap 4 also comes from this joint). No. 5 from first tap on second leg. No. 6 from second tap on second leg, No. 7 from end of winding on second leg.

When connecting the ends of the windings together care should be taken to see that they will help each other along and not "buck" each other. By applying the hand-rule for electro-magnets you can easily figure which ends have to go together. The primary sections are connected up in series with each other, applying the hand rule as in the case of the secondary and the two remaining ends are spliced to a piece of black extension cord for connecting up to the supply. The hole, 8, in Fig. 4, is for this piece of extension cord to go thru, having first bushed it out with a piece of fiber tube from a 30 amp. cartridge fuse.

The top is made from a piece of 1/2"

red birch, cut to the dimensions in Fig. 4. The holes marked 1-2-3-4-5-6-7 are for the binding posts and 8 for the connecting cord. The other holes are for fastening the transformer to top. When fastening transformer to top, four pieces 1/4" gas pipe 1 1/2" long, will separate the core at the right distance from the top.

Fig. 5 gives the dimensions and shows how to cut the sheet for making a box to fit the transformer. It is made from 24 gage sheet iron, having the corners riveted together.

Short-circuits and heavy overloads will not harm this transformer, if not left on for too long a time. This transformer, if built the way described, will work perfectly and is absolutely noiseless at low load and at full load produces a slight hum. It consumes about five watts at no load and draws about 250 watts at full load. The secondary has six steps of three volts each, three volts between each terminal. This transformer is designed to operate on the standard current of 110 volts 60 cycles. The writer has built several of these transformers and they work to perfection under many different conditions.

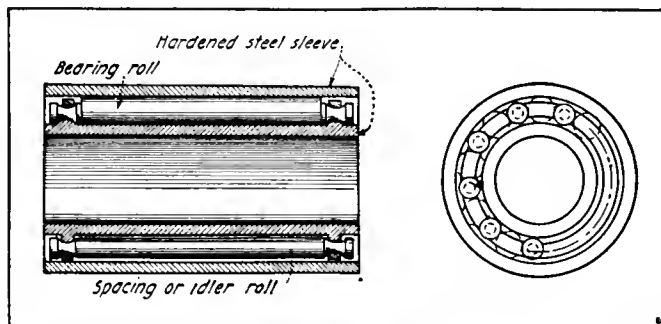
**A NEW WRINKLE IN ROLLER BEARINGS.**

Most machine bearings are made of the ring-oiling type, that is, the bearing is supplied with a reservoir for oil, into which dip one or more rings that run upon the shaft, and thus supply the journal continually with oil. During the operation of the machine there is a continuous flow of oil thru the bearing, which not only keeps the shaft well lubricated, but tends to wash away any particles of metal that may be worn from the rubbing surfaces.

In a dynamo, it is important that the oil from the bearings should not follow the shaft and run out on the armature. The oil itself is not so injurious, altho it tends to destroy the insulating varnishes, but it causes an undesirable accumulation of dust that may greatly impair the insulation.

The accompanying diagram shows a new type of roller bearing, so designed as to run without the use of any lubricants. It is as simple as it is efficient.

This bearing consists of an outer hardened-steel casing and an inner hardened-



A Bearing You Will Want for Motors and Dynamos. It is Particularly Strong and Runs Without Oil or Other Lubricants.

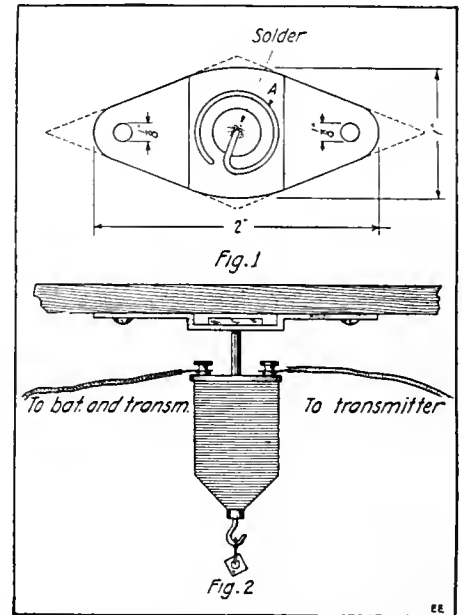
steel sleeve. Between these are placed two sets of rollers of two different sizes, the smaller serving as the spacing or idler rollers and the larger being the essential bearing rollers. The relative position of these rollers is shown in the sectional sketch. The idler rollers are so designed to run on what may be called a track, and are held loosely in place by two retaining rings.

The bearing is suitable for all kinds of work. When used in connection with line shafting, the outer sleeve fits into a shell, held in place in the hanger in the usual manner.

Contributed by PETER J. M. CLUTE, B.Sc.

**THE "TALKING TABLE."**

If the apparatus here described is fastened to the under-side of a dinner table it will set the table in vibration so that any



An Entertaining Wrinkle for the Electrical "Bug" to Try Out—the Talking Table. The Magnet Connects Up with a Microphone and Battery.

number of persons putting their ears flat upon the table, will hear a person talking over the 'phone, if it is connected up as shown in the accompanying sketch.

A small piece of sheet brass is cut as shown in Fig. 1. A piece of soft iron wire, such as that used for cores of induction coils and about 6 inches long, is bent at one end as indicated at (A) Fig. 1 and put thru a hole in the center of the brass plate; the other end is bent into the form of a small hook. Next cut off about 2 inches of a cheap lead pencil and soak it in water till the lead will come out easily, then glue the pieces of pencil to the wire just above the hook. Take a piece of cigar-box wood and cut a piece about 1 3/8 inches in the center so it will fit over the leadless pencil on the wire, and 2 holes to receive the two binding posts, Fig. 2. Glue the disc over the pencil on the wire near the upper end. The binding posts are then placed thru the other two holes. The pencil is now wound with No. 24 B. & S. silk or cotton covered wire, the end of the wire being fastened to the two posts. A small weight, weighing about two or three ounces, is hung on the hook. The apparatus is then screwed to the under side of the table and connected up to a microphone and battery.

Contributed by WADE ROBINSON.

**CLEANING PAINT BRUSHES.**

For cleaning hard paint brushes make a hot solution of lye water; stand the brush so that just the bristles are in the solution.

For making old corks new. Boil in hot water for one-half hour.

Contributed by AN EXPERIMENTER.

A new thermostatic metal which is remarkably sensitive to heat has been invented. The metal may be used in connection with an electric thermostat to control heating systems and to give the alarm in case of fire.

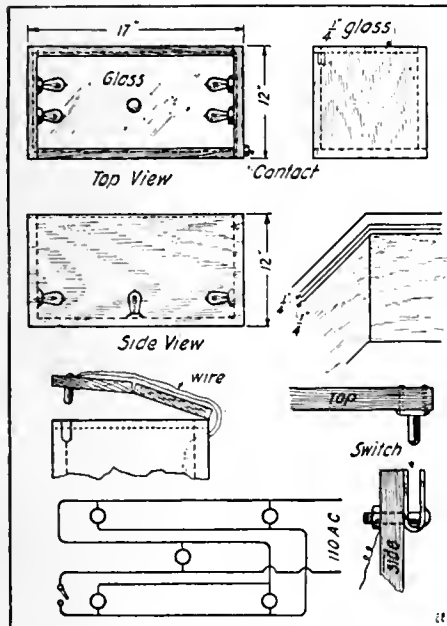


### A PHOTOGRAPHIC PRINTING BOX.

The inconvenience of the printing frame is entirely done away with in this electric printing box. In regard to time the saving is enormous. The necessary material required follows: 1 piece wood 1 1/2"/12"/17" (base); 2 pieces wood 1"/12"/15" (sides); 2 pieces wood 1"/12"/12" (ends); 2 pieces wood 1"/6"/17" (top-hinged in the middle); 1 piece glass (plate) 15 1/2"/10 1/2"; 4 tungsten lamps; 1 ruby lamp; 5 sockets, and 1 lamp cord with plug.

The box is assembled as shown in the figure. The sockets are screwed 2" up from the bottom on the ends and are 5" apart. One socket is put in the middle for the ruby lamp. The next step is to wire the sockets according to the diagram, leaving enough wire to go over the top for the automatic switch which now will be taken up. The object of this switch is to turn on the four white lights when the lid is down. It consists of an L-shaped piece of spring brass or phosphor bronze that is screwed to the cover and fits into a V-shaped piece of metal when the cover is down tight. A piece of wire about 2' long runs over the top to the L-shaped switch. The other side can be wired up from the inside of the box.

The remaining step is to put on the glass plate. The glass should be as heavy as possible; plate glass is the best. There is often quite a heavy strain on the plate from printing and consequently a light glass is liable to crack. The top of the box is now rabbited out 1/4" deep and 1/4" wide from



Amateur Photo Printer Provided with Automatic Switch for Opening and Closing the Light Circuit When the Lid is Operated.

the inside all around, so that the glass will fit in flush with the top. The top is hinged in two places in the middle opening, and two more places on the end to give no play at all to the cover. It is well to cover the inside of the top with a piece of cotton flannel the size of the glass plate. This insures that the negative will be in firm contact with the printing paper.

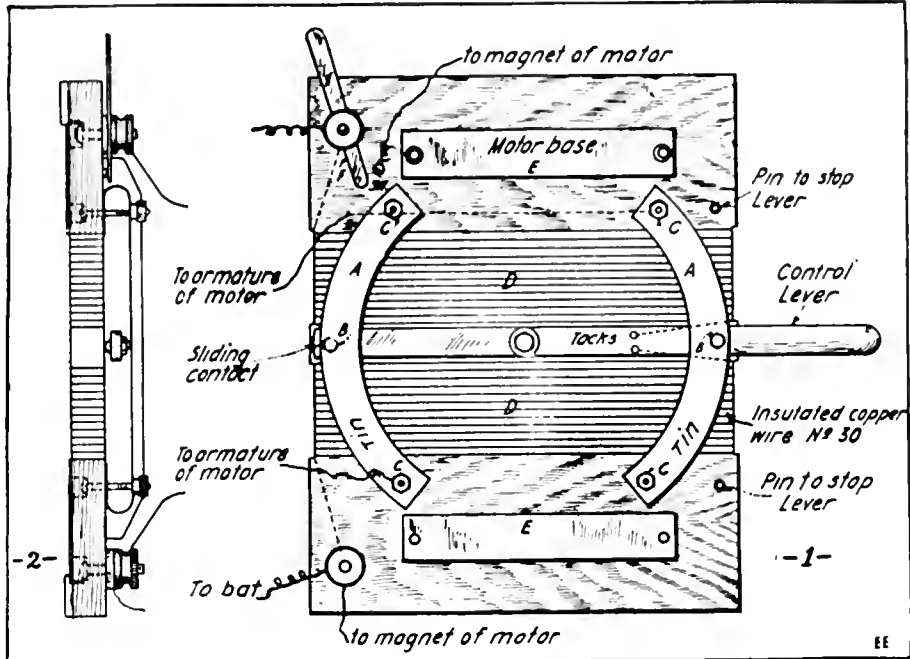
It is seen from the wiring diagram that the ruby lamp is kept burning all the time. This is to allow for printing masks to be adjusted, the negative to be arranged, etc. This printing box is capable of turning out prints at a rapid speed, doing away with the clumsy printing frame. It is very simple in construction and will repay anyone who constructs it.

Contributed by  
MALCOLM MACURDA.

## Reversing Rheostat for Small Motors

This rheostat is built under the motor on a wood base 6 x 8 x 1/2 inches. On each side of the base, 2 3/4 inches from the ends, cut two grooves 1/8 inch deep and 1 inch wide, leaving a space of 1/2 inch be-

final end of the wire is tacked to the lower side of the base. Wind the other side in like manner. The lever is a thin piece of wood 1/2 inch wide, carrying two short binding posts, B B, which serve as sliding



A Handy Reversing Rheostat for Toy Motors. It Controls the Speed in Either Direction and Can Be Actuated from a Distance by a String Attached to the Handle.

tween. Take about thirty-five feet of No. 28 insulated copper wire, fasten one end to a binding post under the base as shown in Fig. 1, and wind it around the base closely and evenly, gluing it near the place where the sliding contact, B, is to work. The

contact points, connecting the arc, A A, and the coil, D, off of which the insulation has been scraped in the path of the slider, B. The nearer the glue is to this path the better.

Contributed by OSCAR ROSE.

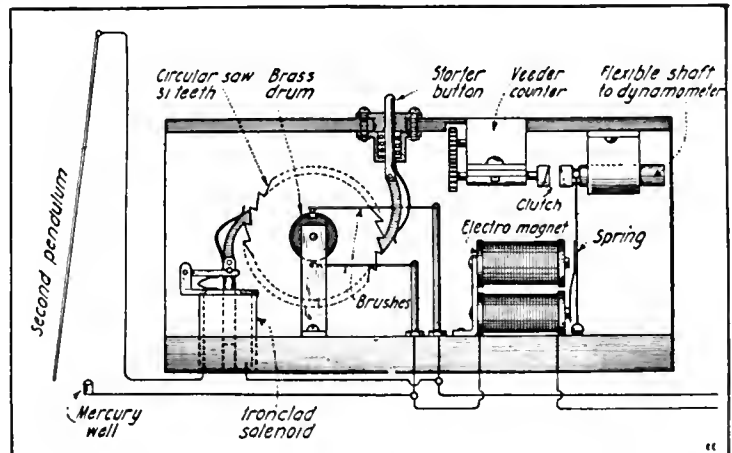
## Revolution Counter for Dynamometer

Electric tachometers have not proven a success where accuracy is demanded such as in dynamometer testing work and therefore several revolution counting apparatus have made their appearance on the market. These latter usually take the form of solenoid operated clutches operating in turn revolution counters. When the fuel-weighting apparatus makes contact, the clutch is engaged and a stop watch started. When the weighed quantity of fuel is used up the scale breaks contact, the counter is stopt and the stop watch stops. Thus an accurate method of determining pounds of fuel per brake horse-power hour is secured.

A "seconds pendulum" is a pretty handy piece of apparatus to have in any laboratory. I built such a pendulum so that at every swing the lower end of the pendulum would brush thru a mercury cup

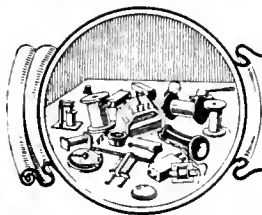
fastened on a suitable adjustable support. The requisites are one solenoid with laminated soft iron core, one old electric bell magnet, a circular saw, a few small gears and a little work.

The small brass drum attached to the saw has a piece of insulation in the path of one of the brushes whose length is suffi-

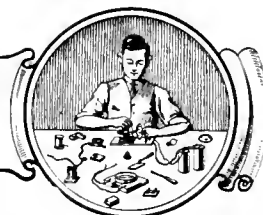


A Clever Revolution Counter for Use with Dynamometer in Testing Work.

cient to cover the circular distance of all teeth over thirty, so that there will be thirty movements of the saw or a time (Continued on page 73)



# HOW-TO-MAKE-IT



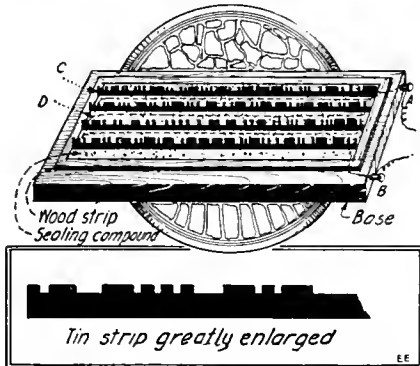
This department will award the following monthly prizes: First Prize, \$3.00; Second Prize, \$2.00; Third Prize, \$1.00. The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of \$3.00 is awarded; for the second best idea a \$2.00 prize, and for the third best prize of \$1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

### FIRST PRIZE, \$3.00

#### A MANUAL TYPE CODE LEARNER.

I give below drawing of a "code teacher" which I am contributing to the "How to Make It" Department.

This code teaching instrument can be easily made at practically no cost. A board



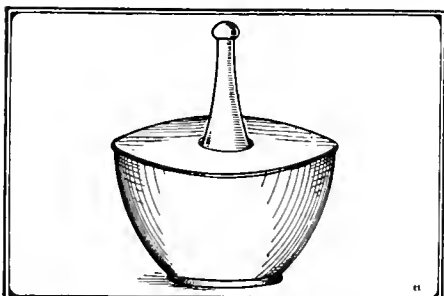
To Make This Simple Code Learner, Cut Out the Dot and Dash Characters on Strips of Tin and Embed Them in Sealing Compound. The Buzzer Circuit is Made and Broken Over These Projections.

(any size to suit the maker) has slits cut into it lengthwise with a knife or saw, as indicated. Tin or brass strips are procured, with a length equal to that of the board. The dots and dashes are cut out along the edges of the strips, as in the drawing. They are put in the slots, then connect all together with a wire. Then take some wood about 1/4-inch square and put it around the edge on the top. Melt some sealing compound and pour it in the box just made by putting the wood strip around the board, to within 1/8-inch from the top of the tin. Then cut out a piece of tin to make the "pen;" connect it up to a buzzer or telegraph sounder and slide the "pen" across the tops of the tin strips, which makes the dots and dashes at any speed desired.

Contributed by LOUIS C. KING.

### IMPROVED MORTAR AND PESTLE.

When a mortar and pestle are used for grinding chemicals dust often gets into the eyes, or small particles are driven out of the mortar and are lost, particularly in the case of hard crystals requiring a consider-



Make This Simple Cover for Your Mortar and Pestle and Keep Out the Dirt.

able force to break them. A simple but very efficient safeguard consists in making a cover for the mortar from a circle of cardboard, with a central hole just large enough to admit the pestle as sketch shows.

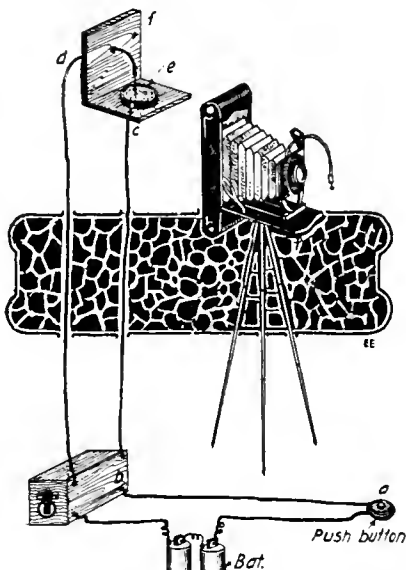
Contributed by H. J. GRAY.

### SECOND PRIZE, \$2.00

#### TAKING YOUR OWN "MUG" IN GROUP FLASHLIGHTS.

When taking group photos by flashlight it is often desired that everyone be in the picture, but as someone must hold the flashpan and set it off at the proper moment, this is often impossible. I have a plan, which is explained below, which allows everyone to be in the photo.

In the diagram *a* is push-button held by photographer; *b* is spark coil, the wires from *a* being connected to the primary side of the coil, with set of dry cells in circuit; *c* is one wire, from secondary side of coil, which is taken thru hole in bottom of holder and soldered to *e*; *d* is other wire from secondary side of coil which is taken thru hole in back of holder *f* and turned down until there is a gap of about one-fourth inch between it and *e*; the covering should be removed from *d* for about one inch from end; *e* is baking powder can cover which should be securely fastened to holder *f* as shown; *f* is holder made of two pieces of



Push the Button and Take Your Own "Mug" with This Unique Electric Flashlight Scheme.

wood about six inches wide fastened together at right angles and covered on the inside with sheet asbestos, which acts as reflector and protects wood. Holder can be placed on either side of camera, but must be back of camera.

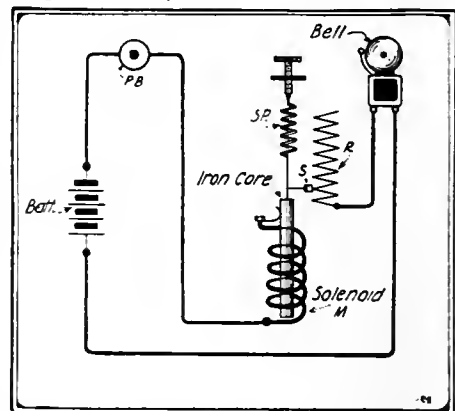
*How It Works.*—The operator puts the proper amount of flash powder in the baking powder can cover, in and around the point of wire *d*. He then arranges his group, using the camera finder for this purpose, leaving, however, a place for himself. The light in the room should be turned low, leaving only enough to see by. The camera shutter is now opened, the photographer takes his place in the group, and at the proper moment pushes the button. The spark between wire *d* and baking powder can cover sets off the powder, after which the photographer closes the shutter, and the picture has been taken.

Contributed by GLEN M. ROYSTON.

### THIRD PRIZE, \$1.00

#### A PROPOSED "BELL SOFTENER."

When some one comes to the door and rings the bell, its sudden sound scares



The Sudden Jar on the Nerves Caused by Ringing the Ordinary Bell Can be Obviated by Inserting a Solenoid-Controlled Rheostat in Series with the Bell and Battery.

everyone. With this device it starts softly and gets louder gradually. The apparatus used is the same as generally employed for this purpose with the exception of the softener, which is a large cylinder wound with resistance (*R*), which is entirely in circuit at the start, but is varied by the slider *S*. When the key *PB* is released, the slider is pulled back to the original position (having been pulled down by the magnet *M*) by the spring *SP*.

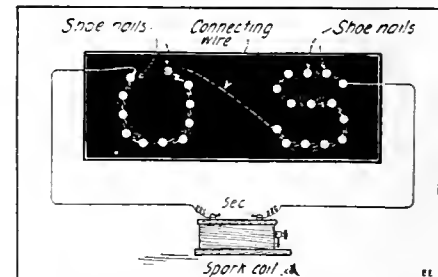
**CAUTION:** Do not have the slider too far from the magnet; make the cylinder short but large in diameter. Do not use too much resistance; allow enough current to pass so that the magnet will work.

Contributed by ERNEST INNES and ETHBERT REED.

### SPARK-LIT INITIALS

I here give a description of spark-lit initials formed from old shoe nails, driven into a block of wood so as to form letters.

A piece of wood 3/4" x 1 1/2" x 3" is used for the base, initials one inch high are drawn on the base and the shoe nails are driven into the initials about 1/32" apart, or a little more. The initials are connected



What is Prettier Than Spark-Lit Initials Such as These, Which Can be Lit Up by Even a Small Spark Coil.

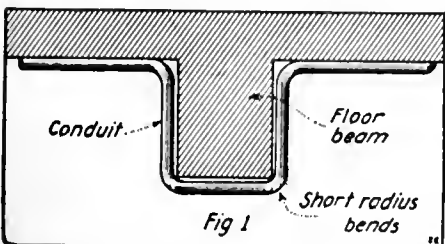
together as shown and wires are connected from the secondary terminals of a spark coil to the letters. When the coil is excited, sparks jump from nail to nail, lighting up the initials in a very pretty way in the dark.

Contributed by DE FOREST G. STICKNEY.

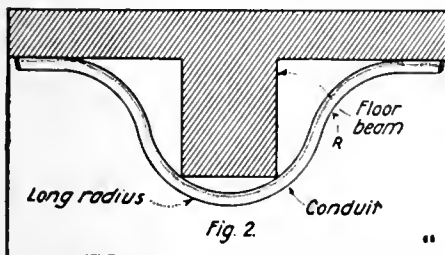
**METHOD OF FORMING A SHORT-RADIUS BEND IN CONDUIT.**

By GEORGE W. SHIRLEY

To make a short radius bend in conduit for a location such as that indicated in Fig. 1, the method to be described can be used. Where turns of the usual radius are



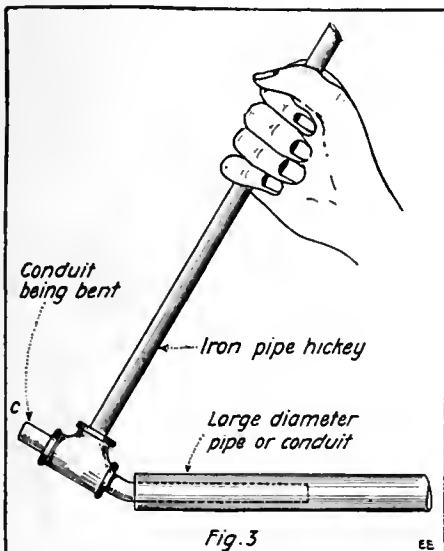
Above: The Electric Conduit Pipe Should Always Be Neatly Bent and Fitted in Place Like This. The Bends Must Be Even Curves, Not Kinked Bends.



Above is Illustrated How Not to Bend Electric Conduit. Such Pipe Bends Soon Loosen, and Besides Present a Very Unworkmanlike Appearance. How to Bend Conduit Right is Explained Herein.

made, the conduits do not lie close to the surfaces and present the undesirable appearance delineated in Fig. 2. But with this method, bends of the approximate form diagrammed in Fig. 1 can be so made that the inner face of the conduit will lie not more than 1/4 inches from the faces of the beam. A sleeve, P, of a larger diameter than the conduit, C, being bent, is slipped over the end of the conduit (Fig. 3) and then the short-radius turn can be formed with a hickey, H.

The electrician uses what is known as a hickey for bending all small pipe curves. The hickey is nothing more or less than a substantial pipe tee fitted with a handle of pipe as shown in Fig. 3. The handle is threaded, of course, so as to screw into the fitting firmly.



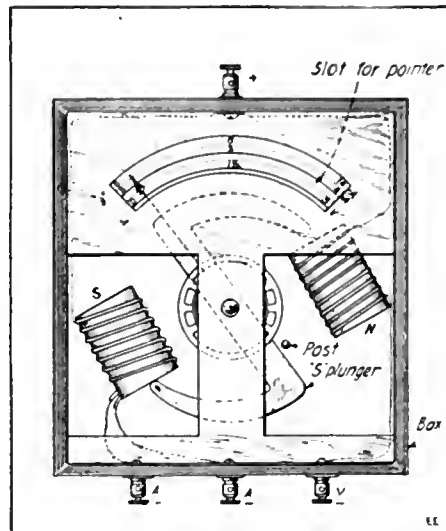
In Bending All Small Conduit Use Is Made of What Electricians Call a "Hickey." This Is Made of a Short Length of Pipe Threaded into a Heavy "Tee."

**A Low-Reading Volt-Ammeter**

Remove the balance wheel, bearings, and hair-spring from an old alarm clock. Using composition wall-board or thin wood, make a box 3x3 1/2 inches and 7/8 in. deep. For ease in adjusting, the front should be cut away as shown, and the front should be easily removable. In the center, both back and front, bore a small hole to receive the bearing screws, which are cup-shaped in the ends. The balance wheel should spin freely when in place.

On a thin sheet of soft iron, taken perhaps from an empty tomato can, draw a circle with a radius of one and one-sixteenth inches. Inside this circle cut an armature like the letter S, as shown in the drawing. Punch a small hole in the center of this "tin" letter S, and slip on the balance-wheel shaft and fasten to it. Push the hair-spring on the shaft above the wheel. The free end of the hair-spring is secured to a small post. The spring must of course be adjusted to the proper tension. A thin pointer made of No. 32 wire is made fast to the balance wheel, letting the end project up thru the slot cut at the top of the instrument. A bit of colored paper should be glued to the end of the pointer.

be nearly .3 watt. One watt should pull the armature or plunger the full distance into the coil. A square of paper covers the opening in the front and a glass fitted into slots excludes the dust. Each coil may be joined to a common post at the top but



Procure an Old Alarm Clock. You Are Then Ready to Start Building This "Triple Scale" Volt-Ammeter, a Most Useful and Desirable Measuring Instrument for the Experimental Laboratory.

Around a stick of wood half inch thick and 5/8 wide, wrap a couple of thicknesses of cardboard, gluing carefully. On this form wind one layer of No. 20 four feet. Fasten this with shellac. Over this coil wind 5 turns of heavier wire, say No. 14. For the voltmeter coil 40 feet of No. 32 may be used. This makes 200 turns and has a resistance of nearly 7 ohms. A dry cell giving 1.5 volts will send over 1/5 ampere thru this coil. 200 x .2 amp. gives 40 amp. turns, or 40 feet x .2 amp. equals 8 amp. feet. .2 amp. at 1.5 v gives .3 watt. When the ammeter coil having 20 turns or 4 feet is carrying 2 amperes it too will have 40 amp. turns or 8 amp. feet, and will exert the same magnetic pull as the voltmeter coil at 1.5 volts.

If we wish to measure a little higher voltage we may use 140 feet of No. 36 copper wire, having a resistance of 50 ohms. Now at 4.5 volts the energy absorbed will

to a separate post at the bottom. Instrument will work in either horizontal or vertical position. Calibration should be done last. If no standard instruments are at hand, each dry cell in series adds 1.5 volts. For the ammeter scales, two cells in series will send 6 amperes thru 48 feet No. 20; one cell will give 3 amperes thru the same wire, and 1 ampere thru 9 feet of No. 32. My "battery tester" has been used often during the past year. Tester may be used for a moment on much stronger currents than examples given.

Contributed by H. H. DAVIS.

**Converting Small Motor Into a Dynamo**

If your motor is not already mounted on a base, it would be well to do so for this experiment. On this base mount two binding posts BB.

Then disconnect the wires which come from the field coil and connect them to two dry cells, as shown in the sketch. Connect two short wires from the brushes to the binding posts BB, the wires being indicated by AA. A switch may be put between the field coil and batteries if desired.

Now holt the motor to any large wheel, D, such as a fly-wheel of a sewing machine. A water motor serves the purpose very well.

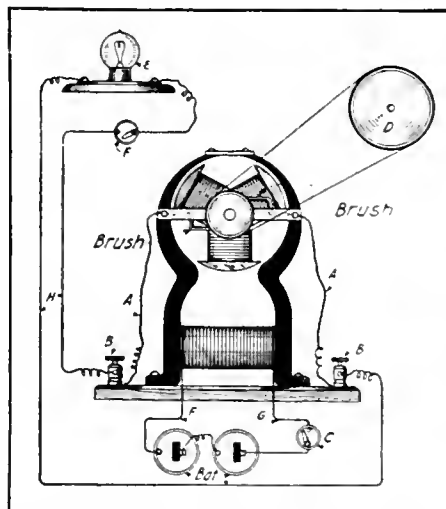
When the armature is revolved at a high rate of speed, current will be generated, which will pass thru the wires HH, connected to a small electric bulb, storage battery or to another toy motor.

In my case the motor was very small, only three inches high, designed to run on two batteries, and when converted into a dynamo it gave sufficient current to burn out a two and seven-tenths (.27) volt bulb, which I had taken from a flash-light.

It must be borne in mind, however, that the voltage of a dynamo is controlled by the size and number of wires with which it is wound and the speed at which the arma-

ture is rotated, as well as the strength of the field magnet.

Contributed by E. L. DURGEN.



To Demonstrate the Principle of the Dynamo the Experimenter Will Find It Extremely Interesting to Drive a Small Toy Motor with a Steam Engine, a Water Motor, or Another Motor, and Exciting the Field by a Few Dry Cells. A Small Lamp Can be Lighted.



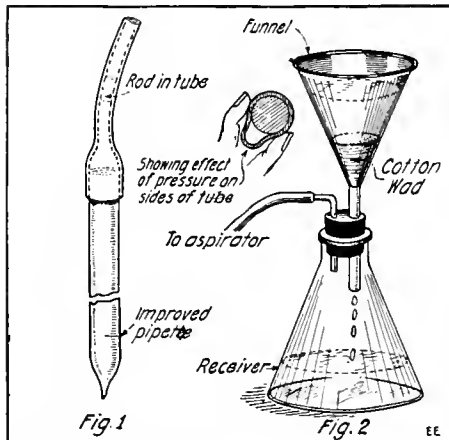


EDITED BY S. GERNSBACK

**PRACTICAL CHEMICAL LABORATORY DEVICES.**

By Thomas W. Benjamin.

THERE are many instruments and operations in chemistry that can be so improved as to make them handier or to shorten the time required for a given

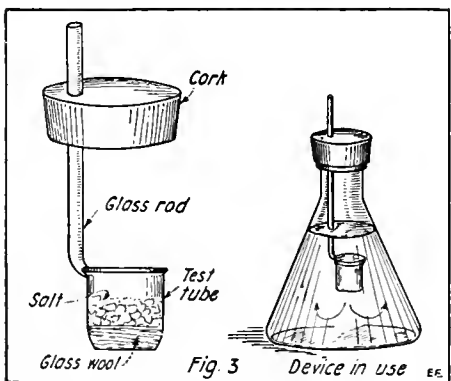


Here Are a Home-made Burette-Pipette and a Vacuum-Filter of Simple and Ingenious Construction Welcome in Every Laboratory.

process. Many of these are in everyday use in large laboratories but the experimenter hears but little of them.

A form of burette, or more properly a pipette, having several advantages is shown in Fig. 1. Instead of the usual form with the stop-cock at the bottom, a plain graduated tube is fitted at the top with a 6-inch length of rubber tubing. The valve in this case is made by sliding a short length of glass rod into the rubber tube, locating the same midway of its length. The tube is normally kept closed by this rod but a slight pressure on one side of the rubber will cause the tube to buckle out and form a channel thru which liquids or air can flow.

The device can be filled either by sucking the fluid up into the tube with the mouth or by immersing it into the fluid with the valve open and removing after the valve is closed. This valve will give a finer regulation of the discharge than the usual stop-cock, a drop



An Automatic Saturator Is Easily Made as Shown in Above Diagram and May Come in Handy.

at a time or a steady stream being readily attainable.

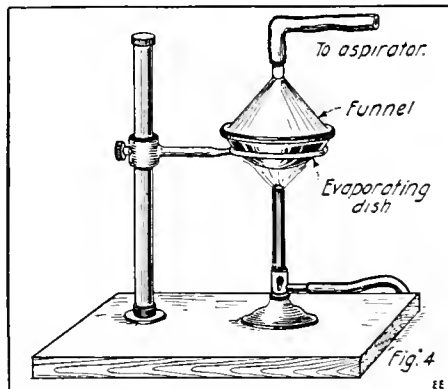
**VACUUM FILTER:** When filtering thick fluids the process may be speeded up by the

use of a vacuum filtering device. To create the vacuum, use can be made of the glass aspirators which are procurable at a very reasonable price. To use this for filtering, the receiver is fitted with a cork having two holes. One, large enough to take the spout of the funnel, the other having a short glass tube inserted. See Fig. 2.

A wad of absorbent cotton is placed in the bottom of the funnel and reaching a short distance up the sides. This is to support the filter paper and prevent it breaking under air pressure. The bent glass tube is connected to the aspirator and when the water flow is started a slight vacuum will exist in the receiver. Any liquid poured into the funnel will be filtered at a rapid rate due to the air pressure forcing it thru.

**SATURATED SOLUTION APPARATUS:** Saturated solutions of salts can be more quickly made by supporting the salt near the surface of the liquid. The idea being that as the salt dissolves the fluid gets heavier and sinks to the bottom, being replaced by other fluid. This circulation is automatic and continues till the saturation point is reached.

A little device, easily made of glass, that can be used with all chemicals is shown in Fig. 3. The body is made by cutting a two inch length from a large test tube and bending in the edges at the cut by heating till soft in a Bunsen flame. A wad of glass



This Suggestion to Get Rid of All Obnoxious Fumes in the Small Laboratory is Certainly Meritorious and Shows What a Little Ingenuity Will Attain.

wool is placed in the tube, being held in place by the turned-in edge. The glass rod used to support the device is fastened in place by heating the rod and tube where they are to be joined until soft and then pressing them together. A cork fitted over the rod will support the device inside a bottle.

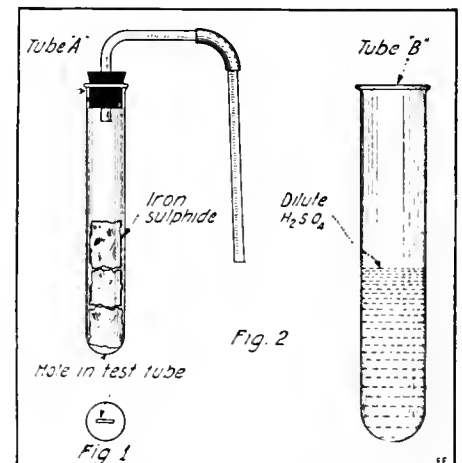
In use the tube is filled with the salt to be dissolved and placed in the bottle containing the solvent at such a height that the top of the tube is just below the surface. Additional salts may be added from time to time as found necessary.

The aspirator mentioned in connection with filtering can be used with advantage when drying or evaporating. In this case the evaporating dish is covered by a funnel the spout of which is connected to the suction tube of the aspirator; see Fig. 4. The vacuum created will draw off all fumes and vapors at a rapid rate. Should the vapor be required for further experiment a condenser can be connected in the line between the funnel and the aspirator to condense the vapor.

**A SIMPLE GAS GENERATOR.**

Frequently small quantities of gas are desired in the chemical laboratory, and no convenient and simple method of generation can be found. The apparatus described is very simple, yet it serves the purpose admirably.

First, procure two test tubes, one having

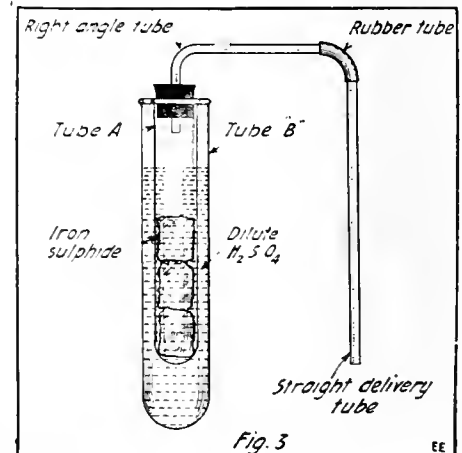


In Simplicity This Little Gas Generator Is Undoubtedly Unrivalled. Two Test-Tubes, a Cork, Some Rubber and Glass Tubing—That's All!

dimensions approximately 5/8" x 7" long, the other approximately 7/8" x 10" long. In the bottom of the smaller test tube file a small hole with a triangular file (Fig. 1), into this test tube fit a one-hole rubber stopper. Fit stopper, with a right angle, connecting tube, and straight delivery tube, as in Fig. 2, and insert in smaller test tube. The smaller tube A, is inserted in the tube B, the flare of tube A prevents it from slipping thru to the bottom of tube B.

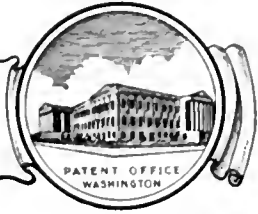
In operating: If H<sub>2</sub>S is to be generated, a stick of FeS, iron sulphid is placed in tube A, and the cork inserted. Dilute sulfuric acid is put into tube B, filling it about two-thirds full. When tube A is inserted into tube B, a large volume of gas is produced.

If hydrogen is wanted, small clippings of iron or iron filings are put into tube A.



The Gas Generator Ready Assembled for Business. Get the Gas-Mask, Archimedes!

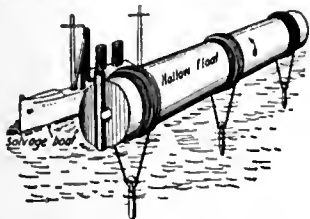
and lowered into the dilute acid in B. Removing tube A stops the generation of gas. (Continued on page 87)



# LATEST PATENTS

### Electric Device for Raising Sunken Ships.

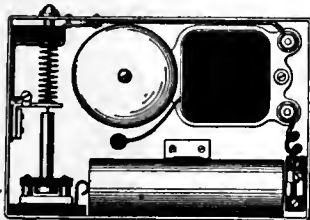
(1,288,108, issued to Vladimir V. Messer.)  
In this novel scheme for raising sunken ships, a number of large floating members or tanks are utilized, which are provided with suitable electric-motor driven propellers



on the interior, for the purpose of causing the float to rotate in the water either in one direction or the other, about its axis. By means of flexible insulated conductors leading from the salvage boat to the float, the motors may be properly controlled, and current supplied to them for their operation. The dependent cables at the bottom of the float are made fast to the sunken vessel, by divers or by other means. These cables can be let out or reeled up by causing the float to rotate, and the cables wound up or reeled off from differentially grooved drums rigidly mounted on the exterior of the float.

### Safety-Chest for Valuables.

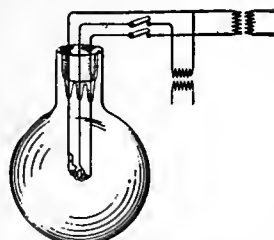
(No. 1,291,051, issued to James L. McQuarrie.)  
By means of an ingenious safety chest, a continuous alarm is sounded in the event of any unauthorized disturbance of the chest. The alarm mechanism is entirely enclosed in a small separate compartment, which may be readily removed, when the chest is open, for repair, etc. The



alarm is actuated by a gravity operated pendulum member, which is freely movable in response to any disturbance of the chest, once it has been set and the chest locked. Also magnetic means are provided for holding the gravity operated pendulum when it is thus moved by agitation of the chest, so as to keep the alarm bell circuit closed continuously.

### Incandescent Arc-Lamp.

(No. 1,290,930, issued to Philip K. Devers, Jr.)  
In this interesting form of incandescent arc lamp, the arc is operated between two electrodes of tungsten or other suitable material, in a gaseous medium of considerable pressure. The inventor provides a new means for starting the arc be-

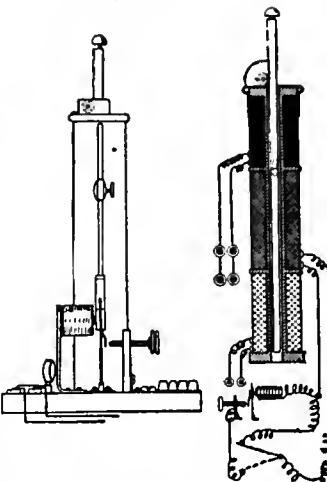


tween the electrodes at low potential, while the electrodes are below a temperature at which the electron emis-

sion occurs. Surrounding the gap between the electrodes, there is provided a spiral heating coil, and the arc-supporting current is impressed across the electrodes at the same time that the heating coil is switched into circuit.

### Medical Coil Apparatus.

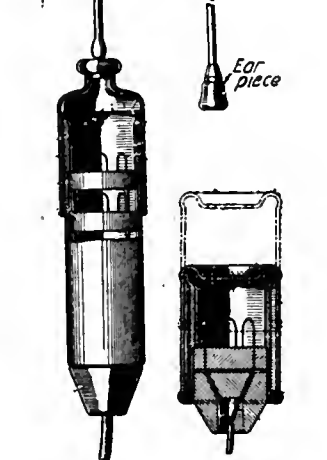
(No. 1,290,628, issued to Louis Mayor.)  
Can be operated from commercial A. C. lighting circuits. There are three windings on the apparatus, one primary and two secondaries. One secondary is connected with sponge or other electrodes for applying the current, while the lower secondary coil provides a low voltage current for operating a small lamp for endo-



scopic work, etc. The soft iron core passing thru the coils is adjustable as to position, by means of a control knob fitted with rack and pinion attachment.

### Adjustable Thermic Telephone.

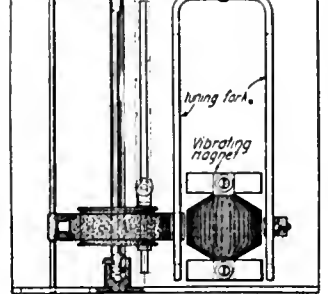
(No. 1,290,114 issued to Pieter de Lange and Robert Aeronut Baron van Lynden.)



An improved form of thermic telephone adapted for certain purposes, or wherever it becomes an object to accurately regulate the intensity of the sound reproduction by varying the volume of the sound chamber. In this particular arrangement the sounding chamber is arranged in two parts, so that one may be slid over the other; thus either lengthening or shortening the cham-

### Constant Amplitude Vibration Motor.

(No. 1,290,264, issued to Leslie R. McDonald.)

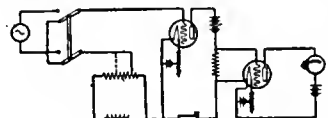


This ingenious motor is made up of a rotary member mounted on a square shaft, which is actuated or propelled about its axis by an adjustable belt member, which is alternately and regularly pulled taut and loosened, by virtue of its attachment to an electrical tuning fork in the manner here illustrated.

### A Vacuum Tube Peak Voltmeter.

(No. 1,287,161, issued to Richard H. Wilson.)

An improved method for measuring the peak voltage between two points of an electrical network, and a further object of which is to measure a direct or alternating voltage without the necessity of constant calibration of the measuring instrument. These results are accomplished by connecting the input circuit of the thermionic valve between the network terminals, across which the voltage is to be measured, and allowing the resulting uni-directional pulsating cur-

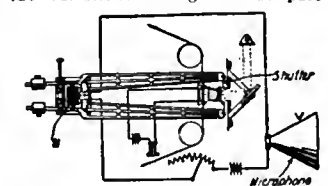


rent in the output circuit to pass thru a resistance or impedance.

### Sound Recorder and Reproducer.

(No. 1,290,711, issued to Manuel Calderon.)

In "recording" the sounds on a photographic film by creating variations and graduations in light to dark, the sound waves are picked up by a microphone, or a battery of microphones. These microphones, thru a battery and rheostat, are caused to actuate an electromagnet, M. This magnet operates on two armatures attached to the pivoted levers shown, to the longer ends of which there are attached light beam shutters, which may enter the beam of light in the manner apparent. The variations as aforementioned in the light and dark graduations are photographed on the film, and correspond to the voice waves. In "reproducing" the voice, the film is past before the beam of light, and the variations in light value pass-

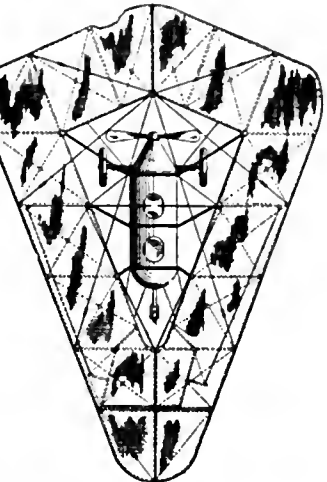


ing thru the film, cause corresponding variations in a battery and telephone receiver circuit, by virtue of their action on a selenium cell placed behind the film.

### A Non-Capsizing Airplane.

(No. 1,284,373, issued to Platon Lazarides.)

The design of this airplane may be of the biplane type. The inventor provides a triangular form of wing, both of which are similar in shape and area, the center of the wings being open, so that the aviator can see upward as well as sideways and downward. One of the principal objects of the inventor is to provide a flying machine such that if the engine should stop in mid-air, it would then become possible for the airplane to settle to the surface of the earth in much the same way as a parachute does. This is accomplished by carefully balancing the entire plane, and the car or body

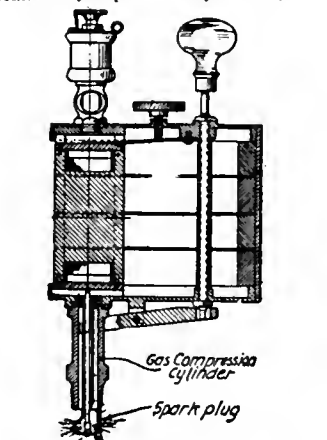


which is suspended at the center of the wings.

### Spark Plug and Generator Combined.

(No. 1,290,190 issued to Albert B. Herrick.)

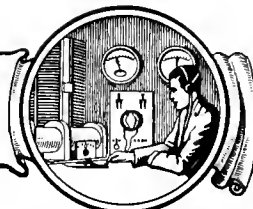
This interesting patent covers a very ingenious gasoline engine spark plug and generator combined, which is operated by the compression of the engine. In other words, this device includes an electro-magnetic generator similar in principle to a magneto which is adapted to be automatically operated by the com-



pression of the gases in the cylinder of an internal combustion engine. In the form shown, the generator constitutes but one coil wound on a soft iron core. This is surrounded by a series of strong steel magnets. At the base of the generator there is a threaded terminal which fits into the spark plug orifice of the gasoline engine, so that the compression can operate therein to push against the piston member.



# WITH <sup>the</sup> AMATEURS



Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay \$3.00 each month for the best photos. Address the Editor, "With the Amateurs" Dept.

## "Amateur Electrical Laboratory" Contest

THIS MONTH'S \$3.00 PRIZE WINNER—N. NUSHAWG

HEREWITH are three views of my "Chemical Laboratory." I think it will be needless for me to give a description of the contents of my laboratory as I had the view so photographed as to cover that part. A brief outline or history of my laboratory I think would not be out of place. The "Lab." as you see it in the accompanying views is an accumulation of five years of experimental work. My first laboratory consisted of an old wash-stand, of which a part can be seen directly behind "yours truly" in the view in which I am standing. Year by year I added to the aforesaid wash-stand, as my finances would permit, until today I have what I consider a model "Amateur Chemical Laboratory."

My laboratory is not only a place which affords me much amusement but is also my "Study Hall" and my "College of Chemistry" combined in one. I maintain a schedule of study which embraces two hours each evening, including the study of chemistry, electricity, biology and other studies interesting to those contemplating a life of science.

Two articles which I would like to call to your attention, noticeable in the general view of my laboratory, are first: the electric furnace constructed from the description found in the April, 1918, issue of the ELECTRICAL EXPERIMENTER. This furnace will be found on the ledge below my apparatus shelf in the right hand side of the picture. The other article is the hydrogen sulfid generator, which will be observed beside my specimen cage just beneath the window (to the left). I am sending a separate description of this apparatus to the Editor, hoping he will see fit to publish the same in "your magazine"; so keep an eye peeled for it.

This laboratory is located in the cellar of my home and is twenty-two feet in length and fourteen feet in width. It is constructed of plaster board and has a four inch air cushion around it on three sides, so as to protect it against any dampness from the cellar. It is heated by a furnace pipe that you will notice running thru the laboratory. It is fitted with electric lights for general illumination and a gas lamp for use in the printing of photos. I have gas and running water at hand. A hood is also among the apparatus; this serves in eliminating all obnoxious odors.

I have been taking the ELECTRICAL EXPERIMENTER since the August issue of 1915, and have each copy since that time. I find it to be the best magazine in its field and have highly recommended it to my friends, gaining the "E. E." quite a few friends by so doing. I have found the "Experimental Chemistry" course by Albert W. Wilson very interesting, having followed and studied each lesson since the first.—N. Nushawg, 534 Arbor Ave., Dayton, Ohio.





# Science in Slang

## 3. The Specks in Space

By EMERSON EASTERLING



It was one of those clear bright summer nights when the moon and stars stood out against the black background of the sky, casting a silvery light upon the faint landscape. We were motoring along a highway, and as the sky loomed out as

the cynosure of the time, our conversation drifted to astronomy, being of the scientific trend, and our company being more or less scientifically inclined. Pointing to the moon, Stokes made the remark, "Old girl, since Adam quit rubbing his eyes and became aware that he was a sentient being your reflections have permeated space and we have become familiar with your lunar highness. Lovers have sworn their LOVE by you, and coyotes have howled under your rays. But not until the spectroscope shows up and dissects the moon beam, laying its vibratory secrets bare before us, we were not so sure after all but that you were green cheese, as the story book affirmed.

"The old time Chinks were the first guys to finger around and get on to the ways of the welkin—in fact they looked right thru the welkin and got wise to such things as eclipses and other primary stuff of the great all-around. It was reported that two old timers named Hi and Ho who profess to be 'there' on the astronomical dope failed to inform their boss, the Emperor of Cathay, of the eclipse that came around unannounced, and it is further stated that according to the regulations of the country, the men were forced to suffer the amputation of their heads.

"Next in order came the Chaldeans, who claimed to be wised up on the aerial phenomena, and who were able to predict eclipses and so forth. They blew their horn and left some records that are real amusing and historically instructing, but they started the ball so that we hear from such guys as Thales, Anaximander, Pythagoras, Anaxagoras and Eudoxus, Hipparchus, Meton and a few choice more astronomers and not from other lines—of course we have heard from some of the birds in other lines, but as a whole they were star gazers and dreamers.

"Then we read of the endeavors of the Egyptians, from the school at Alexandria, and of Ptolemy and his ideas. You know he was the duck that was guilty for the Epicyclic System, which has it down in such a manner that the believer is led to accept the statement concerning the revolution of the planets around a center that is itself doing the merry-go-round stunt. From his standpoint he was right—the only trouble with him was that he overlooked, while gazing so far into the heavens, that our little elongated spheroid was one of the ethereal company in motion with the rest. But the old boy

whitched the old plugs with which Apollo had pulled the old glare around and run the brow wrinkles in other directions when he let loose with his treatise 'Almagest'. All this was way back in B. C. about 200.

"On astronomy, and more so on astrology, the Gypsies were 'there', but to the Greeks we owe the coining of the word 'ASTRONOMY', from the word *vómos*, or *nomos*, which means LAW; and *áστρον*, or *astron*, which means star or + we get the same which means Star-Law. From the Greeks sprung Thales, the man who stands out in the first discoveries of the electrical phenomena, and who was so good at the heavenly twinklers that he was termed the Father of Astronomy. It was him and not Chrissy Columbus that told the World in general that the globe that we now know as the 8,000 mile in diameter ball of dirt and water (which is not necessarily mud) was round instead of a flat chunk upon the shoulders of Atlas. It was he who determined when the equinoxes and the solstices were due to arrive, and he knew beforehand when the famous eclipse of the Sun was to occur—the one that caused the Lydians and the Medes to throw up the sponge in their famous battle, you've read of the incident in history. Then the sundial was invented by a Greek, Anaximander.

"Getting back to the history of the thing we see a poor guy gazing up thru a dilapidated old farmhouse roof—where there was no roof—and thinking. Well, he thought so hard that we now still read of the Copernican theory of the universe. He stuck our planet in with the rest of the whirling globes and fireworks. He got a hunch from Pythagoras.

"Brahe then came along and modified the theory of Copernicus and cut out the 'cycles and epicycles' stuff, and as he was not housed up in a farmhouse he built a magnificent observatory. Then came the apt pupil of Brahe's, Kepler, who compounded a pile of laws and stamped his cognomen on history,

"After a while Galileo grew up from the skipping rope and marbles age and invented the telescope and pendulum. Looking thru the glass instrument he found that Jupiter had a moon—not the kind that showed up when some of his marbles collided with too much force, tho. After he slipt us a handful of physics and astronomy and the

like we become aware that from the dressing room of Life there steps out a Sir Isaac Newton, who saw the apple fall and told us all about gravitation. Of all the 'Big Bugs' in astronomy, as well as mathematics, we lift our hat a little higher to Ike.

"I once read of the Arabians as being up on the Astronomical dope," I ventured.

"Yes, they were," Stokes replied. "A duck by the name of Ulugh Beg, who was not an ugly beggar but an astronomer, catalogued a bunch of stars. They took to that and astrology, like the Egyptians and Moors.

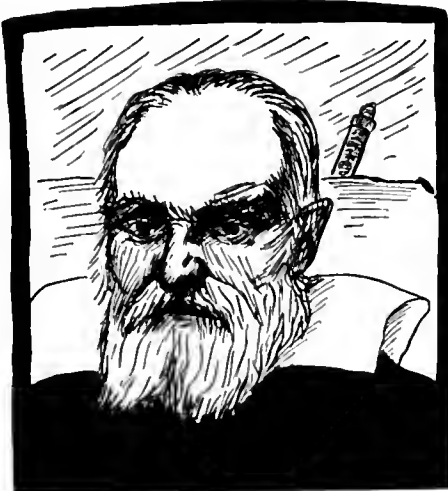
"Then Laplace topt off Newton's 'Principia' with his *Mécanique Céleste*.

"Naturally, the first thing to be considered is the Sun. The savages recognized it as the means of life on our planet (of course they knew of no other) and worshipt it as their God, in the same manner as we do the \$, only they openly acknowledged it. In plant life we are aware of an attraction by it. Only the blind cannot see the effect it has upon everything in general. Now, with a lot of the experiments behind us, we have it figured out that we are 93,000,000 miles from Old Sol, and that the hot old



EMERSON EASTERLING

Ike Newton, the Gink Who Invented Gravitation by Means of the Cider-Fruit.



Galileo, the Bird Who Defied the World by Telling It that It Turned Around Instead of Standing Still, as Was Thought.

boy is composed of much the same material as our Earth, and we also have it doped out that the temperature up at the Sun arrives at the twelve thousand mark, F. It has a 'photosphere' where we have our hydrosphere and a 'Chromosphere' where we have our atmosphere. The mathematical wonders have it down in their note books as follows for the weights of the Earth and Sun, respectively: 6,000,000,000,000,000,000,000 and 2,000,000,000,000,000,000,000,000,000 tons. To reduce that down to ounces would take Steinmetz at least a second—you know him. Then the candle-power looks like this on paper: 1,575,000,000,000,000,000,000,000,000.

"How would you say that if you did not have your pencil along" asked Bender.

"Well, the first, replied Stokes, looking down at his paper, "is six sextillion. The (Continued on page 69)



# THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.

4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

## REWINDING TELEPHONE MAGNETO.

(993) Walter F. Hawley, Buffalo, N. Y., writes us:

Q. 1. How can he rewind a 3 bar telephone magneto to produce 10 volts?

A. 1. This question cannot be answered exactly, excepting on one condition, and that is that you would need a magnetometer at hand with which to measure precisely the strength of the magnetic flux in maxwells per square inch of pole-face area.

We can suggest from our experience in this line, however, that the armature be wound full with No. 17 to 18 B. & S. gage S. C. C. or enameled magnet wire. This would be suitable for a potential of 8 to 10 volts. Of course, the voltage can always be increased by raising the speed, but naturally there is a limit to this, as the machine will not safely stand too high a speed.

## A. C. SOLENOID.

(994) Stanley Dohrzynski, Cuyahoga Falls, Ohio, asks the Oracle:

Q. 1. For data on winding a small A. C. solenoid about 3 inches in diameter and 3½ inches long, with a ⅝ inch iron core.

A. 1. Unless such an A. C. electromagnet is very carefully designed, which would require elaborate calculations, and also unless it is carefully and very exactly built according to these specifications as computed, then the current taken will vary considerably from that calculated. Also in the case of the solenoid, with a movable core, the current will vary from a very high value when the core is just entering the coil, down to a certain minimum value, when the core is pushed all the way into the coil.

The only thing we can suggest in your case would be to experiment with several sizes of wire. For the size of solenoid you have in mind, you might try winding it full with No. 18 D. C. C. magnet wire. The weight which such a solenoid could lift with the core all the way in the coil would probably be in the neighborhood of one-half pound. The iron core must be laminated, not a solid piece.

## 1 K. W. WIRELESS TRANSFORMER DATA.

(995) J. R. Johnson, McConnelsville, Ohio, writes this department:

Q. 1. Please give data for winding a 1 K. W. radio step-up transformer.

A. 1. We are pleased to give you herewith data on 1 K. W. close core step-up transformer.

The laminated sheet iron core should measure 15 inches long and 8¼ inches wide, and have a cross-section of 2 × 2 inches, or 4 square inches. The primary winding which should have taps taken off from each layer should comprise 344 turns of No. 10 B. & S. gage D. C. C. magnet wire. The secondary should comprise about 12 pounds of No. 32 D. C. C. magnet wire, thoroly impregnated with paraffin and beeswax

while being wound into pies. There should be 24 pies or coils, each ¼ inch thick. This secondary winding should give 14,176 volts with 300 turns in the primary; 21,265 volts on 200 turns in the primary, and 42,530 volts with 100 turns in the primary in use. Of course, when the normal number of primary turns are reduced in order to raise the secondary voltage, a suitable iron core

## The "June" Number of the Electrical Experimenter

*Electrifying Our Battleships—The electrically driven U.S. battleship "New Mexico," by Charles M. Ripley, of the General Electric Co.*

*Problems of Telephotography—Written by an authority on the subject—Leroy J. Leishman.*

*"My Inventions"—No. 5, by Dr. Nikola Tesla, himself.*

*In the Wonderland of "Tin Can Toys"—by George Holmes.*

*Photographing Nauen's Radio Signals in America—A Startling Scientific Achievement.*

*Close-Ups of the Newest Scientific Movies—The Role of Electricity and Science in Photoplays.*

*How American Electricians Solved the "Submarine Detector" Problem.—Illustrated.*

*A New "Pocket Wireless" That Actually Works—with photos of the Apparatus in Use.*

*Rogers Underground Wireless for the Amateur—by H. Winfield Secor. Don't miss this article—It answers all the "Radiobug's" questions.*

*Improved Capillary Battery—by Thomas Reed.*

*The New Kolster Direct-Reading Wave Meter and Decremeter.*

*Choke Coils—How to Design and Build Them, by Prof. F. E. Austin.*

*Experimental Mechanics.—Lesson 12. Twist Drill Practise, by Samuel D. Cohen.*

*The Audion—How to build and exhaust them, with Graphs for different tubes, by C. Murray.*

choke coil or impedance must be used in series with the primary winding in order to control the current, so that the transformer will not over-heat and burn out the windings.

## 2 K. W. STEP-DOWN PIPE THAWING TRANSFORMER.

(996) Joel H. M., Carney Point, N. J., inquires:

Q. 1. Can you supply data on a 110 volt, 60 cycle, A. C. step-down transformer for pipe thawing, the secondary giving about 12 volts.

A. 1. We give herewith data on the construction of a 2 K. W. transformer suitable for operation on 110 volt, 60 cycle, A. C. The secondary is suited to develop a current of about 13 volts and 150 amperes.

The primary winding of this transformer consists of 13½ pounds or 244 turns of No. 8 B. & S. D. C. C. magnet wire, or 2 No. 11 D. C. C. wires can be wound side by side and connected in parallel. The laminated sheet iron core, on one leg of which the primary is wound, should measure 17½ inches long by 8¾ inches wide, and have a cross-section of 2¼ × 2¼ inches.

The secondary winding for this transformer should comprise 31 turns of No. 0 B. & S. gage D. C. C. magnet wire, and will develop a current of about 13 volts and 150 amperes. If this is too difficult to wind on, 2 No. 3 wires may be used or 4 No. 6 wires, connecting these wires in parallel.

## REWINDING DYNAMO.

(997) A. C. McLellan, La Porte, Ind.:

Q. 1. I want to know what size wire the armature or field or both will have to be wound with to get 40 volts and as much amperage as possible from a dynamo as follows:

Field is 6 pole, now wound with No. 20 D. C. wire, 1¼ pound to the pole. The armature has 28 slots, wound with 28 coils, parallel lap winding, and has 2 brushes at an angle of 60 degrees from each other. Each coil is wound with 20 turns of No. 20 D. C. wire. Commutator has 28 bars, diameter is 4¾ inches, length 3 inches, and at a speed of 2,000 R.P.M. it now generates 105 volts and 9 amperes. The dynamo is shunt wound, and when wired for 40 volts I want it shunt also. It seems to pull very hard now without any load on it at all.

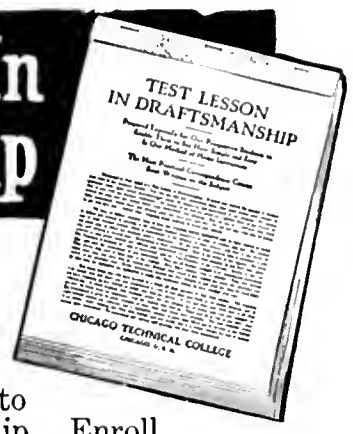
A. 1. We would advise as follows concerning the rewinding of your 105 volt, 9 ampere dynamo:

For 40 volts the field should be rewound with the same amount of wire, or 1¼ pounds per pole of No. 15 B. & S. gage D. C. C. magnet wire. The armature should be rewound with the same number of coils and in the same fashion or style of winding as previously used, but each coil should be composed of 7 turns of No. 15 B. & S. gage D. C. C. magnet wire.

You mention that the dynamo armature seems to turn very hard without any load on it at the present time. This most likely is not due to any electrical reasons, but merely mechanical ones. We would suggest that the bearings be carefully inspected; also on some small dynamos fitted with a number of brushes, the brush friction is made too great, and they should be readjusted so as to have just sufficient spring tension against the commutator to eliminate any undue sparking. In some cases,

(Continued on page 50)

# FREE Test Lesson In Draftsmanship



Send for this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and

let us tell you about the Chicago "Tech" method. The free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation. Send the coupon.

**\$25 to \$100 a Week**

Draftsmen always command good salaries. And now when American industries are to be called upon to meet vast foreign and increased domestic demands, the opportunities are greater than ever. This is the time for you to prepare for a better position—a higher salary.

**Come to the College or Learn At Home**

Hold your present position while training. Our experts will instruct you by mail. Only your spare time is required. You are directly under practical draftsmen and engineers. You are taught exactly the work required in the drafting rooms of big concerns. No time put in on unnecessary studies. This means thorough instruction and early graduation.

**Easy Payments**

The fees for Chicago "Tech" Courses are very moderate—and you can pay on easy terms. And also, you obtain in a few months what it would take several years to acquire by ordinary methods. You can get an early start. You are soon ready to take a paying position and to quickly get back the cost of your course. Then keep on earning more.

**FREE Instruments**

Every student of the Chicago "Tech" mail course in Draftsmanship receives this set of instruments, or a cash credit in case he already has a set. These instruments are of the same make and size as are used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.

## Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Splendid opportunities open now. Send coupon and get all the facts.

**Learn All This in Spare Time**

**Principles of the Automobile.** Every point made clear about the basic principles of propulsion—steam, gas and electric cars. Power transmission systems in pleasure and commercial cars, etc., etc.

**Gasoline Engines.** All about the different types. A complete course in gas engine construction, operation and repair.

**Power Plants and Transmissions.** Application of power by 4-6-8-12 cylinder engines. Types of clutches, gears, drives, axles, etc.

**Carburetors and Fuel Supply Systems.** All methods demonstrated. Fuel valves. How to test. Gasoline and air mixtures. Regulation, care and management, etc., etc., etc.

**Lubrication and Cooling** All about oils and how to test them. Splash and circulating systems. Operation in different cars explained. Diagrams and tables. Cooling systems completely illustrated, etc.

**Batteries.** Electrical principles explained. Instructive diagrams of wiring and connections. Coils, condensers, vibrators, etc., etc.

**Magneto Ignition.** Principles and practical operation of various types and systems with diagrams. Generation of current. Field, armature, high and low tension, all explained. Complete in every point.

**Starting and Lighting Systems.** All modern methods. Starters—spark, mechanical, air, acetylene, electric, battery—shown in detail with diagrams and full explanations. Charging. Motor and generator adjustments, etc., etc.

**Know How to Find and Fix Troubles**

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men and men who know how to inspect cars. This course makes you proficient. Prepares you to take a job as an expert. Not enough competent men now available.

**WRITE** Send the coupon and get catalog and all information about the Course, the small fee and the easy terms. All this sent on request. Mail coupon now.

## Send the Coupon—Now

The sooner you are prepared the sooner you will be holding a job that pays a large salary and opens the way to advancement. Many executives, general managers and superintendents began as draftsmen.

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send you the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything.

**CHICAGO TECHNICAL COLLEGE,**  
545 Chicago "Tech" Building, Chicago

Without obligation to me, please send me your FREE Test Lesson and other interesting literature covering the subject indicated below.

Mark X opposite work in which you are especially interested.

<input type="checkbox"/> Architectural Drafting	<input type="checkbox"/> Plan-Reading—Building
<input type="checkbox"/> Machine Drafting	<input type="checkbox"/> Plan-Reading—Shop Men
<input type="checkbox"/> Electrical Drafting	<input type="checkbox"/> Estimating
<input type="checkbox"/> Structural Drafting	<input type="checkbox"/> Surveying
<input type="checkbox"/> Sheet Metal Drafting	<input type="checkbox"/> Map Drafting
<input type="checkbox"/> Builders' Course	<input type="checkbox"/> Auto and Gas Engines

Name.....

Address.....

City.....State.....

College or Home Study? State which.....

**Chicago Technical College** 545 Chicago "Tech" Bldg. Chicago, Ill.

*You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.*

# Thousands of Wonderful Opportunities in the Electrical Field

## The Trained Man Is Needed Everywhere

By L. L. COOKE,

Chief Engineer, Chicago Engineering Works

**B**USINESS conditions throughout America and even the world today are such that there are now truly wonderful opportunities for trained men in the electrical field. The electrical business has grown so fast and electricity is being continually applied to so many new uses that the demand for trained electrical men is growing faster than the supply.

Even on the farm electricity is now becoming common and thousands of farm lighting and power plants have already been installed. This shows how broadly electricity is applied today, and suggests something of the very great demand for hundreds of thousands more of trained electricians.

"Where will we get the men," is the question heard on every side. Electrical Manufacturers are spending thousands of dollars a week advertising merely for help. Look at the "Help Wanted" columns of any newspaper and see for yourself the demand for trained men. The salaries paid to young men with a thorough knowledge of electricity are unbelievable. The size of the pay envelopes going into the pockets of electrical workers every week reflects the scarcity of men to fill these responsible positions. So, not only is the electrical field greatly vacant now due to the absence of electrical men enlisted in the war services of our government, but it will be more greatly vacant when war's results are counted, and the need for men to fill the industrial places of our soldiers and sailor boys will swell the demand.

Moreover, the reconstruction and readjusting periods to follow in the war's wake are going to increase the employment of electrical workers beyond even the natural immense requirements. Electricity is yet to do its biggest services to the world after the war. The unlimited are its boundaries now, electricity and men who know its functionary phases and operations will have even wider scope and opportunity for years after peace is declared.

The most vital question for the young man of today to answer is not

"Shall I enter the electrical profession?" but "What is the quickest, easiest and surest way to become a trained electrical man?" Time was when it took from three to four years to turn out an accomplished electrician who could be entrusted with any job that came along. Only a few years ago it used to cost thousands of dollars to make an accomplished electrician, which amount was made up in expensive tuition, board, etc., as well as money lost in non-production while the student was learning. Hundreds of thousands of dollars were lost in this manner because the student, seldom, if ever, is a producer while studying. This means a tremendous loss to the nation, as a minute's reflection will readily show.

Correspondence instruction has changed all this. By this method the student wastes no time on unnecessary branches. He gets exactly the training he will use in practical work and throughout his entire course he has the direct personal instruction of specialists in the branch he has selected.

Further, he can do his studying at home, in his spare time. He does not have to give up his regular job until he has qualified as a Certificated Electrician and is ready to enter his new profession. Think of the thousands of dollars this one great feature of correspondence instruction has saved this country in the past year alone.

I urge every young man with ambition and pluck to grasp the opportunity that present conditions offer the electrically trained man. Don't hesitate because of age or experience. Young men, boys and old men are needed and must fill the gaps to keep business going. Do your part. Prepare yourself for a real position by specializing in some branch of electricity. All you need is a few months' practical, snappy instruction from a competent engineer and you will be ready to go after some real money. But do it now. Our boys are returning filled with ambition, strong and healthy after two years' out-door living. How can you hope to compete throughout the reconstruction period without the special knowledge and advantages training will give you?

The Chicago Engineering Works are ready to help you. A specially designed course has been prepared that will fit you in the shortest possible time to take up the extremely interesting and profitable work as a Certificated Electrician. The course is the result of many years' teaching of young men in this vast field. It is intensely practical. It is highly condensed, simplified, up-to-date and complete. You can make a splendid success in this study, and the

school will guarantee, under bond, to return every cent paid for tuition, if you are not entirely satisfied when you receive your Electrician's Certificate granted you as a graduate of the school. We teach contracting and electrical drafting along with the course and hundreds of our graduates are now successful contractors.

You can take the entire course in your spare time. No interference with your regular duties. We understand just what you must know and have devised a really wonderful way of instruction by mail. We have trained thousands of men and will train you to your complete satisfaction or the course will not cost you one cent.

Remember, that you will not be under the slightest expenses except the tuition price. A splendid Electrical Outfit is given free to every student and much of the training is done by actual work with this outfit. You have no car-fare or living expenses as you would have if you studied at a trade-school. You don't have to buy your outfit, or pay for the maintenance of expensive school equipment as you would elsewhere. The electrical outfit which we give every student includes Electrical Tools, Instruments, Materials, etc., and is given absolutely free.

The price of the course, you can pay in small installments if you want to—in other words, you can pay as you go along. These payments you can take out of your salary which you receive from your regular employment, it not being necessary to give this up until you are fitted and ready to take a good position as a real electrician.

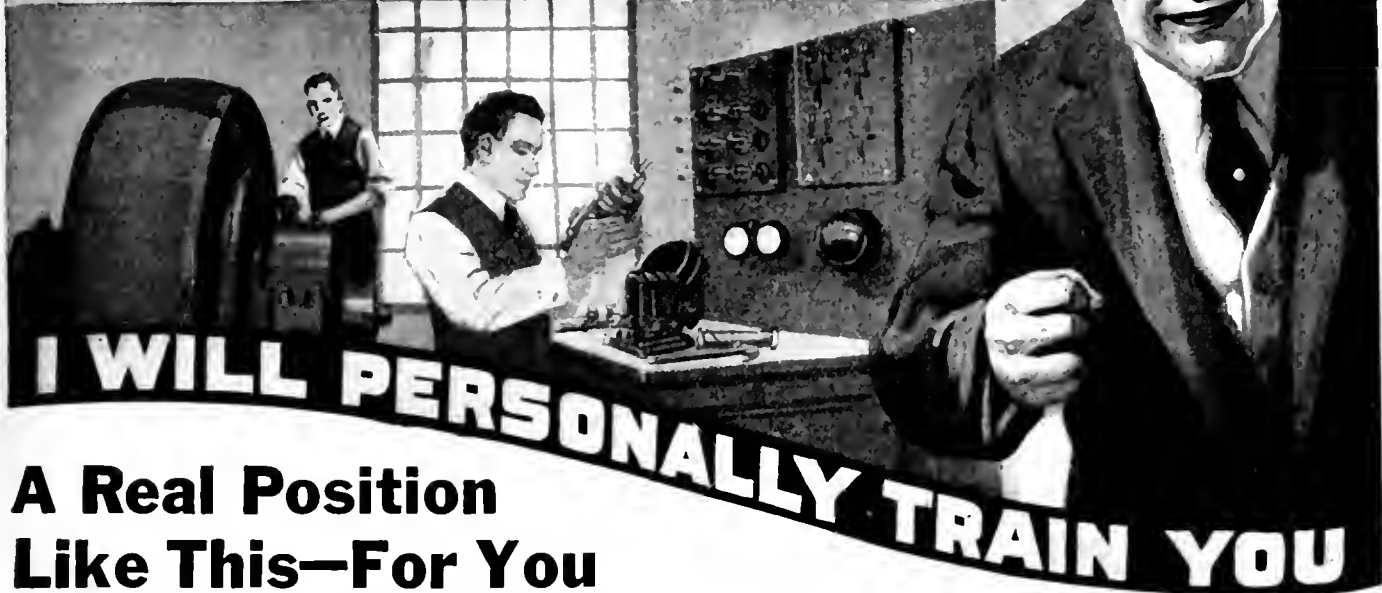
One excellent feature of the assistance the Chicago Engineering Works is giving young men to help them succeed is the free employment service. The standing of the school is so high and the quality of students so well known that many firms rely entirely upon our graduates to fill vacancies in their staffs. We are continually receiving requests from employers to send them trained Electrical men. We assist our students to good positions and keep in touch with them for years, helping and advising them in every way possible.

I cannot urge all young men too strongly to get into the field of electricity. I know the vast opportunities for bright men and the opportunities have never been better than they are now and will be for the next ten years. The industry needs you and will give you a good chance to make a success of your life. Write us and let us tell you all about what we can do for you.

We have just prepared a new book on Electricity and its Opportunities and I want to send you this wonderful book—FREE. Write me personally telling me just what you are doing and what you would like to do. I'll gladly answer your letter myself and give you the benefits of my many years' experience in this field. But whatever you do, don't neglect the golden opportunity now offered live men. Address L. L. Cooke, 443 Cass St., Chicago, Ill.—Adv.



# BE A CERTIFICATED ELECTRICIAN



## A Real Position Like This—For You

The country needs thousands of trained, Certificated Electricians to fill good positions—and at big pay. It's all a matter of knowing how, and I will teach you by up-to-date, modern instruction. You can learn at home, without interfering with your regular work, by my highly successful method of *Home Instruction in Practical Electricity*.

**Prepare NOW and be ready in a few months to earn your \$46 to \$100 A WEEK**

### Send for this Book

My book, "HOW TO BECOME AN EXPERT ELECTRICIAN," has started thousands of young men on the way to splendid success. A new edition of this has just been printed. I want every young man interested in Electricity to have a copy, and will send you one, ABSOLUTELY FREE and PREPAID. Write me today.

### How I Train My Students

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to enable him to get and hold good positions, and to earn big pay. I have trained hundreds of men who are holding splendid electrical jobs.

I give each of my students personal attention and a complete and thorough training. I give him a SPLENDID ELECTRICAL OUTFIT FREE, and much of the training is done by actual work. When my students

graduate and receive their Certificate, they are ready for a real position. But *still more*, at any time you wish you can come to our splendidly equipped Electrical Shops for special training. No other school can give you this.

### A Real Opportunity for YOU

Wishing is never going to make your dreams come true. You've got to *study—to learn*. A man is worth possibly \$2 or \$3 a day from his neck down—and no more; but there is *no limit* to what he can be worth from his neck up.

A *trained mind* is what gets the big pay. It is this training that you need, and I can train you in a few months. Are you ambitious to make a real success—then send me the coupon—today.

### Electrical Outfit FREE

To every student who answers this ad I am giving a Splendid Electrical Outfit of standard size Electrical Tools, Instruments, Materials, etc., *absolutely free*. Furthermore, to every Electrical Student I give a truly *valuable* surprise that I cannot explain here.

### Free Employment Service

I am continually receiving requests from employers to send them trained Electrical men. I assist my students to secure good positions. I keep in touch with them for years, helping and advising them in every possible way.

### Write Now—Don't Delay

Delay never got you anything. Action is what counts. Get started—and get started now. Write me send me the coupon right NOW.

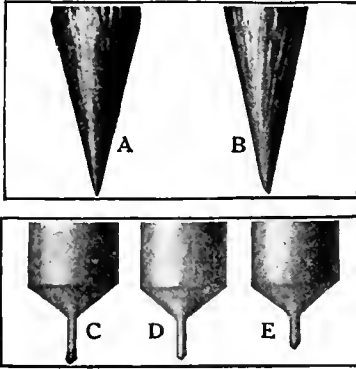
**L. L. COOKE, Chief Engineer**  
**CHICAGO ENGINEERING WORKS**  
**441 Cass Street Dept. 25 Chicago, Ill.**

**YOU CAN DO IT**

**USE THIS "FREE OUTFIT" COUPON**  
 CHIEF ENG. COOKE,  
 Dept. 25, 441 Cass St., Chicago, Ill.  
 Sir: Send at once—fully prepaid and entirely free—complete particulars of your great offer for this month.  
 Name.....  
 Address.....  
 City.....  
 State.....

THE ORACLE

(Continued from page 46)



Study these microphotographs!

- A—New ordinary steel needle.
- B—Ordinary steel needle after playing one record. Note the worn point!
- C—New Sonora Semi-Permanent Silvered Needle. Note that the parallel sides (which are not tapered) always fit record groove perfectly.
- D—Sonora Needle after playing one record. No perceptible wear.
- E—Sonora Needle after playing over fifty records. Needle has worn down, but is in perfect playing condition.

Preserve Your Phonograph Records



Semi-Permanent Silvered NEEDLES Replace steel needles!

They play 50 to 100 times and are used on ALL MAKES of steel needle records. Unequaled for convenience, economy, improvement of mellowness of tone and the increasing of life of the records.

Loud—Medium—Soft  
30c per card of 5. In Canada 40c

FREE! Sample Sonora Needle will be sent FREE on request. Write for it

Sonora Phonograph Sales Company, Inc.

GEORGE E. BRIGHTSON, President  
279 Broadway, Dept. G., New York  
Toronto: Ryrie Building

CAUTION! Beware of similarly constructed needles of inferior quality



Don't Grope for Words

We are all trying to SELL something—it may be brains, or automobiles, or soap—but words are the universal medium of exchange. LEARN TO USE THEM CORRECTLY—PROFITABLY. Get a command of English! Spend a few minutes daily with Grenville Kleiser's Mail Course, in Practical English and Mental Efficiency. It will surely teach you how to

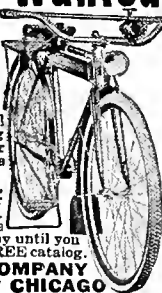
Use Good English—and Win

Enlarge your Stock of Words—Use the Right Word in the Right Place—Write Compelling Business Correspondence, Stories, Advertisements, Speeches—Become an Engaging Conversationalist—Enter Good Society, etc.

Ask for free particulars today. We send them by mail. No agent will call. FUNK & WAGNALLS COMPANY, Dept. 267, NEW YORK, N. Y.

Rider Agents Wanted

Everywhere to ride and exhibit the new Ranger Motorbike completely equipped with electric light and horn, carrier, stand, fuel tank, coaster-brake, mud guards and anti-skid tires. Choice of 44 other styles, colors and sizes in the famous "Ranger" line of bicycles. DELIVERED FREE on approval and 30 DAYS TRIAL. Send for big free catalog and particulars of our Factory-direct-to-Rider marvelous offers and terms.



TIRES—Lamps, Horns, Wheels, Sundries, and parts for all bicycles—at half usual prices. SEND NO MONEY but tell us exactly what you need. Do not buy until you get our prices, terms and the big FREE catalog. MEAD CYCLE COMPANY Dept. D107 CHICAGO

also, the armature may rub against the field poles, and this can be easily ascertained by removing the armature and noting if there are any shiny spots on the field poles or armature core.

ELECTRIC ARC TEMPERATURE

(998) James G. Peck, Elmira, N. Y., says:

Q. 1. What is the temperature of the electric arc produced between two 1/2 inch carbons?

A. 1. In regard to data for building an arc light from two 1/2 inch diameter carbons to give you a temperature of 3,500 degrees Centigrade, any arc, large or small, gives about the same temperature roughly speaking; the large arcs using larger carbons simply giving a greater quantity of heat, but not a higher temperature. The electric arc will give you the greatest temperature of any ordinary source of heat known. The average arc, using 1/2 inch carbons, either cored or solid, consumes about 5 amperes, on 110 volts, and the candle power is about 1200.

Appended are some interesting high temperature sources of heat:

- Bunsen burner.....1,870 deg. C.
- Oxy-coal gas flame.....2,000
- Oxy-hydrogen flame.....2,800
- Oxy-acetylene flame.....3,500
- Electric arc (furnace).....3,500

RADIO LOOSE COUPLER DESIGN

(999) Alvin Harrison, Albert Lea, Minn., asks:

Q. 1. Several questions on designing loose couplers for wireless receiving circuits.

A. 1. In standard practice it is usual to provide both primary and secondary coils with loading inductances, these inductances being either a separate part of the circuit, or else combined with the coupler windings themselves, preferably the latter.

The primary as well as the secondary circuits are, in the most efficient design of coupler, made so as to form a continuous coil capable of being tuned to the highest wave length which it is desired to receive. Any other form of loading inductance which is separate from the windings of the coupler only form a source of loss, for it requires a certain amount of energy (I<sup>2</sup>R) to excite this separate loading inductance, and, as it does not form a part of the main coupler winding, and is not useful in producing a part of the common electromagnetic field which transfers the energy from the primary to the secondary circuit, as you will see, in any event then it must be a source of unrecoverable loss.

We would refer you to a very good article on "Building a 20,000-meter Undamped Receiving Set," by William Burnett, Jr., page 258, August, 1917, issue; also

"The Design of Large Radio Receiving Transformers," by Chas. S. Ballantine, Radio Engineer, page 732, February, 1917, issue.

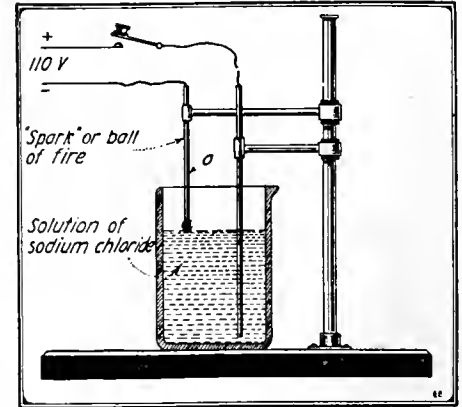
"The Calculation and Measurement of Inductance," by H. Winfield Secor and Samuel Cohen, parts 1, 2 and 3, which appeared in the March, April and September, 1917, issues.

PECULIAR SPARK BALLS.

(1000) R. J. O., San Antonio, Texas, writes:

Q. 1. I am a reader of the ELECTRICAL EXPERIMENTER and desire some information regarding an experiment performed in my "Lab" some time ago which I am at a loss to know "the why and wherefore" of. Thus: I made a solution of Sodium Chlorid and water, in a small beaker. (See sketch.) Using a current of 110 volts and a small telegraph key to open and close the circuit,

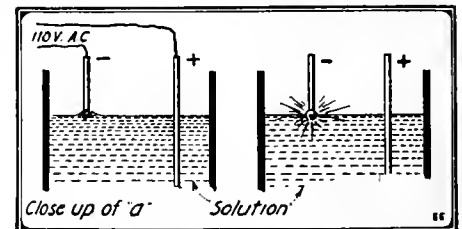
I connected it as shown in the "hook up." I proceeded as in sending a telegraph message and found that a rapid movement of the key produced a stream of what appeared to be sparks between the neg. (—) pole about 1/32 of an inch above the solution. The so-called "sparks" will continue to ap-



First Stage of "Spark Ball" Experiment.

pear as long as the copper wire lasts. (It melts rapidly). My question is "What are those sparks?" If not sparks, what is it?

A. 1. The experiment which you describe is nothing new and is well known to those who have experimented with electrolytic interrupters a good deal. This experiment can be performed not alone with sodium chlorid, but with almost every acid. Providing the current is strong enough, a ball of fire will appear at the end of one wire which touches the surface for the following reason: As soon as the point touches the liquid which has a more or less high resistance, the solution at this point immediately starts to boil. At the same time hydrogen gas is evolved, and the electric current setting fire to it explodes this minute quantity of gas, thereby giving rise to a small explosion. This phenomenon occurs in very



Second and Third Stages of "Spark Ball" Experiment. The Theory of Its Action is Very Interesting.

rapid succession, and the explosions take place several thousand times per second. Mr. H. Gernsback some years ago obtained quite large "fire balls" of this sort by using a fine carbon pencil as one electrode.

200 WATT TRANSFORMER DATA.

(1001) James Dicks, Delhi, La., inquires:

Q. 1. Please give me data on 200 watt step-up wireless transformer for operation on 110 volts, 60 cycles.

A. 1. The laminated sheet iron core for this transformer should measure, for a 200 watt transformer, 10 1/2 inches long by 6 1/2 inches wide and 1 x 1 inch in cross-section. The primary winding, placed on one of the long legs, should comprise 660 turns No. 15 B. & S. gage D. C. C. magnet wire. Before winding on the primary coil, the iron core leg should be insulated with four layers of oiled linen or Empire cloth.

The secondary winding should comprise 17 pies or sections, each 1/4 inch thick, with paraffin paper discs between them when assembled. The size of the secondary wire should be No. 34 B. & S. gage D. C. C. and 3.7 pounds of secondary wire are required. There should be about 35,000 turns in the secondary, and the secondary voltage with

(Continued on page 52)



# How Would You Train 50,000 Employees?

**Western Union's Big Problem** Think of an army of 50,000 men and women, differing greatly in ability, adaptability and previous training—remember that all of them were self-supporting wage-earners, who could not afford to let anything interfere with their regular occupations—consider that it was their employer's desire to make intensive training practical for all, without lessening their present efficiency—and you have some idea of the complex employe-training problem that confronted the WESTERN UNION when it undertook to make it possible for any of its 50,000 employes to acquire a higher degree of efficiency in their work.

**How it was Solved** As WESTERN UNION found that there were no courses covering completely and thoroughly the highly specialized telegraph business, it had special texts written by its own experts, who thus became the personal instructors of its employes. After careful inquiry, the Company decided that the correspondence instruction method would give all employes an equal opportunity, while its flexibility would meet any individual needs and circumstances. And finally WESTERN UNION arranged to loan the price of the Course to deserving employes who might be unable to meet even the moderate fee asked for training.

*The actual conduct of courses and instruction was entrusted to the American School of Correspondence, Chicago, whose Educational Charter and 22 years' successful experience eminently fitted it to carry out WESTERN UNION'S plans to make special training possible to any of its 50,000 employes.*

## Don't Dodge Promotion

Whatever occupation you would prefer to follow you can't dodge the fact that you're dodging promotion—dodging the job ahead, with its guarantee of better pay—so long as you refuse to train yourself thoroughly for the work you want to do. The man or woman with training is bound to succeed—for trained workers are the scarcest commodity in industry. A glance at the "Help Wanted" columns of your daily paper—a question put to your boss—will quickly prove this. The American School can properly develop your natural ability—make you a thoroughly skilled worker. A small part of your spare time—some of the hours you now waste—invested in systematic study will soon fit you for the position, and pay, you want.

## Make This Test

We will train you on a make-good basis—allow you to test out the practical value of any Course by covering the first ten textbooks without risking one cent. This means that if you're not satisfied with your progress—if you find you're not getting money-earning training from the course—we'll refund every cent you've paid us. Full satisfaction or your money back is the only basis on which we accept students. If the fairness of this offer appeals to you—as it has to thousands—check and mail the Coupon for Free Bulletin. You assume no obligation.

### AMERICAN SCHOOL OF CORRESPONDENCE

Dept. W7445 CHICAGO, U. S. A.



TRAINING—THE KEY TO SUCCESS

Please send me booklet and tell me how I can fit myself for the position marked X: **ASC**

- |  |   |
|--|---|
| ..... Western Union Courses            | ..... Steam Engineer                          |
| ..... Telephone Engineer               | ..... Lawyer                                  |
| ..... Draftsman and Designer           | ..... Business Manager                        |
| ..... Automobile Engineer              | ..... Cert. Public Accountant                 |
| ..... Automobile Repairman             | ..... Accountant and Auditor                  |
| ..... High School Graduate             | ..... Bookkeeper                              |
| ..... Fire Insurance Expert            | ..... Stenographer                            |
| ..... Sanitary Engineer                | ..... Gen'l Education Course                  |
| ..... Heating and Ventilating Engineer | ..... Com. School Branches                    |
| ..... Master Plumber                   | ..... Electrical Engineer                     |
| ..... Civil Engineer                   | ..... Electric Light and Power Superintendent |
| ..... Structural Engineer              | ..... Hydroelectric Engineer                  |
| ..... Mechanical Engineer              | ..... Wireless Operator                       |
| ..... Shop Superintendent              | ..... Architect                               |
|  | ..... Building Contractor                     |

Name .....

Address .....

# Tires at Wholesale

Save 1/3 Your Tire Cost

Tires	Tubes	"Armor"	
30 x 3	\$13.60	\$2.90	\$3.00
30 x 3 1/2	17.00	3.45	3.60
32 x 3 1/2	19.65	3.60	3.60

Other sizes quoted on request.

Order these 5,000 mile Beacon "Rib-Skid" Tires, Red Tubes and "Inside Armor" at above prices on money-back approval, or write at once for full description and our plan of selling First Grade, Fully Guaranteed Tires, etc., direct-to-you at wholesale prices. Give size of tires and name of car. Address

MODERN TIRE CO., 659 7th Street, RACINE, WIS

## Pocket Tool Chest

9 Tools in 1

Strong Knife  
Leather Punch  
Sawing Aid  
Screw Driver  
Alligator Wrench  
Each a strong, practical tool. As easily carried as a 3-blade knife, and has no more parts. Length, 4 in. Pliers and wire cutters are drop-forged tool steel—cut barbed fence wire as easily as 8-inch pliers. Blade is tempered cutters' steel. Each tool works independently. Once used, always carried by Electricians, Railway Men, Motorists, Mechanics, Horsemen, Sportsmen.



Sent postpaid in U. S. for \$1.75 (add 5c if insured). Highest quality construction, fully guaranteed. Elican Specialty Co. 874 Merchants Bank Bldg. Indianapolis, Ind.

## BIG PROFITS for YOU in HB BATTERY CHARGING

Start now to build big battery business. Opportunities best this season—more old cars driven—new Fords with storage batteries. HB users are easily clearing

\$100 to \$200 Extra Profit Every Month

Some even more. Get in the game! This HB 7-Battery Charger recharges 1 to 7 auto batteries at once. Current cost 15c to 15c per battery. Motorist pays 60c to \$1.50. Figure your profits. No electrical or mechanical experience required to operate. No expensive renewals or adjustments.

HB Puts The Money-Make in Your \$25 Garage on Money-Back Guarantee Balance in 9 monthly payments of \$20 each. Earnings easily pay for machine. Pay your \$25 initial payment check to this ad and send today for trial order. You run no risk under HB Absolute Money-Back Guarantee. Don't delay. Get busy! Get those profits!

HOBERT BROS. CO., Box 5E, Troy, O.  
Successful manufacturers since 1893



## POPULARITY FOLLOWS THE UKULELE

If you play quaint, dreamy Hawaiian music or latest songs on the Ukulele you will be wanted everywhere. We teach by mail 20 simple lessons; give you free a genuine Hawaiian Ukulele, music, everything—no extras. Ask us to send the story of Hawaiian music. You will love it. No obligation—absolutely free.

The Hawaiian Institute of Music  
1400 Broadway, Suite 1105, New York



## BUILD A \$100 PHONOGRAPH

Assemble your own Phonograph Do it yourself easily. Have the finest machine. Astounding saving. We give you the phonograph secrets, complete instructions 10 cents.



CATALOG FREE!

ELECTRO MECHANICAL PARTS CO.  
160 N. Wells St. CHICAGO

## LANGUAGES QUICKLY LEARNED ON ALL PHONOGRAPHS

"Like learning a tune—and as easy." Our Disc Records repeat the correct accent and pronunciation until you know it. Family and friends enjoy language study by the LANGUAGE-PHONE METHOD And Rosenthal's Practical Linguist  
War has created unlimited opportunities for those who know languages. Prepare now to better your position or increase your business. Used and recommended by educators in leading colleges. Write for booklet and Free Trial Offer.  
THE LANGUAGE PHONE METHOD  
931 Putnam Building, 2 W. 45th St., N. Y.

**The Seneca** Built for the Owner \$990.00  
Simple, sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding.  
4 cyl. - 27 H. P. 10 1/2 wheelbase  
Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.  
THE SENECA MOTORCAR CO., 45 Seneca Factory, FOSTORIA, OHIO



## THE ORACLE

(Continued from page 50)

all primary turns in use is 5,890. The secondary voltage is increased in proportion as the number of primary turns in circuit at any time are decreased. The secondary leg of the core should be well insulated with 10 layers of oiled linen before placing the pies in place.

### NEUTRAL POINT OF D. C. DYNAMO AND A. C. MOTOR SPEED CHANGES.

(1002) R. G. LeTourneau, Stockton, Cal., asks the Oracle:

Q. 1. Several questions concerning the shifting of the neutral point on a D. C. generator and speed changes of induction motors.

A. I. The neutral point on the commutator of the D. C. generator changes at least slightly with changes in speed of the armature as you mention, unless the machine has one of the following precautions taken in its design: The machine might have a very powerful field, which would cause a very even and rigid distribution of the flux at the pole tips; the machine might be provided with *interpoles*, such as provided on any one of the leading machines on the market at the present time, which tends to preserve an even distribution of the field flux, and thus to preserve a practically fixed neutral point, thus obviating the necessity for shifting the brushes, even on overloads of 50 per cent. Or again the machine might be provided with variable air gaps between the field pole tips and the armature, such as in the Stow design, where all of the field poles are geared together by means of worms and gear rods to a common hand-wheel on the top of the machine, which enables the field poles to be advanced toward or receded from the armature and the air-gap flux distribution varied.

You are correct in assuming that several different speeds can be obtained from an A. C. motor by changing the groupings of the field poles, i. e., by changing the number of poles, such as by causing the field to produce 4 poles, 6 poles, 8 poles, and so on. This system is adopted in some of the leading A. C. motors now on the market. You will find data on this subject by referring to books on A. C. machinery.

### A. C. TEST FOR "SHORTED" ARMATURE COILS.

(1003) Earl E. Teater, Wheeling, West Va., writes the Oracle:

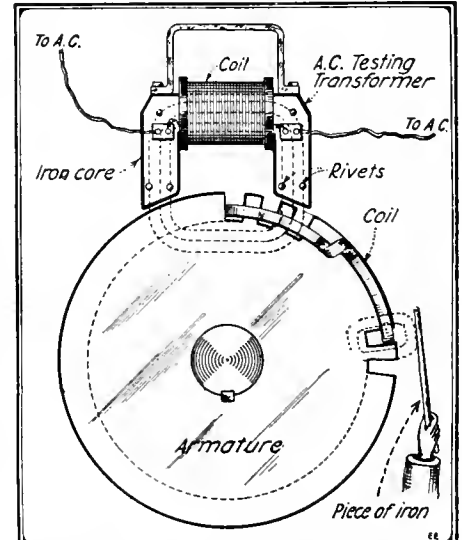
Q. 1. For data on a simple A. C. testing scheme for short-circuited armature coils.

A. 1. Herewith we describe an A. C. testing device for determining whether armature coils are short-circuited or not and which is used in repair shop work. The small transformer has a single winding on it, which is excited with alternating current suitably controlled by connecting it in series with a lamp bank or choke coil, etc. Using this transformer primary, as it may be called, and holding it in contact with the armature, in successive positions, as the armature is turned from coil to coil, there is set up thru the armature core a magnetic flux, which induces a current in the armature windings. If one of the coils happens to be short-circuited, as becomes apparent, this current will heat up the coil. Also by turning the armature a complete revolution and holding a small piece of iron against it, the coils being tested for short-circuits will be easily located, as the piece of iron held near the coil will vibrate, due to the resultant magnetic field set up by this coil and the current passing thru it. The transformer device should not be put in position nor removed while current is flowing thru the magnetizing coil of course.

To make this testing transformer, a

laminated sheet iron core of the shape indicated in the diagram is built up, and it may be riveted at several points. It should have a width equal to the approximate length of the armature, and also a pole-face curvature as nearly like that of the armature core as possible. The winding on this transformer may, for a small size device to be used in testing out small magneto or auto lighting dynamo armatures, be composed of about 75 turns of No. 14 B. & S. insulated magnet wire.

A very satisfactory and simple test for short-circuited as well as open-circuited armature coils can be carried out by connecting a buzzer across the brushes, and thus testing from bar to bar with a 75 ohm telephone receiver. If a coil is short-circuited or partially short-circuited, then no sound or a weak sound will be heard in the telephone receiver. It has been found that this test will give better and more accurate



Home-Made A.C. Tester for Short-Circuited Armature Coils. The Materials Required to Build It Are Available About Any Shop. Its Action Is Simple, Yet Positive.

results in a minimum of time, than is the case where the Wheatstone bridge is used. Open-circuited coils will manifest their presence when the proper bars are bridged by a very loud noise in the receiver. It is common practice in many shops to use this test in connection with the 110 volt, 60 cycle A. C. lighting current, the necessary current being past thru the armature in series with a 110 volt lamp.

If you have a good voltmeter on hand or possibly an ammeter without the shunt on it, you can also make tests quickly for open or short-circuited coils or grounds by the bar-to-bar test, passing direct current thru the brush points on the commutator. For this work the armature is usually mounted in a testing cradle, comprising a wooden frame and one upright which carries a pair of adjustable copper or other brushes which will transmit the testing current to diametrically opposite points on the commutator, for the two-pole armature, or four points ninety degrees apart for a four-pole armature. In any case where the telephone receiver and A. C. or buzzer method are used, or the voltmeter method, the criterion of the tests for a perfect armature is to obtain a similar or very closely similar degree of sound in the receiver for each coil, or an equivalent similarity in the voltmeter readings for every coil on the armature. If any appreciable difference is noted in the meter readings or in the telephone, then the connections of the commutator, and also the leads of the coils should be carefully examined. Sometimes a high reading will result from a poorly soldered lead connection to the commutator bar, which on a superficial examination may appear to be a first-class soldering job.





Always in the Home on \$30 a Week



I Used to Worry About Money Matters



# “At Dawn the Answer Flashed on Me!”

**T**HERE are only a few \$50,000 jobs—yet of all the men in the country it is difficult to find enough to fill the few big jobs available. There are plenty of men for the \$25-a-week positions—but the thousand-dollar-a-week openings “go begging.” How this young man trained himself for earnings of \$50,000 a year is one of the most interesting chapters in the annals of even present-day fortune making. This is the story told me, almost word for word, by the young man *who did it*.

“Three short years ago I was \$5,000 ‘in the hole’—and earning \$30 a week. I had a wife and two children to support, and I used to worry myself sick about the future. “Today—it seems like a dream—all my troubles are over. I am worth \$200,000—enough to keep me and my family in comfort for the rest of our lives. I own two automobiles. My children go to private schools. I have just purchased, for cash, a \$25,000 home. I go hunting, fishing, motoring, traveling, whenever I care to.

“LET me say in all sincerity that what I have done I believe any one can do. I am only an average man—not ‘brilliant’—have never gone to college—my education is limited. I know at least a hundred men who know more than I, who are better educated and better informed—and their earnings probably average less than \$50 weekly while my income is over \$1,000 weekly. I mention this to show that earning capacity is not governed by the extent of a man’s education—to encourage those who have not had the advantage of a comprehensive education.

“What, then, is the secret of my success? Let me tell you how it came about.

“One day, about three years ago, something happened that woke me up to what was wrong with me. It was necessary for me to make a decision on a matter which was of little consequence. I knew in my heart what was the right thing to do, but something held me back. I said one thing, then another; I decided one way, then another. I couldn’t for the life of me make the decision I knew was right.

“I lay awake most of that night thinking about the matter—not because it was of any great importance in itself, but because I was beginning to discover *what was*

How a young man jumped from \$30 a week to \$50,000 a year. His remarkable success he attributes to the way he uses his will. “What I’ve done, I believe any one can do,” he says.

*wrong with me.* Along towards dawn the answer flashed on me and I resolved to make an experiment. I decided to cultivate my will power, believing that if I did this I would not hesitate about making decisions—that when I had an idea I would have sufficient confidence in myself to ‘put it over’—that I would not be afraid of myself or of things or of others. I felt that if I could smash my ideas across I would soon make my presence felt. I knew that heretofore I had always begged for success—had always stood, hat in hand, depending on others to give me the things I desired. In short, I was controlled by the will of others. Henceforth, I determined to have a strong will of my own—to demand and command what I wanted.

“WITH this new purpose in mind, I applied myself to finding out something more about will power, and in my investigation I encountered the works of Professor Frank Channing Haddock. To my amazement and delight, I discovered that this eminent scientist, whose name ranks with James, Bergson and Royce, had completed the most thorough and constructive study of will power ever made. I was astonished to read his statement, ‘The will is just as susceptible of development as the muscles of the body!’ My question was answered! Eagerly I read further—how Dr. Haddock had devoted twenty years to this study—how he had so completely mastered it that he was actually able to set down the very exercises by which anyone could develop the will, making it a bigger, stronger force each day, simply through an easy, progressive course of training.

“It is almost needless to say that I at once began to practice the exercises formulated by Dr. Haddock, and I need not recount the extraordinary results that I obtained almost from the first day. You already know the success that my developed power of will has made for me.

“People sometimes worry because they cannot remember or because they cannot



I Now Own a \$25,000 Home



Go Travelling Whenever I Want to



—And Live in Luxury

*concentrate.* The truth is, will power will enable them to do both. The man who can use his will can not only concentrate and remember, but can make use of these two faculties. And I want to leave this one word with you—no knowledge, no plan, no idea is worth a penny unless it is used—and it cannot be used unless some one’s power of will does it!”

**P**ROF. Haddock’s rules and exercises in will training have been placed in book form, and I have been authorized by the publishers to say that any reader who cares to examine his startling book on will power may do so without sending any money in advance. In other words, if after a week’s reading you do not feel that “Power of Will” is worth \$3, the sum asked, return it and you will owe nothing.

When you receive your copy for examination I suggest that you first read the articles on: The law of great thinking; How to develop analytical power; How to guard against errors in thought; How to drive from the mind unwholesome thoughts; How to develop fearlessness; How to use the mind in sickness; How to acquire a dominating personality.

It is interesting to note that among the 225,000 owners who have read, used and praised “Power of Will” are such prominent men as Judge Ben E. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, ex-U. S. Chinese Ambassador; Gov. McKelvie of Nebraska; Assistant Postmaster-General Britt; General Manager Christeson, of Wells Fargo Express Co.; E. St. Elmo Lewis; Senator Arthur Capper, of Kansas, and thousands of others.

As a first step in will training, I would suggest immediate action in this matter before you. It is not even necessary to write a letter. Use the blank form below, if you prefer, addressing it to the Pelton Publishing Company, 30-J Wilcox Block, Meriden, Conn., and the book will come by return mail. This one act may mean the turning point of your life as it has meant to me and to so many others.

**Pelton Publishing Company, 30-J Wilcox Block, Meriden, Conn.**

I will examine a copy of “Power of Will” at your risk. I agree to remit \$3 or return the book in 5 days.

Name .....  
Address .....



### Men Wanted for Airplane INDUSTRY

Wonderful opportunities—great scope for advancement—and big pay—await you in the airplane industry. This does not mean actual flying, but in any and all of the various branches of the industry. It is the coming profession—the future means of transportation. U. S. Mail is already being carried by airplanes. Factories are springing up everywhere and trained men are in big demand.

### Openings in Many Branches

You can get into this profession while it is still in its infancy as a mechanic, engineer, repairman, instructor, inspector, builder, contractor, salesman or professional aviator. The minute you understand the science and mechanics of aviation you can step into a high-salaried position.



### We Guarantee Our Training

We absolutely and unreservedly guarantee that our Home Training Course will enable you to qualify for a good position as soon as you graduate. The Course itself has been written by noted aeronautical engineers, and covers the entire fundamentals of practical aeronautics. Every lesson is written and illustrated so clearly that you cannot fail to understand it. But see for yourself. Take ten lessons. Then if you are not satisfied you are not out one cent. We guarantee satisfaction.

### Prepare Now for a Big Future

Only by specialized instruction can you expect to succeed in aviation or in any line of business. Training alone will fit you for a big job—and NOW is the time to begin. Check and mail the coupon for Big Free Bulletin and Money-Back Guarantee.

### AMERICAN SCHOOL OF CORRESPONDENCE

Dept. F 7445 CHICAGO, U. S. A.



### TRAINING THE KEY TO SUCCESS

Please send Free Bulletin and explain how I can qualify for the position checked.

- .....High School Graduate
- .....Electrical Engineer
- .....Elec. Light & Power Supt.
- .....Hydroelectric Engineer
- .....Telephone Engineer
- .....Telegraph Engineer
- .....Wireless Operator
- .....Architect
- .....Building Contractor
- .....Civil Engineer
- .....Structural Engineer
- .....Mechanical Engineer
- .....Shop Superintendent
- .....Steam Engineer
- .....Draftsman and Designer
- .....Lawyer
- .....Business Manager
- .....Certified Pub. Accountant
- .....Accountant and Auditor
- .....Bookkeeper
- .....Stenographer
- .....Fire Insurance Expert
- .....Sanitary Engineer
- .....Master Plumber
- .....Heating & Vent. Engineer
- .....Automobile Engineer
- .....Automobile Repairman
- .....Airplane Mechanic
- .....General Education Courses
- .....Common School Branches

Name.....

Address.....

### Let Me train YOU in AVIATION



My advice to you is to start right now to take my **HOME COURSE IN AVIATION**

and prepare to fill one of the big jobs later. Wonderful opportunities. Trained men in big demand. Prepare now for big future. Lessons are easy to understand. Write TODAY for my FREE BOOK, "The Science of Aviation," and I will send it to you personally and will send it to the address that will interest you. Address: CAPT. GEO. F. CAMPBELL, Chief Instructor, National Aero Institute, 538 S. Dearborn St., Dept. 7445, Chicago

Capt. G. F. Campbell, formerly Third Ace of the Royal Flying Corps, that will interest you. Address: CAPT. GEO. F. CAMPBELL, Chief Instructor, National Aero Institute, 538 S. Dearborn St., Dept. 7445, Chicago

### "SEXUAL DISASTERS"

is something different. Actual cases from pen of a physician. Warns you against hundreds of sex evils in very plain language. More interesting than fiction. Sent immediately, postpaid, for \$2.00. MONONGAHELA NOVELTY CO., Box A-565, MONONGAHELA, PA.

## Popular Astronomy

### Astronomical Distances

(Continued from page 25)

ured with considerable accuracy and is known to be four and a third light years. Tho there may be a few faint stars or non-luminous stars nearer to us than Alpha Centauri, and there is, in fact, one inconspicuous star known to be slightly nearer, the distinction of being the nearest of the brighter stars has long been held by Alpha Centauri. As our own sun continues his journey thru the universe the two stars (our sun is a star just like Alpha Centauri) will finally draw away from each other after many ages have past and some other sun of space will be our nearest star. The distances that separate the stars from each other probably average as great as the distance from the sun to Alpha Centauri. Within a sphere whose center is at the earth and whose radius is five parsecs, or about sixteen light years, there are only about twenty known stars. There is therefore small chance of collision among bodies that are so small in proportion to the tremendous intervals of space that separate them from each other. There is ample room for the individual stars to pursue their journeys thru space without interfering with each other's motion so long as they are as widely scattered as they appear to be in this portion of the universe. That our own sun has continued its journey thru the universe for some hundreds of millions of years without any catastrophe such as would result from closely approaching or colliding with another sun of space shows on how grand a scale our sidereal system is fashioned.

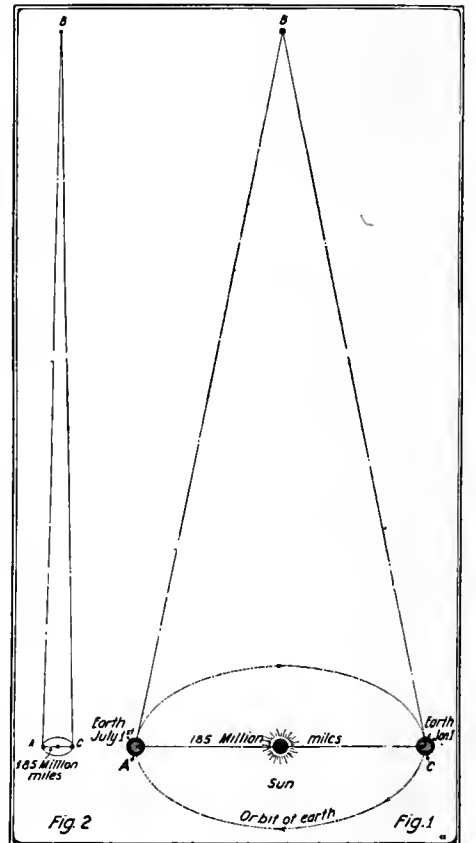
Stars that are ten, fifty or even one hundred light years from the earth are our near neighbors in space. They are the stars that show a slight displacement in the heavens or measurable parallax viewed from opposite sides of the earth's orbit. There are probably a thousand stars among the hundreds of millions of stars within reach of the greatest telescopes whose distances have been determined in light years by direct measurement of their displacement in the heavens resulting from the change of position of the earth in its orbit. The most distant of the stars are apparently immovable in the heavens showing neither the effect of the sun's motion or their own motion thru space. Methods for ascertaining the distances of many far remote stars and star-clusters have been devised, however, and some comparatively recent investigations have yielded determinations of the distances of these objects indicating that the diameter of the system of stars to which our sun belongs approximates to at least three hundred thousand light years. It is difficult to grasp the full significance of this fact. It means that hundreds of millions of the suns of space through the visible universe at distances from us and from each other running into hundreds, thousands and even hundreds of thousands of light years. The light waves from some tiny object that we can just barely glimpse in one of our great reflectors may have started on their journey thru space over one hundred thousand years ago when men of the Old Stone Age inhabited our planet earth!

Astronomers have found as a result of their investigations that the sidereal system to which our solar system belongs is in the form of a flattened spheroid with its longest axis in the plane of the Milky Way. We have shown in a preceding article on the Milky Way how all the various units of our system, stars, nebulae and star clusters are distributed with reference to this plane, including our own sun. The extent of this star system composed of hundreds of millions of individual suns in addition to nebulae and clusters is, as we have said, at least three hundred thousand light years

along its longest axis, while globular star clusters distributed above and below its central plane have been found to be at distances from it ranging from ten thousand to two hundred thousand light years. This entire organized system is our sidereal universe. Space beyond is unexplored. The globular star clusters are the most distant celestial objects so far discovered. The spiral nebulae may be entirely within the limits of this system or future determinations of the distances of the fainter spirals may extend the limits set by the globular clusters to include spirals found to be still more distant.

We can conceive the possibility that our sidereal universe, vast as it is known to be, may be but a unit in some still greater organization and that other similar systems lie beyond the reach of existing telescopes at unimaginable distances of a higher order.

The mind of man is overwhelmed by the thought of sidereal systems as vast as our own lying far beyond our ken. Whether or not such external systems do exist and are with our own sidereal system units in some still vaster creation we cannot know.



How Star Distances Are Measured by Means of Parallax.

We have attempted to grasp feebly the vast expanses of time and space that are to be found within our own sidereal system, but the finite mind of man cannot grasp the wonders of a creation in which our entire sidereal system may hold a position as subordinate as does our own planet in the sidereal universe to which our sun belongs.

The distances of stars are almost inconceivable to the human mind. They are computed by what is known as the parallax. In order to make this plain to the non-technical reader, Fig. 1 shows the method used. When the astronomer wishes to measure the distance of a distant star, he takes an exact observation of the star on January 1st when the earth is in position C. Then on July 1st he again observes the same star with very accurate instruments. Then he will have an angle A, B, C. The

(Continued on page 56)



**"Saved \$100.00 On My Diamond"**

The \$85 diamond you see compares favorably to a ring recently bought at \$155 (a saving of \$100.00) on request.

This firm nearly 3/4 century old, rated over \$1,000,000.00, lends money on high grade jewelry. Amazing bargains in unpaid loan diamonds. Free examination.

**Why Pay Full Prices**

Prove for yourself that it's unnecessary. Send your name for wonderful list, free. Accurately described in detail. Radically different from catalogs. See these prices before you buy.

**Send for Latest List**

**Diamond Loans** Must sell unpaid loans. Hundreds of diamonds far under market prices. Free examination. Amazing bargains proved by customers' letters. Write today.

Jos. DeRoy & Sons, 8050 DeRoy Bldg. Only Opposite P. O. Pittsburgh, Pa. Reference: Dan's or Bradstreet's; Marine National Bank; Union Trust Co., Pittsburgh.




**BOYS! BOYS! JOIN The JUNIOR YANKS**

Be the first to organize a company in your town. A real boys' organization—no grown-up leaders. Secure an officer's commission for yourself. Get four to six boys to join you.

The only boys' organization teaching military signals, wig-wagging, wireless telegraphy, machine gun and rifle drill, how to dig trenches, make tree entanglements, dug-outs, listening posts, how to advance and retreat, do scout and guard duty; all the things a real soldier knows.

Write today and we will tell you how to become a "Junior Yank" and officer, receive the official Junior Yank trench cap and collar ornaments, and a complete military outfit without one cent of cost.

Send ten cents (stamps or coin) for the official magazine in colors, "The Junior Yank" and a copy of the manual of drill and rifle practice. Have all your boy friends write at the same time. Address: Junior Yanks, 202 W. Ohio St., Chicago, Ill.




**USE HB BALL BEARING ELECTRIC MOTORS**

**HB Electrical Motors Save Power**—Get Ball Bearing equipped HB Motors, as they save you a substantial sum each month on your power bills. Absolutely they are trouble-proof, economical, amply designed, just right for your requirements—one-half to 15 h.p., they substantially lower your power costs. Easy to install and operate. Require practically no attention. \$20.00 gives you an HB Ball Bearing Motor. The balance on easy terms. Suits your requirements.

Let our engineering department assist you. Send in your problems. State kind of machinery you wish torun and type of current available. Can also furnish Battery Charging Outfits, Lighting Generators, etc. Pin this ad to your letterhead and mail for further information today.

**HOBERT BROTHERS COMPANY**  
Box 5E Troy, Ohio  
Successful Manufacturers Since 1893



**Earn \$35. to \$100. WEEKLY**

**ALL OR SPARE TIME**

You can make \$35.00 to \$100.00 a week. I want hustlers, money-makers, to work with me, to advertise, sell and appoint agents. Biggest thing in years. City conveniences without plumbing. Used in any room. Sells on sight. Demonstrating tub furnished. Fields small, self-emptying, non-leakable. Guaranteed 10 years.

**AGENTS MAKE SALES EASILY**

Two sales daily means \$80.00 a week. Leggett, Ohio, "Worked two hours, took two orders, profit \$10.00." Hayhurst, Neb., "Took 11 orders in 4 1/2 days—profit \$50.00, ordered 12 more tubs." Manning, Iowa, "Sold 10 tubs in one day—profit \$30.00." DeHart, Neb., "Sold 12 tubs in three days—profit \$60.00." And hundreds of others making big money. 70 percent of homes have no bath tubs. Experience and capital unnecessary. Credits given to the right man. Get full particulars and "special plan" all parts.

H. S. Robinson, Pres., THE ROBINSON CABINET MFG. CO., 4975 Factorio Building TOLEDO, OHIO



**ELECTRICAL ENGINEERING IN ONE YEAR**

training again open to civilians. Over 3000 men trained for electrical industries in experience of more than a quarter of a century. For men of ambition and limited time. Condensed course in Electrical Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity, Mathematics, Steam and Gas Engines, Mechanical Drawing. Students construct dynamo, install wiring and test electrical machinery. Course with diploma, complete.


Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. Write for catalog. 27th year opens October 1, 1919.

**BLISS ELECTRICAL SCHOOL**  
260 Takoma Avenue, Washington, D. C.

Comics, Cartoons Commercial, Newspaper and Magazine illustrating, Pastel, Crayon portraits, Poster and Fashions. **Earn Big Money.** Taught by Mail or Local Classes. Write for illustrated booklet, terms and list of successful pupils.

**Be an Artist**

ASSOCIATED ART STUDIOS, 13A Flatiron Bldg., N. Y.



**ASTRONOMICAL DISTANCES.**  
(Continued from page 54)

distance from A to C being roughly 185,000,000 miles, and the angle being known, it is easy to figure the distance from B to A by means of trigonometry. But if the star B is at an immense distance such as is shown in Fig. 2, the angle A, B, C becomes very small. As some of the stars are billions upon billions of miles removed from the earth, it will be readily seen that there will come a point when the angle A, B, C ceases to exist. In other words, the distance A to C, altho 200,000,000 miles, will practically vanish—as it is so little—and the angle becomes so sharp that A, B, C is practically nothing but a straight line. As a matter of fact most of the stars which we see are so far removed from the earth that they have no appreciable parallax, and it is therefore impossible to know how many billion miles such a star is removed from the earth. As a matter of fact only a comparatively few stars exist that show an appreciable parallax, even with the extraordinary degree of perfection attained in measuring instruments. Such is the inconceivable magnitude of interstellar distances.

Distances from the sun to the planets and to the nearest star in terms of the astronomical unit (distance from earth to sun) and in millions of miles.

Table I.

	In Astronomical Units	In Million Miles
Mercury .....	0.39	36.0
Venus .....	0.72	67.2
Earth .....	1.00	92.9
Mars .....	1.52	141.5
Jupiter .....	5.20	483.3
Saturn .....	9.54	886.0
Uranus .....	19.19	1,781.9
Neptune .....	30.07	2,791.6
Alpha Centauri (nearest star) .....	273,000.00	26,000,000.0
Value of light year.....	63,000.00	6,000,000.0
Parsec .....	206,265.00	20,000,000.0

Time required to travel from the earth to sun, moon, planets and nearest star by airplane, (at the rate of 200 miles per hour), and with velocity of light, (at rate of 186,324 miles per second).

Table II.

To	By airplane	With velocity of light
Moon .....	7 weeks	1 1/4 seconds
Sun .....	52.09 years	7 min. 50 sec.
Venus .....	14.37 years	2 min. 18 sec.
Mercury .....	32.46 years	5 min. 6 sec.
Mars .....	27.72 years	4 min. 21 sec.
Jupiter .....	222.68 years	35 min. 15 sec.
Saturn .....	452.37 years	1 hour 11 min.
Uranus .....	963.38 years	2 hours 32 min.
Neptune .....	1,539.30 years	4 hours 2 min.
Alpha Centauri 14 1/2 million (nearest star) .....	years	4.35 years

Note: The above results were obtained by using the mean distances of the planets from the sun and the nearest approach of the planets to each other.

**RELIEVING THE CAR CRUSH.**  
(Continued from page 15)

lide! The westerner wants to get off and the easterner wants to get on, naturally.

Now an old axiom says that one mass can't take the place of another mass without displacing that first mass. But tho we have learned in our physics class that water is not compressible, Subway passengers are compressible to the NTH degree.

Then after a homeric battle in which both sides display a titanic amount of muscular effort the "westerner" is finally ejected forcibly from the car and a half dozen "easterners," with the "gentle" help of the subway gladiator, are packed into the train, which proceeds on its way until the next station, where the same little game of forcible subtraction and addition is enacted all over again.

The cure? There are three doors on each New York subway car: Two on each end and one (about the same size as the front and end door combined) in the center. If the outgoing passengers could use, say, the end doors only and the incoming travelers the middle doors only, and if this rule would be strictly enforced, don't you think that this would help to make the Subway a better place to travel in?

And, besides, Kipling would be right. "East and West, they never shall meet!" Anyway, not so rudely!

**ELECTRIC VIOLIN-VIRTUOSO A MARVEL.**

(Continued from page 21)

is obtained by means of a third magnet which vibrates the tail piece thru the medium of the shaker bar.

To produce the wonderful orchestral effects achieved by the Violano-Virtuoso, as the instrument is called, it is necessary to use not one but four bows—one for each string.

These bows consist of numerous conical discs of specially prepared flexible celluloid, the edge of each disc acting as the hair of a bow. And it is possible for these revolving bows to play simultaneously on all of the four strings. These 4 bows are operated by bow magnets and are mounted on a bow shaft extending over the bridge. This, in connection with the fact that the instrument has sixty fingers against the four available to the human violinist, is the reason why this instrument can, with facility, render the most difficult concertos, etc.—the master-pieces of the world's musical literature—some of which it is manifestly impossible for any save the greatest human virtuosi to achieve.

The bows are automatically rosined. Suspended above the strings is the rosin box from which the strings automatically obtain the proper supply of rosin. This box is controlled by a governor and according as the speed of the motor raises or lowers—the greater the bow speed and the closer the box comes to the bows, which by their revolutions against the surface of its rosin, automatically obtain a greater or less supply as required.

Our illustration shows the electrically operated violin, as well as its accompanying player piano. Both instruments playing together, thus give rise to a very creditable musical performance.

**ALL KINDS OF LIGHTNING.**  
(Continued from page 20)

denly took it into his head that he was going to take some superlative lightning photos on a certain summer day. In this particular instance, the thunder storm had not been behaving very nicely, according to the photographer's notions, but he thought he would take a chance any way. We might mention before going further, that the thunder storm did not come up in the usual way, and proceed to discharge veritable forked "Bolts of Thor," but satisfied itself with merely hanging around in the offing, and giving a perfect imitation of the best flash, or so-called "heat" lightning, you ever saw. What happened was this. The photographer waited until several of these flashes had occurred and the rain had begun to fall, when he thought the lightning discharges would sharpen up enough to photograph most beautifully. However, he miscalculated the extent and the frequency of the flash lightning, which in this particular case hung on for a long time, and accompanied each flash of forked lightning, which was rather slight in quantity, with the total result that after six 8x10 negatives had been exposed, and then rushed expectantly into the dark room and developed, they showed,—what do you suppose? Well, sir, those six plates turned out to be six of the finest snap-shots of the surrounding landscape and buildings that you ever laid eyes on. By actual comparison you could not tell them from a sunny mid-day snap-shot of the surrounding country taken with the same camera.

Thus the motto would seem to be, that to obtain good lightning photos, one should take advantage of a very dark overhanging storm which gives the greatest contrast of course, for the lightning flashes to appear against. At night would seem to be a most opportune time to photograph lightning discharges, but many excellent pictures have been obtained in the day time as well, under suitable conditions as just outlined.



# ELECTRICITY



## Taught By a Practical Man and in Your Home!

I am teaching electricity and electrical drafting to many men, young and old, and trust you will become sufficiently interested after reading this advertisement, that you will send for my catalog which tells what I am endeavoring to do and also places before you the simple way in which the instruction work is handled. The catalog is written in a very plain manner, much in the same style as my lessons are written, and tells you exactly what you get and what the course can do for you. My catalog, as well as my advertisements, is written in a very careful, conservative manner so there is no possibility of you expecting something you will not get.

### The Purpose of the Course of Study

I have been designing courses in electrical instruction and teaching electricity, off and on during the past 17 years, and during that time I have had an unusual opportunity to make a special study of the teaching business, from the standpoint of a practical man. This course of my own is designed with a view of reaching those who do not have a lot of time and money to devote to study work, and to give them as thorough a knowledge as possible of electricity, in the shortest possible time. The instruction is given like you were working on various jobs, giving the explanation necessary for the understanding of the theory covered by the subject under discussion. There are many conditions which seldom occur in the every day run of electrical experience, and these conditions I lay particular stress on. This part of the instruction makes the course particularly attractive and valuable to those already engaged in active electrical work.

### It Is Up To You

The instruction work is laid out and given in a way easily understood. It is not a cut and dried book plan, but the les-

sons are prepared especially for the purpose for which they are used and additional instruction is given to the individual student, with a view of meeting his particular needs. I have the information to give and I believe the ability to impart it to others, a fact which is in a way proven by other institutions which have made use of my services in the design and perfecting of instruction courses. To understand this work, IT IS UP TO YOU to stick with me and I will surely stick with you till you understand any part of the work you have gone over.

### Practical Men Take My Course and Recommend it to Others

Sixty percent of my students are actively engaged in electrical work and find the instruction I give well suited to their needs. Several of these men have had their fellow workers take the course also and they are taking the instruction together making a class-room proposition of it and the results are in every way satisfactory to all concerned. One of these classes was started by a Chief Electrician, one of my students in Glen White, W. Va., who now has practically all the men under him taking my course. I believe the fact that these men who understand electrical work approve of my course to this extent is one of the strongest endorsements I could get.

### What Electrical Men Say Of My Course

In my catalog are letters from men I have taught, some being men I have taught when connected with other institutions years ago, and they are printed with a view of showing you that I have a clear, simple way of getting the information to one so it can be understood. I am printing here extracts from letters received recently from a few of my present students, from which you will note that they are in every way satisfied with the course and the method of handling the instruction.

This letter is from Stanley Dobson, of Moncton, New Brunswick. "I wish to say that I am well pleased with your method of teaching and I trust I will please you as well by my application to the lessons."

"Feeling that in your electrical course you offer a most practical system of training for anyone in the electrical work, I would refer you to a young man here in Moncton from whom you might secure an enrollment in your school. His name is Mr. Walter Stratton."

"I thought I would mention him to you as I have already recommended your school very highly."

This letter is from John Anderson, Farrall, Pennsylvania. "I am writing this so that you may know me better and know I am in earnest in taking this course. I am a foreman in this plant and all I have learned is through practice and that is the reason I want to learn more. The other day the Assistant Chief at this plant said to me that he had taken a course some time ago and I asked him about your course and he advised me to write to you. This man worked under me sometime ago and now I am working under him and I do not want it to happen again."

This letter is from Max Engleman, New York City. "Your first installment on the electrical course received and I went to work and liked the method of your instructions very well. You will find the answers to the examination questions attached to this letter. I am occupied as a waiter and would be only too glad to move into a real trade. Hoping to succeed and thanking you for your help, I am, yours very sincerely, Max Engleman."

This letter is from the same man two months later. "In the book review of the Electrical Experimenter, I saw a description of the Burgess Blue Book, which I would like to possess and wish you would mail me a copy. I have given up my

position as waiter and am now employed as electrician in the Ritz Carlton Hotel and so far like the work very much. With best regards, I am Yours very truly, Max Engleman."

Another letter from Mr. Engleman about a week later. "Your lessons together with your Blue Book received and I thank you very much, and I think it is like everything else that is connected with your name, really 'A No. 1.' My work in the hotel consists of work on motors, dumb waiters and elevators and from time to time I do repair work on small apparatus. Yours sincerely, Max Engleman."

The following is from J. L. Knight, Chief electrician of the coal mines at Glen White, West Virginia, who is taking my course together with a number of men who work under him. "I am just in receipt of your valued letter and am more than pleased with the suggestions and information therein and you can rest assured that I shall do all that is possible for the school and the boys and at the same time learn much myself. Speaking of the lessons I have never seen anything as interesting as they are, and, as soon as I got a new lesson I get right after it and don't stop until I think I have mastered the subject. Our assistant general manager looked over our lessons last night and he did not hesitate in saying that the lessons were the best that he had ever seen. He is a college man with a number of years' experience in the engineering business and knows a good thing when he sees it and I feel sure that he will write you regarding your work within the next days. We received the returns on the last lessons and all of us are more than pleased with the work that you are giving. I never saw a more enthusiastic bunch of men than they are over the lessons and everyone is buckled down to work and is going to try and make good. For myself, I wish to say that I took a course some years ago in electric railways and lighting and that I have gotten more out of your lessons thus far, and I know that if I live until I complete this course, with the knowledge that I will get out of it connected with the 14 years of practical experience, I shall be able to hold any kind of a position. Your school has a good write-up in the County paper this week and I have seen that due credit was given Mr. Yorke Burgess. I will send you a copy of this as soon as it is out. All of the boys are better pleased every day with the lessons and there is nothing but compliments for the Burgess Electrical School in this little town of Glen White."

### Fifty Fifty

I work absolutely on a 50-50 basis with my students. You pay me the comparatively low price I ask, and I give you the instruction and other help as is stated in my catalog. No student is permitted to pay cash for his entire course on starting, the course being paid for in small monthly payments as you go along. Students have the privilege of discontinuing the work if they should find that it was not just what they were after, and their payments stop at the same time. This is my way of doing business and I would not want your money when I was not giving you the instruction.

### Apparatus, Instruments, Material, Etc.

Certain electrical apparatus, instruments, material, charts, drafting implements, etc., as detailed in the catalog, are included in the course and are a part of the regular instruction for which there is no extra charge as it is covered by the regular monthly payments.

FILL OUT COUPON FOR ONE OF MY CATALOGS WHICH GIVES FULL INFORMATION

**BURGESS ELECTRICAL SCHOOL**  
745 E. 42nd St., Chicago, Ill.

**YORKE BURGESS,**  
**BURGESS ELECTRICAL SCHOOL,**  
745 East 42nd Street, Chicago, Illinois.

Gentlemen:—

Send me catalog describing your course in Electricity and Drafting.

NAME.....

ADDRESS.....

CITY.....

STATE.....

# CHEMISTRY



"The Joy of Father and Boy."

## "ELECTRO"

# Chemical Laboratory

We present herewith to our friends our new E. I. Co. Chemical Laboratory which contains real chemicals and apparatus 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, apparatus 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. See list of Chemicals herewith.

The apparatus furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparatus furnished with this outfit is printed also herewith.

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' Apborisms, 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.

**The price is still \$5.00**

Shipping Weight 10 lbs.

(Can be shipped by Express only.) Send your order today to:

It contains the following 44 chemicals:

Alum  $Al_2(SO_4)_3 \cdot (NH_4)_2SO_4$   
 Antimony (powdered) (Sb)  
 Ammonium Aqua  
 $(NH_3 + H_2O)$   
 Ammonium Carbonate  
 $(NH_4)_2CO_3$   
 Ammonium Chloride  $(NH_4Cl)$   
 Ammonium Sulphate  
 $(NH_4)_2SO_4$   
 Barium Chloride  $(BaCl_2)$   
 Boric Acid  $(H_3BO_3)$   
 Brimstone (Sulphur) (S)  
 Calcium Chloride  $(CaCl_2)$   
 Calcium Oxide (CaO)  
 Calcium Sulphate  
 $(CaSO_4 \cdot 2H_2O)$   
 Charcoal (Carbon) (C)  
 Chloride of Zinc  $(ZnCl_2)$   
 Copper Sulphate  $(CuSO_4)$   
 Ferrous Sulphate  $(FeSO_4)$   
 Ferrous Sulphide  $(FeS)$   
 Glycerol (Glycerine)  
 $C_3H_5(OH)_3$   
 Hydrochloric Acid (HCl)  
 Iodine (I)  
 Iron Chloride  $(FeCl_2)$   
 Iron Oxide  $(Fe_2O_3)$   
 Lead Acetate  $Pb(C_2H_3O_2)_2$   
 Litmus Paper  
 Magnesium Carbonate  
 $(MgCO_3)$   
 Manganese Dioxide  $(MnO_2)$   
 Mercury (Quicksilver) (Hg)  
 Nickel Chloride  $(NiCl_2)$   
 Oxalic Acid  $(H_2C_2O_4)$   
 Sodium Bicarbonate  
 $(NaHCO_3)$   
 Sodium Borate  $(Na_2B_4O_7)$   
 Sodium Carbonate  $(Na_2CO_3)$   
 Sodium Chloride (NaCl)  
 Sodium Nitrate  $(NaNO_3)$   
 Sodium Phosphate  
 $(Na_2HPO_4)$   
 Sodium Sulphate  $(Na_2SO_4)$   
 Sodium Sulphite  $(Na_2SO_3)$   
 Stannous Chloride  $(SnCl_2)$   
 Sulphate of Nickel  $(NiSO_4)$   
 Sulphate of Zinc  $(ZnSO_4)$   
 Sulphuric Acid  $(H_2SO_4)$   
 Tin (Granulated) (Sn)  
 Zinc (Metal) (Zn)  
 Zinc Carbonate  $(ZnCO_3)$

The following apparatus are furnished:

One Standard Washbottle  
 One Alcohol Lamp  
 One Conical Glass Measure  
 One Erlenmeyer Flask  
 One Glass Funnel  
 One Delivery Tube  
 Six Assorted Test-Tubes  
 One Test-Tube Holder  
 Ten Sheets of Filter Paper  
 One Glass Dropper  
 One Spoon Measure  
 Glass Tubing  
 One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.



**THE ELECTRO IMPORTING CO., Mfrs.**  
 231 FULTON STREET NEW YORK CITY



See our full page Ad, on page 88 for Free Cyclopeda

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

# Will Man Freeze the Earth to Death?

(Continued from page 8)

Rising prices and increasing scarcity surely will drive us to other fuels. Alcohol has been cited as a probability, mainly because it can be produced anywhere crops are grown. The truth of this matter is that if the fuel requirements of the world were to be supplied by the world's crops there would be no crops left to feed the world's inhabitants.

The final summation simply is that when coal and oil both give out we will have an era of substitutes beside which the war bread of the past year will be heavenly. We will scratch around, burn up all our forests, dig our peat bogs to the bottom, and do what we can to find other substances to supply the deficiency. All the substitutes will be costly, both from point of view of actual price and in point of efficiency. Those who cannot afford to use them will simply have to move toward the equator or freeze to death.

Radium is the one direct answer to the problem raised by this situation. True, it exists only in minute quantities in the earth's crust. True, under our present system of extraction it costs prohibitively. Still, it is the only logical answer.

Why? While radium is present only in proportions of from one to three grains per ton in the outer thirty miles of the earth's crust—excluding the oceans, of course, in which there is only a trace—there is sufficient of it in the upper two miles of crust to supply all possible power wants of man. The fact that it now costs us over a half-million dollars a pound to extract it is no argument. The scientific brains of the world never has been focust on the problem of securing radium. Only the inventive skill of a small number of people has been concerned with the processes of mining and extracting any kind of precious metal. With only a few dozen laboratories in the world knowing anything whatever about radium, the cost of securing the metal has been cut in half in the last four years. In the event that radium showed itself to be the only salvation for men outside of the equatorial zone, would not this cost be slaughtered? Would not radium be extracted by the ton instead of by the milligram? When it is considered that by the extraction of all the radium in a belt of land, ten miles wide by three miles deep, extending around the earth sufficient of the metal would be secured to run civilization just as it stands until eternity, without further outlay for power of any kind, does this seem impossible? It would be an undertaking for centuries, undoubtedly, but what of it? There would be little or no depreciation in the metal secured year by year, and every tiny particle mined and extracted would do away with the necessity for just so much other fuel. In case the project were started under Government or other competent supervision, the probability would be strong that the descending price curve of radium would cross the rising cost curve of other fuels in the course of from fifty to one hundred years.

The only alternative to this desperate plan that seems to be offered to our descendants is the piping of steam and hot air from the earth's interior. On a small scale this has been done already in Italy, but scientists have pointed out that serious disturbances, earthquakes, cracking of the crust and other disasters involving huge losses of human life would be certain to follow the experiment of trying this on a large scale. The trouble mainly would be caused by the sudden cooling of certain portions while the other parts remained in a molten state. The great catastrophe of a tremendous crack appearing in the middle

of the Pacific Ocean, with the resultant clouds of live steam and poison gas covering the earth and killing all animal and vegetable life, would be the great debacle most to be dreaded. Taking all into consideration, radium seems like the best and safest possibility.

One strange possibility which has an equally queer parallel in the case of radium extraction on a large scale is the quick doom which would face the earth if men piped all their heat from the earth's interior. Providing millions of these vents for power uses on all continents would cool the iron center of the earth speedily.

Under the present scheme of things, Professor Maurier estimates that the earth will cool to the temperature of the moon (-110 degrees Centigrade) in twenty-eight million years. Human life as we know it will have been extinct, in all probability, for twelve or thirteen million years of this term, unless man finds some material in which to clothe himself thru which body heat cannot pass, and grows his crops in huge heat-insulated greenhouses.

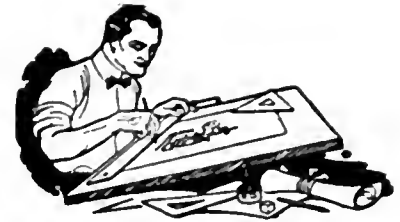
If the vents were opened, however, the heat of the earth's center would flood the atmosphere, even if used as economically as possible. It would rise to the outer edges of our air, coming into contact with the bleak (absolute zero) temperatures of the void, and cooling. Instead of the gradual change extending over millions of years, man would be confronted by a situation to which he probably could not adapt himself. The end of the world would come in ten thousand, yes, perhaps in five thousand years.

Even if the radium power system were inaugurated, something similar might take place, tho by no means as suddenly. Radium apparently was placed in the earth's crust for one particular purpose. That was to keep the earth from cooling off quickly.

We have seen that twenty pounds of radium would equal nine tons of anthracite in a year's time. The amount of radium in the thirty-mile crust of the earth, according to Professor Henri Becquerel of the French Academy, is sufficient almost to equalize the daily loss of heat thru the atmosphere! That means that if there were a little more radium in the earth this planet never would cool off at all! Also it means that if the earth were of the same consistency all the way thru, and not mostly molten iron or steel, the amount of radium being of the same proportion as at the surface, the globe would get hotter constantly. In the course of a few decades or centuries it would burst into flames and burn to a cinder.

The big point for us to grasp, however, lies in the fact that we are living now on earth solely because the crust contains radium. If this had not been the case the earth would have become cold and dead eons ago. If man, for any reason, becomes so grasping or in such dire necessity that he extracts all of the radium from the crust, he simply will be limiting his chances of a long stay very definitely.

This, however, is a remote possibility. The radium is scattered thru the whole crust to an average depth of thirty miles. Below this there is a highly heated tho solid zone in which there probably is a certain amount of radium. This zone extends eighty miles in depth, and below it is molten iron, the core of the earth. Man will have his hands full extracting the radium from the upper two or three miles of the crust. Since this will give him all he ever can need, unless the demands of future civilization grow much faster than any of our estimates figure, he would not touch the greater portion.



## EARN \$35 TO \$100 PER WEEK

### As a Mechanical Draftsman

#### Thousands of Men Wanted

You can learn Mechanical Drawing at home in your spare time through our practical Home Study Course and qualify for Big Pay. We have placed hundreds of our students in good paying positions. Government departments and private concerns are continually calling upon us for our graduates.

#### Become a Chief Draftsman

and get to the very top in this well-established and rapidly growing profession. The training given by the Columbia School of Drafting will give you just the knowledge you need to make good as a Chief Draftsman. No previous training is necessary. You can begin our course now and make rapid progress from the start under the Personal Instruction of the President of the School, Mr. Claflin, by mail. His carefully prepared lessons and personal letters of advice make each step easy and interesting.

#### Draftsmen Now Getting \$35 to \$100 a Week

with big chances for better pay as the demand grows. All big engineering, construction and manufacturing projects must first go through the drafting room before the workmen can commence. All such enterprises depend upon large numbers of draftsmen. Salaries are advancing steadily.

#### Drawing Outfit Free with Our Course

As soon as you enroll you will be sent our drawing outfit for your own use throughout the course. This entire outfit will be yours to keep. You are not obliged to return it after completing the course.

#### Not Only a Correspondence School

The Columbia School of Drafting is probably the largest residence school in the country specializing in the training of professional Draftsmen. Our Home Study Courses are an extension of the same instruction as given locally.

#### Illustrated Catalog FREE

Simply fill in the coupon below, return it to us and we will send you free a copy of our illustrated catalog which tells all about our practical Home Study Course and how you may secure our instructions at once on easy terms so as to quickly qualify for one of the big positions open.

Send This Coupon Today.

COLUMBIA SCHOOL OF DRAFTING  
Dept. 982, 14th and T Sts., Washington, D. C.

Without obligation to me, please send me your Illustrated Catalog and tell how I may secure your practical training in Drafting and your help in securing a position as Draftsman.

Name .....

Address .....

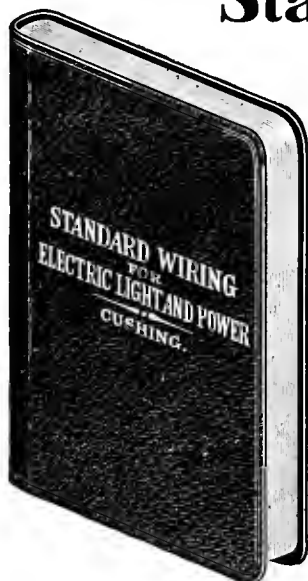
City..... State.....

"The National Authority on Electric Wiring for Twenty-Five Years"

## All You Need to Know About Wiring

is in the Latest Edition of

# "Standard Wiring"



**T**HIS year's edition, completely revised to date, is the only accurate book on electric light and power wiring and construction published.

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting or motor installation, for any voltage, current and drop desired for any system. Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

How to install and operate generators, motors and every kind of wiring device with diagrams of connections. Special chapters on illumination, House Wiring, Electrical Units and their Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc.

*It Will Make You an Expert Wireman*

**Leather Cover - Pocket Size - 375 Pages - Price \$1.50**

Sent to any address, postpaid, on receipt of price

**H. C. Cushing, Jr., 10 West 40th St., New York**

## New York Aero Show

(Continued from page 19)

ily imagined for the visitor was shown a complete composite photographic map of the city of Washington, D. C., which was taken from an airplane in a trip lasting but two hours and fourteen minutes. Hundreds of photos are taken by the rapid-fire cameras, and after developing and printing these have to be evenly matched and assembled. Large photographs taken about New York along the river, showing the ferry boats, etc., were taken during the afternoons of the different days, and the plates would be rushed to the aéro show, there developed and finished and prints made by the Army's photographic experts, the mounted photographs being on exhibit at the show in from one hour to an hour and one-half after they had been taken by the aviator flying above the city.

The machine gun exhibit attracted much attention, particularly the means used for synchronizing two machine guns on the battle-planes, so that they both fired dead ahead and thru the revolving propeller, the bullets passing accurately thru the spaces between the blades every time these spaces came in line with the machine gun barrels. The Packard Automobile Company, makers of the well-known Packard motor car, exhibited a new pleasure and battle-plane fitted with the Packard 12-cylinder aircraft engine, which somewhat resembles the Liberty motor. The Liberty motor, which was on exhibit, attracted considerable attention, and the number of these motors built by each of the large automobile concerns during the war were shown. There was a large sea-plane on exhibit which had flown to the show.

Speed enthusiasts in the flying world had their attention riveted on what was purported to be the fastest airplane in the world, the "Christmas Bullet," a small model of which was exhibited at the Aero Show. It was very well built, and the most remarkable feature of the design of the "Bullet" is that there are no struts between the planes, and also there are no guy wires, as in the usual types of monoplanes. The wings are supported by the cantilever principle, and besides they are *flexible*. The "Christmas Bullet" bi-plane is guaranteed to make 200 miles an hour, and it attained a speed of over 185 miles per hour on a recent trial flight, when equip with a six-cylinder 185 H.P. Liberty motor. It is claimed by its builders to be the safest and fastest airplane in the world. Not only this, but its lifting capacity compared to its size is greater than that of any other 'plane, it is stated. As will be evident, this ingenious design of 'plane is constructed on the principle of true bird flight, which therefore makes it self-balancing and serviceable in any kind of weather. The wing surface is 170 square feet, and the total weight is 2,100 pounds, which includes fuel for three hours.

This airplane is intended to play the rôle of the first "taxi-plane" ever used in steamship service, and is to be operated at the port of New York by one of the leading steamship companies for overtaking a ship a day out at sea with sacks of belated mail, dispatches, etc.

Among the interesting airplane engines exhibited at the Show was the well-known "Dusenbergs." This Company exhibited a powerful new model 12-cylinder aircraft engine, in which each set of six cylinders operated a separate crank shaft of its own. The power from the individual crank shafts was then transmitted to the propeller shaft by means of two gears, one on each side of the main driving gear secured to the propeller shaft.

## FREE TO THE RUPTURED

**DON'T WEAR A TRUSS**

**FREE TRIAL**

TRADE MARK  
STUART'S ADHESIVE  
PLAPAO PAD

DATE  
APRIL 5  
1919  
PLAPAO

Inner surface made self-adhesive purposely to prevent slipping and to keep constantly applied the absorbent-astringent medication called PLAPAO. Close the hernial opening as nature intended so the Rupture CAN'T come down.

PLAPAO EXIDES

THROUGH THIS

adhesive purposely to prevent

slipping and to keep constantly

applied the absorbent-astringent

medication called PLAPAO. Close

the hernial opening as nature

intended so the Rupture CAN'T

come down.

IT'S THE NON-SLIPPING  
YET, NON-RIGID PAD  
AND WHAT IS WITHIN  
... THAT COUNTS...



Awarded  
Gold Medal  
and Grand Prix.

### Do Away With Steel and Rubber Bands That Chafe and Pinch

You know by your own experience that the truss is a mere makeshift—a false prop against a collapsing wall—and that it is undermining your health. Why, then, continue to wear it? **STUART'S PLAPAO-PADS** are entirely different—being medicine applicators made self-adhesive purposely to prevent slipping and to hold the distended muscles securely in place. No straps, buckles or springs attached. No "digging in" or grinding pressure. **Soft as Velvet—Flexible—Easy to Apply—Inexpensive.** Continuous day and night treatment at home. No delay from work. Hundreds of people, old and young, have gone before an officer qualified to acknowledge oaths, and swore that the **PLAPAO-PADS** cured their Ruptures—some of them most aggravated cases—and of long standing.

### Send Today For FREE PLAPAO--No Charge for it--Now or Ever

Simply write your name and address below. Send this advertisement for absolutely **FREE TRIAL** PLAPAO and 48-page Book on Rupture. No charge for it—now or ever. Nothing to be returned. "Be wise today 'tis madness to defer." Address, **PLAPAO CO., Block 844, St. Louis, Mo.**

Name..... Address.....

GREEN AUTOMATIC MACHINE



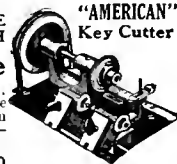
**ADD TO YOUR INCOME** WITH LITTLE EFFORT  
**\$5 to \$10** A DAY MADE EASY WITH

**New Improved Green Automatic Machine**

Sharpens, Hones and Straps all kinds of safety razor blades, in one operation, from four to six blades per minute. For both Quality and Quantity, this machine is in a class by itself. There is nothing like it on the market. Let us send you our free booklet explaining everything including the "AMERICAN" Key Cutter—cuts square, angular or round slots.

AMERICAN SHARPENING MACHINE CO. (Inc.), Dept E E, 184 W. Washington St., CHICAGO

"AMERICAN"  
Key Cutter





## The True Wireless

By Nikola Tesla

(Continued from page 30)

trates an arrangement described in my U. S. Patent No. 568178 of September 22, 1896, and corresponding dispositions of wireless apparatus. The captions of the individual diagrams are thought sufficiently explicit to dispense with further comment. I will merely remark that in this early record, in addition to indicating how any number of resonant circuits may be linked and regulated, I have shown the advantage of the proper timing of primary impulses and use of harmonics. In a farcical wireless suit in London, some engineers, reckless of their reputation, have claimed that my circuits were not at all attuned; in fact they asserted that I had looked upon resonance as a sort of wild and untamable beast!

It will be of interest to compare my system as first described in a Belgian patent of 1897 with the Hertz-wave system of that period. The significant differences between them will be observed at a glance. The first enables us to transmit economically energy to any distance and is of inestimable value; the latter is capable of a radius of only a few miles and is worthless. In the first there are no spark-gaps and the actions are enormously magnified by resonance. In both transmitter and receiver the currents are transformed and rendered more effective and suitable for the operation of any desired device. Properly constructed, my system is safe against static and other interference and the amount of energy which may be transmitted is billions of times greater than with the Hertzian which has none of these virtues, has never been used successfully and of which no trace can be found at present.

A well-advertised expert gave out a statement in 1899 that my apparatus did not work and that it would take 200 years before a message would be flashed across the Atlantic and he even accepted stolidly my congratulations on a supposed great feat. But subsequent examination of the records showed that my devices were secretly used all the time and ever since I learned of this I have treated these Borgia-Medici methods with the contempt in which they are held by all fair-minded men. The wholesale appropriation of my inventions was, however, not always without a diverting side. As an example to the point I may mention my oscillation transformer operating with an air gap. This was in turn replaced by a carbon arc, quenched gap, an atmosphere of hydrogen, argon or helium, by a mechanical break with oppositely rotating members, a mercury interrupter or some kind of a vacuum bulb and by such *tours de force* as many new "systems" have been produced. I refer to this of course, without the slightest ill-feeling, let us advance by all means. But I cannot help thinking how much better it would have been if the ingenious men, who have originated these "systems," had invented something of their own instead of depending on me altogether.

Before 1900 two most valuable improvements were made. One of these was my individualized system with transmitters emitting a wave-complex and receivers comprising separate tuned elements cooperatively associated. The underlying principle can be explained in a few words. Suppose that there are *n* simple vibrations suitable for use in wireless transmission, the probability that any one tune will be struck by an

extraneous disturbance is  $\frac{1}{n}$ . There will

then remain *n*-1 vibrations and the chance that one of these will be excited is  $\frac{1}{n-1}$ .

hence the probability that two tunes would

### WANTED!

#### OFFICE MEN

Auditors, Accountants, Office Managers, Credit Men, Cashiers, Bookkeepers and Cost Clerks—\$1,200 to \$7,500.

#### FACTORY MEN

Electrical and Mechanical Engineers, Factory Managers, Superintendents, Foremen, Designers, Draftsmen—\$1,500 to \$12,000.

#### CONSTRUCTION MEN

Civil and Structural Engineers, Transmitters, Construction Superintendents and Foremen, Estimators, Designers and Draftsmen—\$1,200 to \$10,000.

**TRADES**—Machinists and Tool-makers, Auto Repairers, Electricians, Stationary Engineers, Firemen, Plumbers, Carpenters, etc.—\$1,200 to \$2,000.

All these positions were advertised in a single issue of a Chicago newspaper

These books were written by experts in plain, everyday language. They are free from puzzling technical terms. Numerous illustrations, diagrams and tables make difficult points as simple as A-B-C. They are handsomely bound in half or full leather (except Law and Practice, which is bound in law buckram) and stamped in gold. Fill out the coupon.

#### Automobile Engineering

Five volumes, 2400 pages and 2000 illustrations. Prepares for Garage Foreman, Automobile Mechanic or Chauffeur. Invaluable to car owners. Regular price, \$25.00. Special price, \$17.50.

#### Machine Shop Practice

Six volumes, 2200 pages and 2500 illustrations. Prepares for Machine Shop Superintendent or Foreman, Foundryman, Pattern Maker, Tool Designer or Tool Maker. Regular price, \$30.00. Special price, \$19.50.

#### Sanitary, Heating and Ventilating Engineering

Four volumes, 1454 pages and more than 1400 illustrations, etc. Prepares for Sanitary Engineer, Heating and Ventilating Engineer, Master Plumber or Plumber. Regular price, \$20.00. Special price, \$13.50.

### 50c A WEEK

Yes, if you decide to keep the set you have selected, send \$2 within seven days and then \$2 a month (50c a week) until the present low price has been paid. Have you ever heard of a more generous offer? Remember, you take no chances whatever—we send the books for examination and you are not obliged to keep them if you do not care to buy. Mail the coupon now—before you turn the page.

#### Steam and Gas Engineering

Seven volumes, 3300 pages and 2500 illustrations, plates, diagrams, etc. Prepares for Stationary, Marine or Locomotive Engineer or Fireman. Regular price, \$35.00. Special price, \$21.50.

#### Law and Practice

(with Reading Course in 25 bound pamphlets). Thirteen volumes, 6000 pages and 24 illustrations. Prepares for all Bar Examinations. A wonderful aid to business men. Regular price, \$72.00. Special price, \$39.50.

#### Practical Accounting

Four volumes, 1840 pages and 800 illustrations, plates and diagrams. C. P. A. questions and practical problems. Prepares for Accountant, Bookkeeper or Cost Clerk. Regular price, \$20.00. Special price, \$12.50.

**Learn Watchwork, Jewelrywork and Engraving** A fine trade commanding a good salary, and your services are always in demand. Address HOBLOLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

# Which Job Can You Fill?

Which one of them could you fill? If you haven't the knowledge necessary to break into the *big-pay class*, decide to *get that knowledge NOW!* Any of the books listed below will quickly fit you for a well-paid job—at home—in your spare time.

#### Carpentry and Contracting

Five volumes, 2138 pages and more than 400 illustrations. Prepares for Contractor, Building Superintendent and Carpenter Foreman. Regular price, \$25.00. Special price, \$17.50.

#### Civil Engineering

Nine volumes, 8900 pages and 3000 illustrations, plates and diagrams. Prepares for Civil Structural Engineer, Transmitter, Estimator, Designer or Chief Draftsman. Regular price, \$45.00. Special price, \$29.50.

#### Telephony and Telegraphy

Four volumes, 1728 pages and 2000 illustrations, plates and diagrams. Prepares for Telephone Engineer, Wire Chief, Exchange Manager, Trouble Man or Telegrapher. Regular price, \$20.00. Special price, \$12.50.

#### Fire Prevention and Insurance

Four volumes, 1500 pages and 600 illustrations, diagrams, forms, etc. Prepares for Countyman, Rate Clerk, Inspector or Agent. Regular price, \$20.00. Special price, \$15.50.

#### Electrical Engineering

Seven volumes, 3000 pages and 2900 illustrations, plates and diagrams. Prepares for Electrical Engineer, Power Plant Superintendent, Substation Operator or Electrician. Regular price, \$35.00. Special price, \$19.50.

#### Accountancy and Business Management

Ten volumes, 3650 pages and 1987 illustrations, forms, etc. Prepares for Certified Public Accountant, Auditor, Office Manager, Accountant, Credit Man or Bookkeeper. Regular price, \$50.00. Special price, \$24.50.

## One Week Free Trial

We'll gladly send you any set for seven days' examination. Don't send us a penny; just pay the small shipping charge when the books arrive. Examine them carefully—use them at your work for an entire week. At the end of that time, if you feel they aren't worth far more than we ask, return them *at our expense*. If you keep them, pay the bargain price on the easy terms explained below.

#### American Technical Society

Dept. X3385 Chicago, U. S. A.

American Technical Society, Dept. X3385, Chicago, Ill.

Please send me set of \_\_\_\_\_ for 7 days' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send \$2 within 7 days and \$2 each month until I have paid the special price of \_\_\_\_\_. If I decide not to keep the books, I will return them by express at your expense. Title not to pass to me until the set is fully paid for.

Name \_\_\_\_\_

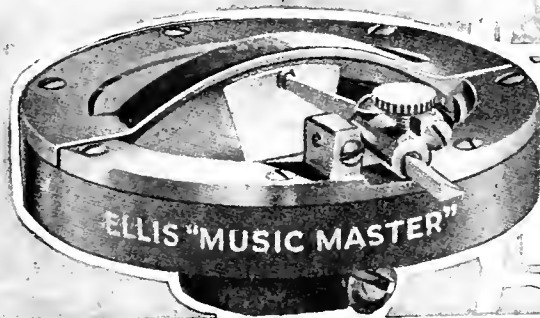
Address \_\_\_\_\_

Reference \_\_\_\_\_

#### WRITE THE WORDS FOR A SONG

We write music, guarantee publisher's acceptance. Submit poems on patriotism, love or any subject. CHESTER MUSIC COMPANY 918 S. Michigan Ave., Room 313 Chicago, Illinois

FOR THOSE WHO  
LOVE GOOD MUSIC



## The Ellis "Music Master" Reproducer

Will make your Talking Machine  
"The Soul of the Living Artist"

NO ordinary sound-box can reproduce a composition as originally played or sung by the artist. The true tone coloring is lacking—the beautiful overtones completely lost. And if not perfectly adjusted the ordinary reproducer vibrates, causing a harsh and shrill tone so commonly associated with mechanical music.

But with the Ellis "Music Master" Reproducer all this is changed. Every shade of expression that originally went into the record is faithfully and accurately reproduced. By its special, improved features and construction all harsh discordant sounds are eliminated and the music flows out in a clear, round tone exactly as if the artist himself were in your home, playing or singing at his very best.

You must hear the "Music-Master" to appreciate its great merit

It took 10 years of hard study and constant experimenting to develop this one reproducer that faithfully brings to life all there is in the record.

Words cannot convey to you an adequate idea of how much this wonderful device will do to improve the playing of records. You must see it—hear it—compare the effect with any and all other reproducers you know of; then you will understand why every music-lover owner of a phonograph who hears the "Music-Master" Reproducer wants to own one.

**J. H. ELLIS** Patentee and Manufacturer  
P. O. Box 882 MILWAUKEE, WIS.

Mail this Coupon Now!

J. H. ELLIS, P. O. Box 882, Milwaukee, Wis.

Please send me full information about the Ellis "Music-Master" Reproducer.

Name .....  
Address .....  
City ..... State .....

For all machines—  
Plays all Records

No matter what style, size or make of talking machine you have if it uses disc records you can use the Ellis "Music-Master" and enjoy the real music. Easily put on, it prolongs the life of the records, because it is much lighter in weight than other reproducers. And the price is so low that you cannot afford to be without it—it will double the worth of your instrument.

Write today for full details

Thousands of satisfied users attest to the real value of my reproducer. I want to send you some of their letters and tell you more about my "Music-Master". Fill in and mail the coupon below for full particulars. Ask for Circular E.

## Make Big Profits in Battery Charging



\$150 to \$250 Clear Profit Each Month recharging auto storage batteries. The HB 16-Battery Charger recharges 1 to 16 6-volt batteries or their equivalent at once with current cost of 12c to 15c per battery. Motorist pays 75c to \$1.50. Figure your profits! This season means bigger battery business than ever—more old cars driven—new Fords to have storage batteries. Get busy now! Don't delay! Start after those profits!

\$57 Puts This Money-Maker in Your Garage on Money-Back Guarantee

Balance in 10 monthly payments of \$23. each. Earnings pay for machine. No electrical knowledge necessary to operate. Uses 2 or 3 phase city current. Furnished complete with 2 charging panels capable of charging 1 to 8 batteries each. No adjustments or expensive renewals. Big, permanent profits. Sold on HB Absolute Money Back Guarantee. Order Now—you run no risk. Pin your check to this ad and mail today for trial order. Do it NOW!

Hobart Brothers Company, Box 5E, Troy, Ohio.  
Successful Manufacturers Since 1893.

be struck at the same time is  $\frac{1}{n(n-1)}$ . Similarly, for a combination of three the chance will be  $\frac{1}{n(n-1)(n-2)}$  and so on. It will be

readily seen that in this manner any desired degree of safety against the statics or other kind of disturbance can be attained provided the receiving apparatus is so designed that its operation is possible only thru the joint action of all the tuned element. This was a difficult problem which I have successfully solved so that now any desired number of simultaneous messages is practicable in the transmission thru the earth as well as thru artificial conductors.

The other invention, of still greater importance, is a peculiar oscillator enabling the transmission of energy without wires in any quantity that may ever be required for industrial use, to any distance, and with very high economy. It was the outcome of years of systematic study and investigation and wonders will be achieved by its means.

The prevailing misconception of the mechanism involved in the wireless transmission has been responsible for various unwarranted announcements which have misled the public and worked harm. By keeping steadily in mind that the transmission thru the earth is in every respect identical to that thru a straight wire, one will gain a clear understanding of the phenomena and will be able to judge correctly the merits of a new scheme. Without wishing to detract from the value of any plan that has been put forward I may say that they are devoid of novelty. So for instance in Fig. 12 arrangements of transmitting and receiving circuits are illustrated, which I have described in my U. S. Patent No. 613809 of November 8, 1898 on a Method of and Apparatus for Controlling Mechanism of Moving Vessels or Vehicles, and which have been recently dishd up as original discoveries. In other patents and technical publications I have suggested conductors in the ground as one of the obvious modifications indicated in Fig. 5.

For the same reason the statics are still the bane of the wireless. There is about as much virtue in the remedies recently proposed as in hair restorers. A small and compact apparatus has been produced which does away entirely with this trouble, at least in plants suitably remodelled.

Nothing is more important in the present phase of development of the wireless art than to dispose of the dominating erroneous ideas. With this object I shall advance a few arguments based on my own observations which prove that Hertz waves have little to do with the results obtained even at small distances.

In Fig. 13 a transmitter is shown radiating space waves of considerable frequency. It is generally believed that these waves pass along the earth's surface and thus affect the receivers. I can hardly think of anything more improbable than this "gliding wave" theory and the conception of the "guided wireless" which are contrary to all laws of action and reaction. Why should these disturbances cling to a conductor where they are counteracted by induced currents, when they can propagate in all other directions unimpeded? The fact is that the radiations of the transmitter passing along the earth's surface are soon extinguished, the height of the inactive zone indicated in the diagram being some function of the wave length, the bulk of the waves traversing freely the atmosphere. Terrestrial phenomena which I have noted conclusively show that there is no Heaviside layer, or if it exists, it is of no effect. It certainly would be unfortunate if the human race were thus imprisoned and forever without power to reach out into the depths of space.

The actions at a distance cannot be proportionate to the height of the antenna and the current in the same. I shall endeavor to make this clear by reference to diagram in Fig. 14. The elevated terminal charged to a high potential induces an equal and opposite charge in the earth and there are thus  $Q$  lines giving an average current  $I = 4Qn$  which circulates locally and is useless except that it adds to the momentum. A relatively small number of lines  $q$  however, go off to great distance and to these corresponds a mean current of  $i = 4qn$  to which is due the action at a distance. The total average current in the antenna is thus  $I_m = 4Qn + 4qn$  and its intensity is no criterion for the performance. The

electric efficiency of the antenna is  $\frac{q}{Q + q}$  and this is often a very small fraction.

Dr. L. W. Austin and Mr. J. L. Hogan have made quantitative measurements which are valuable, but far from supporting the Hertz wave theory they are evidences in disproof of the same, as will be easily perceived by taking the above facts into consideration. Dr. Austin's researches are especially useful and instructive and I regret that I cannot agree with him on this subject. I do not think that if his receiver was affected by Hertz waves he could ever establish such relations as he has found, but he would be likely to reach these results if the Hertz waves were in a large part eliminated. At great distance the space waves and the current waves are of equal energy, the former being merely an accompanying manifestation of the latter in accordance with the fundamental teachings of Maxwell.

It occurs to me here to ask the question—why have the Hertz waves been reduced from the original frequencies to those I have advocated for my system, when in so doing the activity of the transmitting apparatus has been reduced a billion fold? I can invite any expert to perform an experiment such as is illustrated in Fig. 15, which shows the classical Hertz oscillator and my grounded transmitting circuit. It is a fact which I have demonstrated that, altho we may have in the Hertz oscillator an activity thousands of times greater, the effect on the receiver is not to be compared to that of the grounded circuit. This shows that in the transmission from an airplane we are merely working thru a condenser, the capacity of which is a function of a logarithmic ratio between the length of the conductor and the distance from the ground. The receiver is affected in exactly the same manner as from an ordinary transmitter, the only difference being that there is a certain modification of the action which can be predetermined from the electrical constants. It is not at all difficult to maintain communication between an airplane and a station on the ground, on the contrary, the feat is very easy.

To mention another experiment in support of my view, I may refer to Fig. 16 in which two grounded circuits are shown excited by oscillations of the Hertzian order. It will be found that the antennas can be put out of parallelism without noticeable change in the action on the receiver, this proving that it is due to currents propagated thru the ground and not to space waves.

Particularly significant are the results obtained in cases illustrated in Figures 17 and 18. In the former an obstacle is shown in the path of the waves but unless the receiver is within the effective electrostatic influence of the mountain range, the signals are not appreciably weakened by the presence of the latter, because the currents pass under it and excite the circuit in the same way as if it were attached to an energized wire. If, as in Fig. 18, a second range happens to be beyond the receiver, it could only strengthen the Hertz wave effect by reflection, but as a matter of fact it detracts

(Continued on page 87)



# Learn Public Speaking

## 10 LESSONS FREE

Write — quick — for particulars of this extraordinary offer; an opportunity you will never forget if you take advantage of it. Ten lessons in effective public speaking absolutely FREE to those who act promptly, to introduce our course in localities where it is not already known.

We teach you by mail to become a powerful and convincing speaker—to influence and dominate the decisions of one man or an audience of a thousand. We have trained hundreds and helped them to increase their earnings and their popularity. Learn, in your spare time at home, how to overcome "stage fright" and conquer fear of others; how to enlarge your vocabulary; how to develop self-confidence and the qualities of leadership; how to RULE others by the power of your speech alone; how to train your memory. Our

### WHAT THE COURSE TEACHES YOU.

- How to talk before your club or lodge;
- How to address board meetings;
- How to propose and respond to toasts;
- How to make a political speech;
- How to tell entertaining stories;
- How to make after-dinner speeches;
- How to converse interestingly;
- How to write better letters;
- How to sell more goods;
- How to train your memory;
- How to enlarge your vocabulary;
- How to develop self-confidence;
- How to acquire a winning personality;
- How to strengthen your will power and ambition;
- How to become a clear, accurate thinker;
- How to develop your power of concentration;
- How to be the master of any situation.

### New Easy Method

perfected and taught only by Prof. R. E. Pattison Kline, former Dean of the Public Speaking Department of the Columbia College of Expression, can be learned in 15 minutes a day. Prof. Kline is one of the foremost authorities in the country on public speaking and mental development. Do not let this chance escape you.

## Offer Limited

Send This Free Coupon Now


This Special Offer of TEN LESSONS FREE is made strictly for advertising purposes and will be withdrawn without notice. Write now, before it expires, and receive full particulars with enrollment blank by return mail. No obligations of any kind. Just tear off and mail this free coupon—or a postal will do.

## FREE LESSONS COUPON

North American Institute,  
7445 Manhattan Bldg., Chicago

I am interested in your course in Effective Public Speaking and your offer of ten lessons free. Please send full particulars. It is understood that this request places me under no obligation of any kind.

**Pour Red, White and Blue from a Glass of Water**



You can mystify your friends with puzzling chemical tricks; write secret letters with invisible ink; make your own magic writing paper; pour your own blue ink or ink powder. Write with water and have it turn blue. You can pour seemingly plain water into three glasses and have it turn red, green, white, blue and blue in the third. Send twenty-five cents in stamps and get your outfit by mail, postpaid. If you send right away, we will enter your name to receive a copy of "The Chemcraft Chemist." It's a "Chemcraft" Junior Regular "CHEMCRAFT" Outfit at \$1.50, \$3.00 and \$5.00.

**25c.**

THE PORTER CHEMICAL CO.  
Arcade Building Hagerstown, Md. Postp'd

**Build Your Own PHONOGRAPH, It's Easy With Our Help**

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, turntable, prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer. Agents wanted for our ready built Phonographs.

**Choraleon Phonograph Co.**  
705 Monger Bldg., Elkhart, Ind.



**SAVE OVER HALF**

**ZIP-ZIP** Patented Sept. 3rd, 1918

The Greatest 50 Ct. Article on the Market. Shipped right from the factory the same day we receive your order. The Zip is made of beautiful metal; never breaks or wears out; scientifically made and best workmanship. The rubbers are elastic and lasting with plenty of pep and force. Zip-Zip, complete, only 50c prepaid. We guarantee the name Zip-Zip and our address appear on the article you buy. Order from us or any Sporting Goods Store in your city. Send Stamps, Coin or Money Order.

**AUTOMATIC RUBBER CO.**  
COLUMBIA, S. C.



**50 for ONE DRAWING PAID**

Illustrators—Cartoonists—Commercial Artists make big money extra at home in spare time by our new instruction method. Handsome booklet free expires every time. Write for it today. Get our Special Free Outfit offer.

**Washington School of Art, Inc.**  
1407 H St., N. W., Washington, D. C.



**NATIONAL TRADE DENTAL SCHOOL**

506 S. Wabash Ave., Chicago, Ill.

**LEARN MECHANICAL DENTISTRY—DEMAND UNLIMITED**

A paying professional trade. You will be a trained dental mechanic and receive our diploma when competent. Students given advantage of thoroughly up to date laboratory, and services of graduate Dental Surgeons on practical cases. No effort spared to place graduates advantageously. No age limit. Day or Evening. Individual instruction. No educational requirements. No book or home study. Easy terms. Highest references. Especially attractive proposition to those who write at once for catalog H.

**You Can RENT This Phonograph**

on our new plan! \$10 puts this Young's Superior Phonograph in your home on 30 Days' Trial! Plays all makes of disc records. Cabinet size, 47 ins. high. Rental applies on purchase. \$125 Value for \$62.50. Write for details of greatest phonograph bargain ever offered. Offer Limited. Write Today.

**YOUNG'S SUPERIOR PHONOGRAPH**  
62 W. Madison St. Dept. U. Chicago, Ill.



**GO INTO MOVING PICTURE BUSINESS**

**Small Capital Starts You**

on our easy payment plan. Begin now and get your share. We sell everything. Write today.

**Atlas Moving Picture Co.**  
Dept. 49 538 S. Dearborn St., Chicago

Our Catalog FREE. Show you how to earn \$25 to \$50 per day

**You can be quickly cured, if you STAMMER**

Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.

**Benjamin N. Bogue, 754 Bogue Building, Indianapolis**

**A WONDERFUL NEW INVENTION The Q. S. Target**

Hit! shoots about 100 feet, wooden arrows 20 to 30 feet, with surprising power and accuracy. Boys go wild over it, grown people find it most interesting. Send 10c. (all-very) for sample, terms, etc. Our Q. S. Target is the older boy and grown people. Send 3c. extra for postage and packing on single order. (Agents wanted.)

**THE Q. S. NOVELTY PISTOL CO.,** Oelansan, N. Y.

**EARN MONEY**

Stamping Names on Key Tags. \$50

Either sex. Spare time. Some make Send 25c for Tag with your name on and instructions. Returned if required. Exp. Key Tag Co., Cohoes, N. Y.



# My Inventions

(Continued from page 17)

lamp there. It was the exact spot which I had originally chosen.

So it went day after day with variations, but I was determined to achieve at whatever cost and in the end my efforts were rewarded. By the spring of 1884 all the differences were adjusted, the plant formally accepted, and I returned to Paris with pleasing anticipations. One of the administrators had promised me a liberal compensation in case I succeeded, as well as a fair consideration of the improvements I had made in their dynamos and I hoped to realize a substantial sum. There were three administrators whom I shall designate as A, B and C for convenience. When I called on A he told me that B had the say. This gentleman thought that only C could decide and the latter was quite sure that A alone had the power to act. After several laps of this *circulus viciosus*, it dawned upon me that my reward was a castle in Spain. The utter failure of my attempts to raise capital for development was another disappointment and when Mr. Batchellor prest me to go to America with a view of redesigning the Edison machines, I determined to try my fortunes in the Land of Golden Promise. But the chance was nearly mist. I liquified my modest assets, secured accommodations and found myself at the railroad station as the train was pulling out. At that moment I discovered that my money and tickets were gone. What to do was the question. Hercules had plenty of time to deliberate but I had to decide while running alongside the train with opposite feelings surging in my brain like condenser oscillations. Resolve, helped by dexterity, won out in the nick of time and upon passing thru the usual experiences, as trivial as unpleasant, I managed to embark for New York with the remnants of my belongings, some poems and articles I had written, and a package of calculations relating to solutions of an unsolvable integral and to my flying machine. During the voyage I sat most of the time at the stern of the ship watching for an opportunity to save somebody from a watery grave, without the slightest thought of danger. Later when I had absorbed some of the practical American sense I shivered at the recollection and marvelled at my former folly.

## Tesla in America

I wish that I could put in words my first impressions of this country. In the Arabian Tales I read how genii transported people into a land of dreams to live thru delightful adventures. My case was just the reverse. The genii had carried me from a world of dreams into one of realities. What I had left was beautiful, artistic and fascinating in every way; what I saw here was machined, rough and unattractive. A burly policeman was twirling his stick which looked to me as big as a log. I approached him politely with the request to direct me. "Six blocks down, then to the left," he said, with murder in his eyes. "Is this America?" I asked myself in painful surprise. "It is a century behind Europe in civilization." When I went abroad in 1889—five years having elapsed since my arrival here—I became convinced that it was more than one hundred years AHEAD of Europe and nothing has happened to this day to change my opinion.

## Tesla Meets Edison

The meeting with Edison was a memorable event in my life. I was amazed at this wonderful man who, without early advantages and scientific training, had accomplished so much. I had studied a dozen languages, delved in literature and art, and had spent my best years in libraries reading all sorts of stuff that fell into my hands, from Newton's "Principia" to the novels of Paul de Kock, and felt that most of my

life had been squandered. But it did not take long before I recognized that it was the best thing I could have done. Within a few weeks I had won Edison's confidence and it came about in this way.

The S. S. *Oregon*, the fastest passenger steamer at that time, had both of its lighting machines disabled and its sailing was delayed. As the superstructure had been built after their installation it was impossible to remove them from the hold. The predicament was a serious one and Edison was much annoyed. In the evening I took the necessary instruments with me and went aboard the vessel where I stayed for the night. The dynamos were in bad condition, having several short-circuits and breaks, but with the assistance of the crew I succeeded in putting them in good shape. At five o'clock in the morning, when passing along Fifth Avenue on my way to the shop, I met Edison with Batchellor and a few others as they were returning home to retire. "Here is our Parisian running around at night," he said. When I told him that I was coming from the *Oregon* and had repaired both machines, he looked at me in silence and walked away without another word. But when he had gone some distance I heard him remark: "Batchellor, this is a d—n good man," and from that time on I had full freedom in directing the work. For nearly a year my regular hours were from 10.30 A. M. until 5 o'clock the next

# MY NEW BOOK

## "Muscular Development"

will tell you how to get a wonderful muscular development like mine. perfect health, abundance of vitality and great strength as I have.

The results of my system are shown on my own person and that is recommendation enough. To give every one the opportunity to profit by what I have learned, I will mail my book, for a limited time only, on receipt of



**EARLE E. LIEDERMAN**  
Why not look as healthy and be as strong as I am?  
**EARLE LIEDERMAN, Dept. 208, 203 Broadway, N. Y.**

**10c Stamps or Coin**

This wonderful book will help you. It is profusely illustrated and contains pictures of many of the world's strongest men whom I have trained. Send for it today. Right now, while it is on your mind.

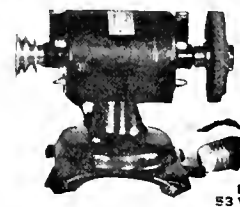
**Mechanics' Utility MOTOR GRINDER**

A Time-Saver and Money-Maker For Shop, Factory, Garage or Home

Attach to any electric light socket and you have a power unit which will do grinding of all descriptions as well as drive small machinery. Can be furnished with chuck end buff for buffing.

Type B—Complete with 4 in. by one-half in. Emery Wheel, \$3.50. Order today.

**RACINE UNIVERSAL MOTOR CO.**  
53 W. Jackson Blvd. Chicago, Ill.



# FRENCH WIRELESS

**FROG** made of steel with large clicker inside, used to learn telegraphy. GREAT FUN. SEND YOUR FRIENDS WIRELESS MESSAGES. SENT complete with code, and to make a big bundle we will send a Ford joke book, Parlor games, etc., all for 10c.

**10c**

Dept. 72, American Toy Co., Lowell, Mass., U.S.A.



**INDEX TO ELECTRICAL EXPERIMENTER**

FOR VOLUME 1, 2, 3, 4, 5

Price **15c.** Postpaid

**EXPERIMENTER PUBLISHING CO.**  
Book Dept. 231 Fulton St., N. Y.



morning without a day's exception. Edison said to me: "I have had many hard-working assistants but you take the cake." During this period I designed twenty-four different types of standard machines with short cores and of uniform pattern which replaced the old ones. The Manager had promised me fifty thousand dollars on the completion of this task but it turned out to be a practical joke. This gave me a painful shock and I resigned my position.

Immediately thereafter some people approached me with the proposal of forming an arc light company under my name, to which I agreed. Here finally was an opportunity to develop the motor, but when I broached the subject to my new associates they said: "No, we want the arc lamp. We don't care for this alternating current of yours." In 1886 my system of arc lighting was perfected and adopted for factory and municipal lighting, and I was free, but with no other possession than a beautifully engraved certificate of stock of hypothetical value. Then followed a period of struggle in the new medium for which I was not fitted, but the reward came in the end and in April, 1887, the Tesla Electric Company was organized, providing a laboratory and facilities. The motors I built there were exactly as I had imagined them. I made no attempt to improve the design, but merely reproduced the pictures as they appeared to my vision and the operation was always as I expected.

In the early part of 1888 an arrangement was made with the Westinghouse Company for the manufacture of the motors on a large scale. But great difficulties had still to be overcome. My system was based on the use of low frequency currents and the Westinghouse experts had adopted 133 cycles with the object of securing advantages in the transformation. They did not want to depart from their standard forms of apparatus and my efforts had to be concentrated upon adapting the motor to these conditions. Another necessity was to produce a motor capable of running efficiently at this frequency on two wires which was not easy of accomplishment.

At the close of 1889, however, my services in Pitsburg being no longer essential, I returned to New York and resumed experimental work in a laboratory on Grand Street, where I began immediately the design of high frequency machines. The problems of construction in this unexplored field were novel and quite peculiar and I encountered many difficulties. I rejected the inductor type, fearing that it might not yield perfect sine waves which were so important to resonant action. Had it not been for this I could have saved myself a great deal of labor. Another discouraging feature of the high frequency alternator seemed to be the inconstancy of speed which threatened to impose serious limitations to its use. I had already noted in my demonstrations before the American Institution of Electrical Engineers that several times the tune was lost, necessitating readjustment, and did not yet foresee, what I discovered long afterwards, a means of operating a machine of this kind at a speed constant to such a degree as not to vary more than a small fraction of one revolution between the extremes of load.

**The Invention of the Tesla Coil**

From many other considerations it appeared desirable to invent a simpler device for the production of electric oscillations. In 1856 Lord Kelvin had exposed the theory of the condenser discharge, but no practical application of that important knowledge was made. I saw the possibilities and undertook the development of induction apparatus on this principle. My progress was so rapid as to enable me to exhibit at my lecture in 1891 a coil giving sparks of five inches. On that occasion I frankly told the

(Continued on page 89)

**Don't Commit A Crime Against The Woman You Love**



LIONEL STRONGFORT

"Dr. Sargent of Harvard, declared that Strongfort is unquestionably the finest specimen of physical development ever seen."

**N**O AMOUNT of love will ever atone for the crime you will commit, if you make some pure, trusting young girl your wife when you are UNFIT to assume the duties and responsibilities of a husband and a father. Her whole future life, her body and soul, will be in YOUR keeping; no one will be able to help her if YOU prove faithless to her trust in you. Don't put the matter aside, you can't get away from it; you can't make any girl happy, if you are weak, impotent, sickly; grouchy with dyspepsia or biliousness, poisoned by constipation, or suffering from any other debilitating ailment. Stop and think, right now, for HER sake, if not for your own. What CAN her marriage to you bring her, but lifelong regret and sorrow, if you are only an apology for a man, with your muscles flabby, your blood like water and your brain woozy as a result of your condition.

**She Thinks You Are a Man**

She trusts, admires and loves what she THINKS you are—a real MAN, mentally, morally and physically, whom she can respect as well as love. She believes you to be a man who can look any other man in the eye and hold your own with him; who is able to protect her under any circumstances; who can make his way in the world and give her the comforts she has a right to expect from her husband; and finally who will ultimately make her the mother of healthy, happy children, a blessing to you both. Think of the kind of children you will make her the mother of if you are one of the great UNFIT! Think of the weak, ailing, rickety, defective boys and girls such men bring into the world—pitiable little creatures, with no chance in life, living reproaches to the father who begot them. Don't close your eyes to these things. They are facts; facts thoroughly understood by every breeder of dogs, cattle and horses; facts recognized by the legislators of several states, who would make it a LEGAL, as well as a MORAL, crime to marry when unfit.

**Make Yourself 100 Per Cent Fit**

Put your past behind you. What if you have led a gay life and sowed a big crop of wild oats? Start NOW to root them out. What if you have burned the candle at both ends and feel now like a human wreck, with your strength of body and mind dissipated and your vitality ebbing away? All the more reason why you should begin now, TODAY, to stop that steady loss, build up your strength again, regain your lost vitality and make a manly, red-blooded man of yourself. It's the ONLY thing to do—the only way to have any more happiness in life—the only way to keep from slipping down into the scrap heap of the hopelessly down-and-out—and you can do it, if you go about it the right way.

**Strongfort Will Show You How**

No matter what your work or business or occupation, you can build yourself up in my way without interfering with it in the least. I'll help you strengthen your heart, lungs, stomach and every other vital organ; I'll help you free yourself from dyspepsia, biliousness, constipation, catarrh or other chronic ailments; I'll help you steady your nerves and clear your brain and send the rich, red blood of life and vital energy coursing through your arteries again, so that you will be THE man your wife believes and expects you to be. I haven't any patented dope or bottled physic to sell you. I haven't any iron-bound, muscle-fatiguing, tiresome routine of exercises or straitlaced, ascetic living to recommend. I am a Builder Up of Men, and I build them up in Nature's way—the way that was successful in making me the strongest man in the world; the way that is succeeding with my pupils, thousands of them, in every country of the civilized world.

**Don't Be Discouraged**

Never mind how low down you have fallen; I don't care a rap what your present condition is or what brought you to it—I know I can improve you 100 per cent in a few short months. I am doing it every day for men who had given up all hope; bringing back their health and strength; making them respected members of society again; filling them with life, and ambition, pep and ginger, and enabling them to make a success in the world. I can do for you what I have done and am doing for others, and I WILL DO IT, if you will mark NOW, on the coupon below the trouble or troubles that are afflicting you, or the points you are most interested in, and MAIL IT TO ME TODAY. My free book, "Promotion and Conservation of Health, Strength and Mental Energy," will show you the quick, easy, sensible, manly way out of your difficulties; the way that has brought renewed hope and confidence and joy of living to thousands of other men; it will show you how to make yourself FIT to live; FIT to marry; or, if you are married already, it will help you become the father of healthy, happy, laughing children who will be a joy to you and your wife as long as you live. YOU WANT THAT BOOK.

**Do Your Part Now**

Do YOUR part, and I'll do MINE—I guarantee it. Fill out and send me the coupon, with three 2c stamps for postage and tacking on the free book, "Promotion and Conservation of Health, Strength and Mental Energy," and I'll send you with it, without charge, helpful, personal information on the conditions that are troubling you. DON'T DELAY—here's the coupon—Do your part NOW.

**LIONEL STRONGFORT**

Health and Strength Specialist

883 Strongfort Institute Newark, N. J.

**FREE CONSULTATION COUPON**

Mr. Lionel Strongfort, Newark, N. J.—Please send me your book, "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY," for postage of which I enclose three 2-cent stamps. I have marked (X) before the subject in which I am interested.

- ..Colds
- ..Catarrh
- ..Asthma
- ..Headache
- ..Thinness
- ..Rupture
- ..Lumbago
- ..Neuritis
- ..Neuralgia
- ..Flat Chest
- ..Deformity (describe)
- ..Insomnia
- ..Short Wind
- ..Flat Feet
- ..Stomach Disorders
- ..Constipation
- ..Torpid Liver
- ..Indigestion
- ..Nervousness
- ..Poor Memory
- ..Rheumatism
- ..Youthful Errors
- ..Vital Losses
- ..Impotency
- ..Gastritis
- ..Heartweakness
- ..Poor Circulation
- ..Skin Disorders
- ..Oedema
- ..Round Shoulders
- ..Lung Troubles
- ..Increased Weight
- ..Stoop
- ..Shoulders
- ..Muscular Development

Name .....

Age ..... Occupation .....

Street .....

City ..... State .....

**1/2 SAVED**  
GET OUR  
**BIG BOOK**



**DO Your Own PLUMBING AND HEATING at low cost**

Send for our big instructive 256 page well-bound Handy-Man Book Catalog. Every Home Owner, Contractor, Electrician, Farmer, Factory Manager, etc., needs it. Shows over 10,000 Fixtures and Supplies in plumbing and heating at wholesale. Shows how to save skilled labor, hard work and unnecessary material by

**OUR NEW Cut-to-fit-Method**



This wonderful book helps you select and install the proper Plumbing, Water Supply System, Hot Air, Water or Steam Plant. Besides being our Wholesale Catalog it lists many practical plans, diagrams, sketches, elevations, etc., showing how to do the work this newer, cut-to-fit way. Any handy man with a few tools can easily do his own installing with the aid of this

**Big Handy-Man Book**

We have spared no effort and have gone to a great expense to compile this valuable book. With economy still a national necessity, it would be unpatriotic to send this expensive book broadcast to non-interested parties. Therefore, we request a temporary deposit for each copy of 25c which we refund on first order, or we send our Bargain Bulletin Free. Address Today

**HARDIN-LAVIN COMPANY**  
40 Years At  
4510-20 Cottage Grove Ave., Chicago  
\$500,000 plants behind our guarantee

**I Earned \$2200 IN FOUR MONTHS**



**THIS is Richard A. Oldham. He earned \$2200.00 in four months with a Haywood Tire Repairing outfit. For 20 years he was telegraph operator on the Illinois Central Railway. He is now 58 years old. He answered my advertisement—quit his job—bought a plant and opened a business. He just wrote me "I have made more in eight months than 2 1/2 years as operator." There are now 500 stations where tire repairing is neglected.**

**I Must Have 500 Men To Fill These Positions**

I have a Big interesting Book to send you. It tells all about tires—gives inside figures and profit. Send for it! What Oldham and others are doing You can do. \$2500.00 to \$4,000.00 per year is conservative. Like Mr. Oldham—One machine will start you. Then open a shop. You can see business all around you. Put out a Haywood Sign and business will come to you. Now get started. Send for the Big Book and start making money.

**M. HAYWOOD, Pres.**  
**Haywood Tire & Equipment Co.**  
1209 Capitol Ave. Indianapolis, Ind.



**Learn to PAINT SIGNS and SHOW CARDS**

I teach you personally, by mail, in a short time. Oldest and largest School. Big field, work interesting. You can

**EARN \$18 TO \$45 A WEEK**

Fritzner, Minn., wrote: "Did job after first lesson, got \$10, profit \$7.06." Crawford, H. Ct. says: "Earned \$200.00 while taking course." Get literature, samples, guarantee; all FREE.

**DETROIT SCHOOL OF LETTERING**  
Established 1899, 655 D. S. of L. Bldg., DETROIT, MICH.



**FUTURE RAPID TRANSIT**  
(Continued from page 7)

an airplane and provided with planes or wings. This provision of planes on either side of the car renders it possible to modify their angle of incidence, to relieve the supporting rail of a larger part of the weight of the vehicle.

The aerial monoflier, as our artist has here depicted, may be propelled by means of one or more propellers placed either at one end of the car or at both ends, and in any case these could be electrically driven, the current necessary for operating the electric motors being taken thru appropriate contact shoes or brushes, resting in contact with insulated conducting rails fixed to the frame-work upon which the monorail is supported. The end view of the monoflier shows clearly the arrangement of the two third rails, one on either side of the monorail, constructed so that they may also serve to insure the maintenance of the car in the proper vertical position, by preventing any lateral displacement thereof. For the purpose of maintaining the car in the proper vertical position by virtue of the third rails just mentioned, there are provided two series of wheels inside the car, as the end view indicates, one set on either side of the monorail structure. From one end of the car to the other, the slot, as it might be called, slightly expands so that the car can negotiate curved sections of rails, which it could not do if the slot running thru the car from front to rear were made perfectly straight. The car is provided with electric lights and the usual protective features, such as electric braking means, electric fans in warm weather, signal lights, etc. The motorman, whose cab is placed in the forward part of the car, has full control of the electric propeller motors, and he can also change the angle of the planes, on either side of the monoflier, so as to cause it to practically float in the air when it is under full headway, the monorail passing thru its center merely acting as a guide rail along which it flies. Electric heaters could be used in the cold weather, and for heating coffee and cooking light meals, etc., in the buffet lunch on board, electric stoves would be available.

In general the monoflier is ovoid in form, thus following the latest practise in the design of dirigible airships, so that it will encounter the minimum of resistance from the air during its displacement. Such a craft should be easily able to attain a speed of 175 to 200 miles an hour and higher, as when it has attained its highest velocity and the planes are properly elevated, the craft will be practically floating in the air, without encountering any retarding friction from engagement with the monorail, excepting when passing around curves. Even here the friction which would normally be encountered might be reduced considerably if not entirely obviated by the provision of a proper air rudder at the rear of the car. When the car had reached the end of its run, owing to its peculiar ovoid shape, etc., it would have to be reversed in position before starting back, or else sent back to its destination by a parallel monorail system, which would undoubtedly be the usual practise, much in the manner shown in the accompanying view. Undoubtedly in the years to come, when such highly congested localities as New York City have become more and more built up with towering office structures, with a daily working population of say 12,000,000 to 15,000,000 people, and the subways and street elevated lines have become crowded to the limit of endurance, then it seems that such a system as this should serve a very useful purpose indeed.

If such a system as here illustrated were properly constructed and designed, it would not only serve as a fine piece of industrial engineering, but it would also give

**AN EASY WAY TO MAKE MONEY** Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made \$60.00 the first day." Others average \$200 to \$500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

**SHALER Tire Repair Outfit**

Improved Wrapped Tread Method Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

**FREE Book**  
"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

**C. A. SHALER CO.**  
2204 Fourth St. Wausau, Wisconsin



**THE MIDGET SLIDE RULE**



has many exclusive features. It will handle three factors at one setting and has a Log-Log Scale, Polyphase or Inverted Scale, Addition and Subtraction Scale, Square Root Scale and Binary Scale. It will add and subtract fractions and give decimal equivalents, multiply and divide fractions and mixed numbers. It will also give the Logarithms of Numbers and the Sines, Tangents, Cosines and Cotangents of all angles. An instruction book, "The Slide Rule Manual," 16 pages, 12 illustrations, is sent with each rule. Length of Logarithmic Scale, 12 inches. Diameter of rule, 4 inches. Body of rule made of 24 size steel, transparent celluloid indicators. Graduations printed in black on a white coating, figures large and easily read. Price, sent postage paid with instructions, \$1.00. Send for free descriptive circulars. Your money back if you are not satisfied.

**GILSON SLIDE RULE CO., Niles, Mich.**

Says the Master Mechanic, The Grab Automatic Grip Puller is a One-Man Puller—Quick-acting, strong and simple in the extreme. May be locked in any desired position. A combination of two or three arms. Heavy Duty Size capacity 1" to 1 1/2". Junior size capacity 1/2" to 7/8". Two sets of jaws furnished with each size.

**Ten Days' Trial** If your dealer or jobber does not have them we will send you one. Try it ten days. If not satisfactory, return to us and we will refund your money. We also make the GREB RIM TROL.

**THE GREB CO., 230 State Street, BOSTON**



Swing 4 in., 11 in. between centers, 17 in. total length. Shipping weight 13 lbs. Bed of lathe is machined. Workmanship first-class. Equipped with wood turning chuck. Can be fitted with 3 in. face plate and drill chuck as special equipment. Order now today. Price \$5.00 cash with order. **SYFHER MFG. CO., DEPT. C TOLEDO, OHIO**




**CONVERT YOUR BICYCLE INTO A MOTOR-CYCLE** Fits any wheel.

Best hill climber. Most reliable. More STEFFEY'S in use than all others. **LOWEST PRICES.** Cash or instalments. Send Stamp for circular.

Agents wanted.

**Steffey Mfg. Co., Dept. E, 5025 Brown St., Phila., Pa.**



**SMALL ENGINES**

Perfect Gasoline Engines—1/2, 1 and 1 1/2 h. p.—for Farm and Shop use. Price, \$27.50 and up. Also.

**WASHING MACHINES**  
We ship on trial. Send for Booklet and Special Offer.

**SIEVERKROPP ENGINE CO.**  
1401-19th St., Racine, Wis.


**STARTER for FORD CARS**



**SAVE 25% to 60%** on slightly used **GRAFLEX-KODAKS**

Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.

**CENTRAL CAMERA CO., Dept. 175, 124 S. Wabash Ave., Chicago**



**INSYDE TYRES Inner Atmor.**

for Auto Tires. Double mileage, prevent blow-outs and punctures. Easily applied to any tire. Thousands sold. Details free. Agents wanted.

**Amer. Accessories Co., Dept. 53, Cincinnati**



high speed traveling facilities for suburbanites, who have to travel ten to twelve miles every night and morning to and from business, such as those who live in the rapidly developing Westchester County section, where undoubtedly many hundred thousand of New York's future populace will reside, as well as those who will make their homes on Long Island.

As the illustration shows, the monoflier is divided into several floors, and if desired, each floor may be subdivided into compartments. The lower floor is preferably reserved for luggage, freight and mail, while the upper floor may be very well utilized for the electric motors operating the propellers and lifting planes. Stairways lead from the lower floors to the upper floor or floors, depending upon the size of the car. The main frame-work of the car is composed of rolled steel sections, and the rest of the structure including the floors and outer covering is of aluminum, the seams being electrically welded so as to present a perfectly smooth surface on the entire exterior in order to minimize the resistance to the air. The windows, which afford an excellent view to the passengers as they skim along over the tops of the skyscrapers far above the city and the surrounding country, are fitted with the new unbreakable glass. Also the outer contour of the windows and doors are made so as to fit very tightly and to preserve an even surface both vertically and horizontally for the purposes aforementioned.

Some other novel features involved in the design of this aerial monoflier, which seem to possess great practicability are as follows: The inventor points out that in order to impart greater stability to the car, its longitudinal axis should preferably be located below the top of the monorail. In other words, the greater part of the weight should be distributed on a line below the monorail level, which line is at a point about one-third the height of the car from the top of the same. The large wheels in the interior slot of the car, which rest on the upper or monorail, are heavily flanged. In order to provide against the possibility of the vehicle leaving the track vertically under the influence of the air pressure beneath its wings, the lower portion of the third rail rollers may be given a circular flange, which in the case under consideration would bear against the lower flange of these rails, and thus serve to maintain the car in contact with the rails. The car could be made longer as desired, but, of course, it could not be made too long, or otherwise it would be impossible to turn curves, unless they had very long radii.

Most probably the reader has become interested in the general working principles of such an aerial monoflier system, particularly in the probable arrangement of the stations, which could be of several types, as our illustration herewith shows. Some of the stations could be erected on the roofs of tall buildings where these were of appropriate height for the purpose, and in some cases where the railway past directly thru the tower of the skyscraper, the station could be built in the "hole in the wall", as it might be called. Each station could be designed in several ways—for instance, it might in some cases be provided with one platform, and the passengers on the monoflier in this case would have to descend from the upper to the lower floors by means of the stairways provided in the car, before reaching the station. The station platforms could be enclosed and provided with sliding doors, so as to be draft-proof in the cold weather, and high speed express elevators would carry the passengers from the aerial railway station to the street, or by taking a local elevator, they could alight on any floor of the building—all of which seems very good from a strictly engineer point of view.



## Different Metals Require Different Hack Saw Blades

If you want to cut structural steel or brass pipe efficiently, you need a different hack saw than for cast iron or machine steel, and you certainly can't work as coarse a blade in a light machine as in a heavy one. To try to do everything with the same blade is simply to do most of it inefficiently.

## Starrett Hack Saws

do the most work with the least effort and in the shortest time because each one is made to meet the exact requirements of different metals in different powered machines.

Our Hack Saw Chart will help you select the proper blade for any kind of work, and you can depend upon it. Our Service Department will help you solve your cutting problems and increase the efficiency of your cutting-off department.

Write us today. Ask for Catalog No. 21 LE.

### THE L. S. STARRETT COMPANY

The World's Greatest Toolmakers.  
Manufacturers of Hack Saws Unexcelled.

ATHOL, MASS.

NEW YORK

LONDON

CHICAGO

Starrett Hack Saw Chart		No. of Teeth	
Material to be Cut	Best Blade	Per Foot	Per Inch
Cast Iron	118	18	1.5
Machine Steel	118	18	1.5
Structural Steel	118	18	1.5
Brass	118	18	1.5
Aluminum	118	18	1.5
Stainless Steel	118	18	1.5
Soft Steel	118	18	1.5
Hard Steel	118	18	1.5
Cast Steel	118	18	1.5
Cast Brass	118	18	1.5
Cast Copper	118	18	1.5
Cast Lead	118	18	1.5
Cast Tin	118	18	1.5
Cast Zinc	118	18	1.5
Cast Nickel	118	18	1.5
Cast Iron	118	18	1.5
Cast Steel	118	18	1.5
Cast Brass	118	18	1.5
Cast Copper	118	18	1.5
Cast Lead	118	18	1.5
Cast Tin	118	18	1.5
Cast Zinc	118	18	1.5
Cast Nickel	118	18	1.5

42-908

## Learn Telegraphy-Wireless

Right In Your Own Home, in your spare time

Remarkable opportunities are offered experienced wireless operators and telegraphers. The demand is greater than the supply—steady positions at increased pay and rapid advancement are assured.



### Combination Wireless-Telegraphy Outfit



will soon make you an accomplished operator. Teaches Light and Sound Signals, both Radio and Morse. Outfit consists of exceptionally fine Telegraph Key, Buzzer, 3 Binding Posts, Lamp, Lamp Socket and Control Switch—all mounted on a highly finished base. Two outfits can be operated at considerable distance apart for sending and receiving practice.

**\$3.00**

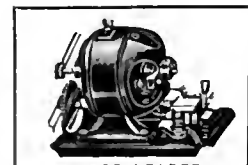
This Same Outfit Without Lamp **\$2.50**

Order to-day. Or your dealer can secure it for you. Descriptive circular and catalog of celebrated Knapp Motors and Electrical Specialties from 10c up mailed free on request.

**Knapp Electric & Novelty Co.**

523 West 51st Street

New York City



**KNAPP LEADER**  
Radiates real power-plant efficiency. Two Speeds and Reverse.  
Price, Complete, \$3.50

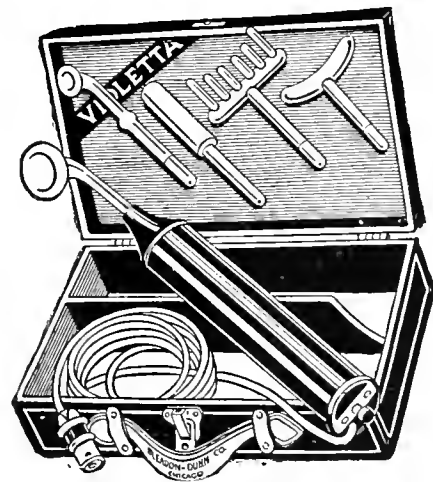


# VIOLET RAYS IN YOUR OWN HOME

Magic-Like Relief for

- Asthma
- Barbers' Itch
- Bells
- Blackheads
- Bunions
- Callous
- Catarrh
- Chilblains
- Colds
- Corns
- Constipation
- Dandruff
- Deafness
- Earache
- Eczema
- Eye Disease
- Falling Hair
- Hay Fever
- Headache
- Goitre
- Insomnia
- Lumbago
- Nervousness
- Neuralgia
- Neuritis
- Obesity
- Pains
- Paralysis
- Piles
- Pimples
- Pyorrhea
- Rheumatism
- Skin Diseases
- Sore Throat
- Sprains
- Tonsillitis
- Whooping Cough

## TRY THE VIOLETTA FREE



Now in your own home you can have wonderful Violet-Ray treatments exactly as are given by eminent physicians and beauty specialists throughout the country. Now you can rid yourself of headaches, catarrh, constipation, eczema, insomnia, lumbago, nervousness. Relieve your pain from neuritis, rheumatism, and other disturbances. Multiply your bodily health, vitalize your nerves, double or treble your energy by using Violet-Rays. Sleep better, increase your strength, and improve your appetite and digestion. Soothe your nerves, reduce or increase your flesh. Tone and strengthen the entire system. Beautify your complexion. All with Violet Rays!

## Not a Vibrator

The Violetta is not a Vibrator. It is not a machine that contracts the muscles—it does not shock, it does not pound the muscles—it is absolutely painless. Violet-Rays administered by the Violetta are wonderful even for infants. Relieve pain and suffering in every part of the body. Simple tests prove that Violet-Rays pass completely through every part of the body, stimulating every cell and organ. It is electricity in its highest remedial form.

## Read What Physicians and Users Say

Trixie Friganza, well known actress says "Cheerfully will I add my praise for Violetta. It's the best 'pain chaser' and 'soother' I've had the good fortune to find. It's WONDERFUL. It cured my brother of neuritis. As for myself I use it for facial treatments and general massage, I cannot say too much for it."

Dr. Bert H. Rice, of Vinton, Iowa, says: "I have good results with the Violetta High Frequency Instrument in all cases of neuralgia. Almost instant relief in Facial Neuralgia."

K. L. Allen, D. C., 205 Boone National Building, Boone, Iowa, says: "I have had very good results with the application of High Frequency Current in cases of Paralysis, Rheumatism and Neuritis and think it a great help in drugless healing."

Dr. Daniels, Lisbon, North Dakota, says: "Have used the VIOLETTA in such cases as Goitre, Bronchitis, Pleurisy, Neuritis, Neuralgia, and Lumbago, and find it very beneficial. In fact, I would not be without it in my office."

Frank Borzone, Seattle, Wash., says: "I purchased the VIOLETTA for my wife who was suffering from an acute attack of Sciatica. From the very first treatment it induced peaceful rest and she is entirely well now."



### Free Book Coupon

BLEADON-DUN CO.  
Dept. 2D,  
11 So. Desplaines St., Chicago, Ill.

Please send me your free book and 10 Days Trial offer on Violetta Violet-Ray Machine.

Name.....

Address.....

City.....

## BOOK FREE

Write today without fail. Mail coupon or just a postcard. Let us send you our 32-page beautifully illustrated free book, describing the Violetta in detail. Read the amazing phenomena produced by Violet-Ray High Frequency current. Why it produces stimulation and sedation. How to give spinal treatments with the Violetta, how to treat various ailments, including nervous troubles, rheumatism, obesity, hay-fever, skin treatments, facial treatments. Mail coupon or postal right now before you turn this page.

### BLEADON-DUN CO.

Dept. 2D

11 So. Desplaines Street Chicago, Ill.

## LOCATING ENEMY GUNS BY FLASH AND SOUND

(Continued from page 14)

As the name suggests, "sound ranging" is based for its operation on the transmission of sound, either thru the air or thru the earth, whenever a gun is fired. Some of this work is performed in conjunction with the flash spotters, for by observing the flash of a distant gun, and then counting the seconds on a split-second watch until the sound is heard, the distance at which the gun is located may be accurately computed, as the velocity of sound thru air is about 1,100 feet a second. The velocity of light is practically instantaneous, or 186,000 miles per second, and secondly it serves very accurately to consider the flash of the gun as the starting point of the onward journey of the sound wave. The accurate locating of any gun is accomplished by having two observers take telescopic or other sightings on the gun, and noting the distance between the two observers and the angles as measured on their respective instruments. Thus it is a simple matter to solve accurately by triangulation the definite location of the enemy cannon.

This is only one side of "sound ranging" science, however, as applied to modern artillery tactics, and the scientists and engineers connected with the work of the artillery, particularly the locating of enemy gun positions, early in the war worked out a highly sensitive sound detecting apparatus which picked up the sound of enemy guns, even at a great distance, as transmitted thru the earth. For this purpose detectaphones and Audion amplifiers prove highly efficacious. Enemy guns 15 miles distant were accurately located by this means, the same triangulation maneuvers as previously outlined being followed. Two and usually three observation (sound-detecting) points being employed, advantage being taken of the values as given by the velocity of sound when transmitted thru the earth, and also by the difference of time at which these sounds arrive at different sound-detecting stations. Used in conjunction with the regular angular measurements, the locating of enemy guns became as simple to General Pershing's artillerymen as weighing out a pound of butter would be to a groceryman.

## EXPERIMENTS IN RADIO-ACTIVITY.

Part III.

(Continued from page 35)

radio-activity noticed that radium induced an activity into substances placed in its vicinity. This induced activity was found to consist of an active deposit formed by the disintegrating radium. In the spintariscope the lens portion was found to assume this induced activity because of its proximity to the active substance. This may be easily shown by use of the electroscope, described in the first article.



Radiograph Taken by the Author, Using An E. I. Co. Spintariscope with Lens Removed. The Figure "U" Was Cut from Brass Sheet.

Using the spintariscope in the possession of the author, the following results were obtained:—empty, the electroscope discharged in 700 seconds; the lens portion was then removed and introduced into the electroscope. This time it only required 320 seconds. This conclusively shows that radium induces an activity into other objects exposed to its radiations. This induced activity, however, soon decays. Other uses for the spintariscope will suggest themselves to the reader, but in any case he will certainly never regret purchasing or else making one.

(To be continued)



**"Slickest Trick You Ever Saw"**



**ONE MINUTE**  
It's a roadster — with sturdy, roomy wagon-bed, big enough to haul ice, wood, and tools, an "every-thing." The next minute it's the niftiest speedster you ever saw—a real coaster, BUILT for coasting, with stream-line body, long and lean like a greyhound. The

**Auto-Wheel Convertible Roadster**

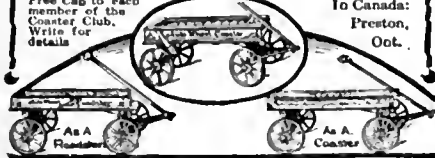
like its older brother, the Auto-Wheel Coaster, is built very much like an automobile, with oval spokes, roller-bearings, and steel axles. Tires of steel, to give long, hard service.

**FREE—FELT PENNANT**  
to every boy who sends us the names of three coaster wagon dealers, mentioning which one handles the Auto-Wheel. Our color catalog goes with pennant.

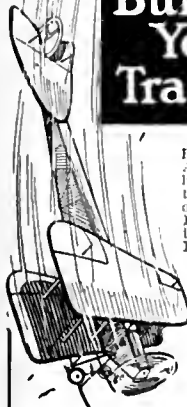
**BUFFALO SLED COMPANY,**  
153 Schenck Street, N. TONAWANDA, N. Y.

Free Cap to each member of the Coaster Club. Write for details

In Canada: Preston, Ont.



**BOYS Build and Fly Your Own Training Plane**



Train yourself in Aviation. Be an Amateur Aviator with an Aeroplane of your own. Learn how Aeroplanes are built; learn the principles of construction, operation and control. We sell IDEAL Accurate Scale Drawings, and Building and Flying Instructions which show you how to build a perfect Model Aeroplane, 3 ft. size, that will rise from the ground by its own power and fly like a big one. Send now for the Drawings and Instructions for the one you want to build.

**Drawings and Instructions for**  
Curtiss Military Tractor **25c**  
Bleriot Monoplane **EACH**  
Nieuport Monoplane **EACH**  
Taubie Monoplane **Set of Seven \$1.50**  
Curtiss Flying Boat **not sold**  
Wright Biplane **\$1.50**  
Cecil Push Racer **not sold**

**Ideal Model Aeroplane Catalog 5c—None Free**  
Tells about Model Aeroplanes, Racing Aeroplanes, Flying Toys, and parts and supplies to build them with. 48 pages. Sent only upon receipt of 5 cents.

**IDEAL AIRPLANE & SUPPLY COMPANY**  
159-161 Wooster St., New York City

**BOYS BUILD THIS CAR**



This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 24 cents for building plans and price list of parts showing how to build this lad's car.

**SYPPER MFG. CO.**  
156 Warren Street  
TOLEDO, OHIO.



**BIG BUNCH OF FUN 10c**

1 New Airship Game with Airships, 1 Chess and 1 Checkers Board and men, 1 Chinese 100-in-1, 1 Set Dominoes, 12 Other Games, 19 Lessons in Magic, 12 Money Making Secrets, Wireless Code, 18 Pictures Pretty Girls, 3 Puzzles, & New Ford Joke Book, All for the with large Catalogue.

Dept. 72

**American Toy Co., Lowell, Mass., U. S. A.**

**STAMPS**

50 diff. Belgium (large bi-color), China, Jamaica, Portugal, Venezuela, etc., 10c; 100 diff. nice packet, 20c; 1,000 w/mixed, 40c; 100 var. U. S., 50c; 1,000 blues, 10c; Arts. wanted, 50c. List free, 1 buy stamps. L. B. Dover, Overland, Mo.

**SCIENCE IN SLANG THE SPECKS IN SPACE**

(Continued from page 45)

last is one octillion, five hundred seventy-five septillion. The weight of the Sun is two octillion."

"Then the Sun weighs twenty-three decillion, forty nonillion grains," put in Punk.

"Approximately," returned Stokes, with his quaint smile.

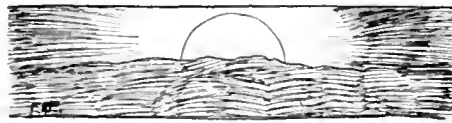
"Do you think that the lines of—er, force, or electricity, that are radiated from the Sun act upon the Earth turning on its diurnal axis and traveling in its course around the Sun in the same manner as the armature of a dynamo?" enquired Bill Dean.

"That is possible, I suppose. At least the radiations from the Sun are, more than likely, responsible for our electrical phenomena and along with it—but we do not know to what extent tho—plant and animal life.

"Some have one theory, some have another, but I would not be surprised at some new stuff that will do to our dope what Galileo did to the old 'Seven Stars' idea. From the thought that our planet was the center (natural to the more or less egotistical Man) of the universe, to the idea that the Sun was IT and then that the Pleiades are the center. Some say they are—we cannot disprove it, as far as I know of the matter. But that is not saying it is final. At present we have no way of peering way out into the infinite space and discerning the outer stellar orbs. With the innovation of the instrument that makes it possible, we will step on a stride further as Galileo did with his telescope, and discover other systems and the orbs that go to make up the system. The more, I believe, we go into the study of the universe and its gloriousness the more aware will we be of its true greatness and vastness.

"Now, as we have inches and feet as linear measurements, we have the distance between the Sun and Earth as the 'Astronomical Unit'—then, when ascertaining the distance of a star way out there in the vast infinite depths that we cannot reach or understand by figures nor even imagination, but can only term Space, by determining its parallax, we are only able to express its distance in 'Light Years'—and when you stop to consider that light travels at the rate of 186,000 miles per second—well buy a tablet and figure it for yourself. To our minds, we cannot conceive of anything without beginning nor end (excluding the circle), and to our minds things must have three dimensions to be understood by us. Now the universe has apparently no beginning nor end as far as we are able to discern.

At this point we drew up at a road house, or Inn. "How about a shot of raspberry juice into the neck to wash that ethereal discourse down," suggested Stokes, in his almost provoking anti-climactical tone and manner, as we entered the building.



**AN OMISSION**

We wish to state that credit for the photographs accompanying the article entitled "The City of Splendid Night," by Amos Stote, published in the January, 1919, issue, should have been given to the New York Edison Co.

Supplied with current from the light socket, a two-fan electric ventilator has been invented which, when set in a window, draws in fresh air and expels that already in a room.



**"I Can Succeed!"**

"What other men have done with the help of the International Correspondence Schools, I can do. If the I. C. S. have raised the salaries of other men, they can raise mine. If they have helped others to advance, they can help me. To me, I. C. S. means 'I CAN SUCCEED.'"

Make up your mind right now that not another day shall pass until you have made your start toward success.

For 27 years men in offices, stores, shops, factories, mines, railroads, and in the Army and Navy have been winning promotion and increased salaries through the I. C. S. More than 100,000 men and women are getting ready right now with I. C. S. help for the bigger jobs ahead.

No matter where you live, the I. C. S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter what career you may choose, some one of the 280 I. C. S. Courses will surely suit your needs.

When everything has been made easy for you—when one hour a day spent with the I. C. S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means—can you let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

**INTERNATIONAL CORRESPONDENCE SCHOOLS**  
BOX 6188, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- |  |   |
|--|---|
| <input type="checkbox"/> ELECTRICAL ENGINEER         | <input type="checkbox"/> SALESMANSHIP                                 |
| <input type="checkbox"/> Electric Lighting and Wires | <input type="checkbox"/> ADVERTISING                                  |
| <input type="checkbox"/> Electric Wiring             | <input type="checkbox"/> Window Trimmer                               |
| <input type="checkbox"/> Telegraph Engineer          | <input type="checkbox"/> Show Card Writer                             |
| <input type="checkbox"/> Telephone Work              | <input type="checkbox"/> Sign Painter                                 |
| <input type="checkbox"/> MECHANICAL ENGINEER         | <input type="checkbox"/> Railroad Trainman                            |
| <input type="checkbox"/> Mechanical Draftsman        | <input type="checkbox"/> ILLUSTRATING                                 |
| <input type="checkbox"/> Machine Shop Practices      | <input type="checkbox"/> Cartooning                                   |
| <input type="checkbox"/> Toolmaker                   | <input type="checkbox"/> BOOKKEEPER                                   |
| <input type="checkbox"/> Gas Engine Operating        | <input type="checkbox"/> Stenographer and Typist                      |
| <input type="checkbox"/> CIVIL ENGINEER              | <input type="checkbox"/> Cert. Pub. Accountant                        |
| <input type="checkbox"/> Surveying and Mapping       | <input type="checkbox"/> TRAFFIC MANAGER                              |
| <input type="checkbox"/> MINE FOREMAN or ENGINEER    | <input type="checkbox"/> Railway Accountant                           |
| <input type="checkbox"/> STATUE MARY ENGINEER        | <input type="checkbox"/> Commercial Law                               |
| <input type="checkbox"/> Marine Engineer             | <input type="checkbox"/> GOOD ENGLISH                                 |
| <input type="checkbox"/> Ship Draftsman              | <input type="checkbox"/> Teacher                                      |
| <input type="checkbox"/> ARCHITECT                   | <input type="checkbox"/> Common School Subjects                       |
| <input type="checkbox"/> Contractor and Builder      | <input type="checkbox"/> Mathematics                                  |
| <input type="checkbox"/> Architectural Draftsman     | <input type="checkbox"/> CIVIL SERVICE                                |
| <input type="checkbox"/> Concrete Builder            | <input type="checkbox"/> Railway Mail Clerk                           |
| <input type="checkbox"/> Structural Engineer         | <input type="checkbox"/> Navigation                                   |
| <input type="checkbox"/> PLUMBING AND HEATING        | <input type="checkbox"/> AUTOBOMILE OPERATING                         |
| <input type="checkbox"/> Sheet Metal Worker          | <input type="checkbox"/> Auto Repairing                               |
| <input type="checkbox"/> Textile Overseer or Supt.   | <input type="checkbox"/> Navigation                                   |
| <input type="checkbox"/> CHEMIST                     | <input type="checkbox"/> AGRICULTURE <input type="checkbox"/> Spanish |
|  | <input type="checkbox"/> French <input type="checkbox"/> Italian      |

Name \_\_\_\_\_  
Present Occupation \_\_\_\_\_  
Street and No. \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

**TYPEWRITERS**  
\$10 AND UP. ALL MAKES. SAVE \$25 TO \$50 on rebuilt at the factory by the well-known "Young Process" Sold for low cash—installment or rented. Rental applies on purchase price. Write for full details and guarantee. Free trial. **YOUNG TYPEWRITER CO., Dept. 618, Chicago**

# Some Government War Secrets

—and the reason for the Victory Liberty Loan

"**W**E HAD promised the Allied war-chiefs that we would have in France by July of last year, 600,000 men. On that date we had a little over 1,900,000. We had behind them nearly 2,000,000 in this country under training who would have been on the front before July, 1919, and we had behind those 4,000,000 men as many more men as were necessary to do the job.

"Four million men in France meant at least 20,000,000 tons dead weight of shipping to take care of them, and we had that program under way and were making our maximum output just about the time the armistice was signed. Twenty million tons of shipping at present cost means just about \$4,000,000,000 or a little over.

"Did you know that those 2,000,000 men in France, who did so much to bring the war to an end, had only one small battery of American-made artillery behind them; just one battery of 4.7 and a few big naval rifles! The rest of the artillery used by the American soldiers was made by Frenchmen in France. But, on the way was a great stream of guns and shells that would have blown the German army off the earth. But that stuff had just come into large production in November, 1918. And it is for the deliveries on that big peak production that we have to pay in December and January and will have to continue to pay for in February."

\* \* \*

"Our program for tanks, of which few got into action, was, I have been told, to provide for a tank in 1919 for every 75 feet of the front."

\* \* \*

"Those are some of the things that cost money, and practically none of those great supplies of artillery, of shells or tanks, even of ships, practically none of that stuff was ever used. What an awful waste! We are asked to pay for a dead horse that never drew a load! It is discouraging, paying for something that is no good!

"Well, let's see if it's any good. Do you realize that the German army was never really routed; that except for a little bit of a stretch down in Alsace-

Lorraine it was never fighting on German soil? They were brave soldiers, the German soldiers. They still had millions of them on the Western front. And yet they surrendered while they were on foreign soil. They had a fleet which had required years and years and years to build and it flew the white flag without firing a shot."

\* \* \*

"I cannot believe that these great stores of munitions were wasted. In addition to the bravery of the American doughboy that arrived in France and got into action in numbers about the 15th of July and turned the tide and drove the Germans back, in addition to his bravery and his almost reckless spirit of determination, for which the praise cannot be too high, I say in addition to that, I believe there was one other factor that brought this war to an end at least one year before the most optimistic of us had dared to hope for. One other factor, and that was that Germany, her general staff, knew that back of the few hundred thousand Americans that really got into big action, and back of the 2,000,000 in France, was another 2,000,000 ready; and despite the fact that we had practically no artillery of American make on the Western front, that there was a great stream of American-made artillery on the way. And it is my conviction that the German staff knew that if they prolonged the war into 1919, they were inviting, not certain defeat, but certain annihilation."

\* \* \*

"We are asked to pay for things that were never used; we are asked to pay for shells that never were fired; for cannon that never reached the battlefield, but we are asked to pay for those things that helped in a major way to bring this war to an end in 1918 instead of 1919. And the bringing of this war to an end twelve months before we could logically look for it means that we are asked to pay for saving the lives of 100,000 or 200,000 American boys who would have died on foreign soil had the war continued another year."

—Extracts from a speech by Hon. Lewis B. Franklin,  
Director War Loan Organization, U. S. Treasury Department.



The "Clean-up"  
Button

# Victory Liberty Loan

Space contributed by

**ELECTRICAL EXPERIMENTER**  
SCIENCE & INVENTION

Prepared by American Association of Advertising Agencies cooperating with United States Treasury Department

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.



Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries address to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of \$1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

**NOTICE TO CORRESPONDENTS**

Questions on Patent Advice are answered in this department every month, and naturally each question must take its turn. We have received so many letters during the past months that it is absolutely impossible for us to answer them all in the "Experimenter." Thus, for instance, the answers appearing in this issue are of letters going back as far as Oct., 1918. We would therefore urge our correspondents to bear this in mind, and if an answer is wanted quickly, correspondents should make themselves acquainted with the rules printed above.

**Sectional Automobile Radiator**

(318) Edwin Schade, Camden, N. J., writes: "I have noted in a recent magazine a photograph of a pile of automobile radiators that have been damaged in the war. It has been my experience in repairing the present type of radiator that it takes anywhere from one-half hour to as high as three days to fix a leak. This is true especially when it happens to be in the interior. My idea is to build a radiator in units. Should one or more units be damaged, they could be replaced by others in a very short time. Kindly advise if such an idea would be of any benefit, and if it could be patented."

A. It is doubtful that a device of this kind would prove satisfactory, for the reason that there would probably be a good deal of trouble to interconnect the various sections, and there would probably be just as much trouble in keeping these connections from leaking as in a well-made radiator. That a device of this kind can be patented is also very doubtful to us.

**Telephone Appliance**

(319) R. C. Kennan, Indianapolis, Ind., submits a drawing and description of a telephone appliance which is designed primarily to eliminate trouble for the man who talks several feet away from the phone and expects people to hear him on the other end of the line. The arrangement also permits using the phone without holding the receiver in the hand. Our correspondent wishes our advice if this device is patentable and if we think a market exists for such a device.

A. This is one of those devices of which probably five thousand have been patented in various forms in the past. Our correspondent's device has a lever at the end of which the receiver is fastened. The arm and the receiver swing in a half circle, and is then locked. The subscriber can then talk without using his hands. The hook connection is automatically established as soon as the lever is raised.

A. There is nothing new to this and, as we stated, many thousand similar ones have been patented in the past. There does not seem, moreover, to be a market for such an appliance.

**Trolley**

(320) Frederick E. Barter, Syracuse, N. Y., encloses a sketch and description of a device to keep the pole of a trolley from jumping off the wire. Our advice is asked.

A. We have expressed our views as to trolleys a great many times in these columns. Our advice to trolley inventors is: "don't". Our ideas were fully expressed in a recent answer to one of our correspondents in these columns. We refer to our March issue, page 825, Patent Advice No. 308.

**Magazine Mailer**

(321) Carlyle Rudolph, Minneapolis, Minn., says: "Is there such a thing as a magazine mailer? A machine that folds, wraps, stamps and gets magazines all ready for mailing. I have an idea which I think is worth something, but don't like to start on it until I know if there is anything similar in use."

A. There are certainly machines to do this. For instance, the ELECTRICAL EXPERIMENTER is folded and wrapped every month on a machine of this kind. While the machine does not automatically stamp the wrappers, this, however, can readily be accomplished by a simple attachment on the market now. If our correspondent has something fundamentally new, he is advised to get in touch with any of the large printing houses who have such machines and he can hear from them as to what the requirements are.

**Safety Elevator Device**

(322) Ralph E. Hast, Elkins, W. Va., explains his invention as follows: "The idea of this invention is to have a device on elevator doors which, when the doors were closed, would close a circuit, allowing the operator to ascend or descend, but when the doors are not closed the circuit would be open, thus rendering it impossible to operate the elevator. The device on the doors would be a partly concealed socket which operates easily but forms a constant circuit when closed and cannot be jarred out of place."

A. There is nothing new in our correspondent's idea. Safety devices of this kind have been used for many years, and are in use right now. Take for instance the New York Subway Elevators, particularly the ones at 181st Street and Broadway, operate with this device.

**Depth Bomb**

(323) George W. Curtis, Detroit, Mich., has invented a depth bomb which works on the sea water-conductivity plan by means of which contacts are closed when the sea water enters the intake of the bomb. Our advice is asked as to the practicality of this device.

A. There is nothing new about this device—many bombs of this kind having been proposed during the war. The regular depth bombs, however, working on the hydro-static principle, are very much simpler and better.

**U.S. PATENTS**



**SEND FOR THIS FORM**

**Don't Lose Your Rights**

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.



255 OURAY BLDG., WASHINGTON, D. C.

**PATENTS**

**TO THE MAN WITH AN IDEA**

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

**RICHARD B. OWEN, Patent Lawyer**  
164 Owen Building, Washington, D. C.  
2276-B Woolworth Bldg., New York City

**PATENTS TRADE-MARKS AND COPYRIGHTS**

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature.

Our illustrated Guide Book, HOW TO OBTAIN A PATENT, sent Free on request. Contains full instructions regarding Patents, Trade-Marks, Foreign Patents, Our Methods, Terms and 100 Mechanical Movements illustrated and described. Articles on Patent Practice and Procedure, and Law Points for inventors. An actual search of United States patents made in all cases before preparing application for patent. **Electrical Cases a Specialty Highest References Prompt Attention Reasonable Terms**

**FREE COUPON!**

**VICTOR J. EVANS & CO., Patent Attorneys**

New York Offices: 1001 to 1007 Woolworth Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St.  
Main Offices: 779 Ninth Street, N. W., Washington, D. C.

Name .. Address ..


  
**U.S. PATENTS**

Our facilities for securing patents enable us to give prompt and reliable service at reasonable rates. Inventors are invited to write to us regarding questions appertaining to securing patent protection. All matters receive prompt attention. Send sketch for preliminary examination.

*Books free on request*

**A. M. BUCK & CO.**  
*Patent Attorneys*

205 Second National Bank Bldg.,  
 Washington, D. C.

**PATENTS**
  
**LACEY & LACEY**

Attorneys-at-Law—Patent Practice Exclusively  
 Solicitors of

**U. S. and Foreign Patents**  
 Trade-Marks, Copyrights

639 F Street, N. W., Washington, D. C.

*Write Us for Our Free Inventors' Book*  
**PATENT-SENSE**  
 ESTABLISHED 1869

**PATENTS**

INVENTORS: Send us sketches or a model of your invention and a description of the device for advice in regard to the best way of obtaining patent protection. Our practical experience covers a period of twenty years. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today.

**TALBERT & TALBERT**  
*Patent Lawyers*

4287 Talbert Bldg. Washington, D. C.

**Competent Patent Service**

By a Former Examining Official  
 of the U. S. Patent Office

**NORMAN T. WHITAKER**  
*Lawyer and Engineer*

480 Whitaker Bldg. Washington, D. C.  
 Branch Office, 87 Nassau St., New York City.

**INQUIRIES INVITED**

**PATENTS**

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing assure fullest value and protection to the inventor. Patents procured through us receive free notice in *Scientific American*.

MUNN & CO., 618 Woolworth Bldg., N. Y.  
 Washington Office, 625 F St., Washington, D. C.

**STAMMERER**

Send 10 cents for my remarkable book, "How To Stop Stammering." Kill the fear of stammering. Re-education the key.

The Hatfield Institute, 109 N. Dearborn St., Chicago, Ill.



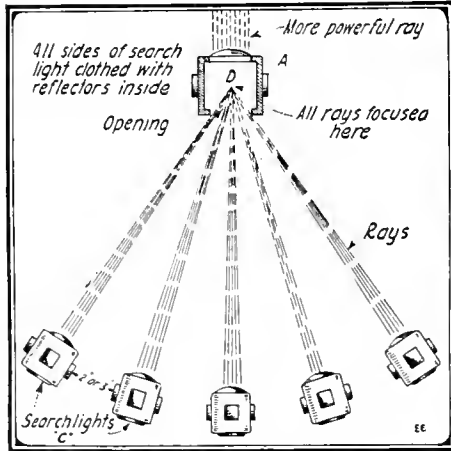
**Phonograph Needle**

(324) R. W. Napper, B. Guiana, S. America, asks us: "Do you think that a patent of any value could be secured on a double-ended gramophone needle, i. e., a needle sharpened at both ends? This would tend to save steel, as each needle could be used twice instead of only once."

A. We do not think that a needle of this kind would be of great benefit and we believe a needle of this kind was once tried. The reason is that a needle of this sort cannot be held as securely as one with the squared off end; it tends to rattle because the upper end is not supported except by a sharp point.

**Searchlight**

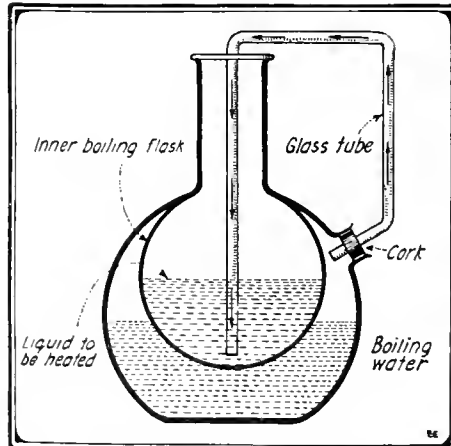
(325) Joel Silver, Newark, N. J., submits the following idea: "I think that if about five searchlights have their rays focused on the inside of another larger searchlight (see illustration) there will be more power; hence a small searchlight, with the aid of others, can be made more powerful. The rear of the main light (A) is cut open (B). All the searchlights (C) have their rays focused upon the center (D) of A. With very good reflectors and a very powerful lens, I am quite sure that a longer distance will be obtained. That is, it will be five times as powerful as one of its size."



A. While the idea is ingenious and no doubt novel, it certainly is not practical, for nothing could be gained either electrically or economically to arrange the searchlights as shown. The reason is that one searchlight can be made to give the same amount of light by using large enough carbons and consuming a corresponding amount of current. Of course, a multiplicity of searchlights are used in a great many cases, but not to concentrate the light on a point. They are usually employed to throw the light over an extended surface.

**Chemical Flask**

(326) Eug. Lavigne, Montreal, Can., submits diagram and sketch of a combined water bath and boiling flask. It is shown in our illustration. He wishes to know if this idea is patentable and if it is practicable.



A. While no doubt a patent could be obtained on this device, we do not think it would be of much value for the reason that it could be used only in very few cases. As our illustration shows, the evaporating water would flow into the central flask and it is quite certain that more or less water would find its way into the central flask, where surely it is not wanted or needed. This is our main objection to the idea.

In the June issue: "HOW TO FINANCE AND MANUFACTURE A PATENT," by Jay C. Hobson.  
 A very important article for all interested in patents.

**Patents Promptly Procured**

Send sketch or model for actual search of U. S. Patents. Highest references. Personal service. Moderate fees. Write for Free Patent Book.

**GEORGE P. KIMMEL, Patent Lawyer**  
 99-T Loan & Trust Bldg. Washington, D. C.

**PATENTS**

Inventors Invited to Write for Information and Particulars  
 Highest References. Best Results. Promptness Assured.

**WATSON E. COLEMAN**  
*Patent Lawyer*


624 F Street N. W. Washington, D. C.

**How to Get Rid of Moles**

A simple, safe home treatment—15 years' success in my practice. Moles (also BIG growths) Dry Up.

Ask for Free Booklet of Full Particulars

**WM. DAVIS, M. D.**  
 1140 State Street Perth Amboy, N. J.



**LEARN WATCH REPAIRING**

You can learn by our modern and original system of instruction every part of the Watch Repairing Trade at home as good or better than at a shop. You can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from \$20 to \$35 per week. For particulars apply to the

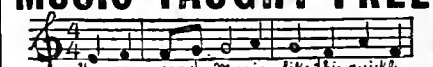
Milwaukee School of Watchmaking 165 Mason St., Milwaukee, Wis



**MUSIC TAUGHT FREE**

You can read Music like this quickly

In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils. American School of Music, 57 Lakeside Bldg., Chicago



**"Hang Your Own Lighting Fixtures"**

One Light Bracket \$1.05—4 Light Shower \$6.15  
 Semi-Bowls \$5.85—Plate & Ball 85c, complete with glassware, Wired, Fine finishes. Send for Photos complete line.

**ERIE FIXTURE SUPPLY CO.**  
 Sta. C., Erie, Pa.

**SELENIUM CELLS**

Guaranteed 99% pure selenium

Made by people who know their business, for the most difficult work, requiring very sensitive, quick acting cells.

Special cells to order.  
**THE SELENIUM LABORATORIES.**  
 New York Offices, 56 West 45th St.

**EASIEST SHORTHAND**

Learn in 8 evenings home study; then acquire speed with K. I. Shorthand. Amazingly simple, easy. Approved by experts. Write dictation, messages, etc., rapidly as spoken, after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; aid in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Slight cost. **K. I. Shorthand**—for busy people, including YOU. **FRUIT LESSONS.** Guarantee and brochure with Testimonials free, postpaid. Address: **KING INSTITUTE, EL 300, Station F, NEW YORK CITY**



**Feldman's "Geyser"**

Electric Water Heater  
*Instantaneous Hot Water*

**FELDMAN MFG. CO.**

1500 Times Bldg. New York City

**RAISE BELGIAN HARES** For Huge Profits

easily and pleasantly made. We furnish stock and pay you \$5.00 a pair and express charges for all you raise. Contract and book "Fortunes in Hares", by mail free.

NATIONAL FOOD & FUR ASSOCIATION  
 Dept. 24 MILWAUKEE, WISC.





**COLD LIGHT**

(Continued from page 23)

proper conditions the small light wave may be given off by the electron without affecting the whole molecule in the least. That is cold light.

An interesting experiment can be performed with a vacuum tube, which illustrates completely the principle of light production by ionization, and at the same time explains the principle of the Moore light. Few people, other than scientists, realize what a peculiar thing the production of light in a vacuum or Geissler tube is. The light is evidently not the product of heat, but depends on the fact that the electric spark breaks the gas molecules up into charged particles or ions. And this phenomena is most noticeable when a certain degree of exhaustion is reached in the tube.

When air is pumped out of a tube in which there is an electric spark discharge, several different stages, as shown in Fig. 3, are successively reached. At first the discharge in the tube is the ordinary disruptive spark. In the next stage it forms a quiet thread of light thru the tube. Then the thread of light becomes a broad pencil of light, and finally with more exhaustion the whole tube is filled with a soft luminous glow, which is technically known as the *positive column*. This is the point of highest conductivity of the tube, and may be reached with an ordinary air pump. With further exhaustion, by means of a special air pump, the resistance increases, the cold light disappears, and the point is reached where X-ray phenomena and fluorescence appear. The color of the light in the tube depends on the gas used in the tube and is undoubtedly the product of the ions. Just before the war a Frenchman, Claude, devised a means of producing in quantities the rare gas, *neon*, which gives an intense yellow light in a vacuum tube. The carbon dioxide which Moore uses gives a white light. Other gases, possibly rare ones, may be found which are better still, and *helium* has been suggested as a standard by some. However, up until the time the U. S. Government discovered the way of producing it in immense quantities for balloon work, during the war, it was too rare to be practical. The more the conditions in such a light can be improved, and the more nearly the light is a pure ionization or cold light, the higher the luminous efficiency will be. An interesting table is given, showing the progress which has been made up to the present, including the vacuum tube.

*Luminous Efficiency of Various Illuminants*

Candle .....	2 per cent
Gas mantle .....	5 per cent
Carbon lamp .....	6 per cent
Flaming arc .....	15 per cent
Vacuum tube .....	40 per cent

**REVOLUTION COUNTER FOR DYNAMOMETER**

(Continued from page 39)

duration of thirty seconds. The time element may be changed at will by the use of saws of any desired number of teeth.

To start the apparatus, the starter button is brought into action until both brushes bear on the metal drum. This completes the circuit and engages the clutch thru the electro-magnet and spring thus starting the counter. At every swing of the pendulum, the circuit thru the solenoid is made and broken, thus drawing the saw—as illustrated—thru a circumferential distance equal to one tooth. After thirty swings of the pendulum one brush is again bearing on the insulated section of the drum and the counter clutch is disengaged. A reading of the counter gives accurately the number of revolutions of the dynamometer in thirty seconds. This counter may also be used in connection with a fuel weighing apparatus.

Contributed by W. H. WEBER.



**Become an Electrician In One Year Here Or Learn An Electrical Trade In 6 Months**

**T**HIS school teaches electricity thoroughly, from the very fundamentals, including the laws and principles of electricity and the theory of direct current—together with practical lectures and problems, actual training in laboratory work and electrical machine departments of designing, building, repairing, installing, operating, etc. And the faculty here are practical electrical engineers who know how and what to teach because they know what knowledge and ability the great field of Electricity requires.

As one example of this school's thoroughness and practical training and development witness the pictures above showing view of Motor Generator Department, where students actually generate Electricity, making all connections and performing all the necessary operations, on the same practical basis as in a power plant or large industrial concern.

The thoroughness in essentials here, the practical training and able faculty, together with this school's broad facilities and intensive abilities, are the reasons why you can become an Electrician here in one year, or master one of the Electrical Trades in 6 months.

If you are determined to achieve success in the Electrical Field this is your school. You will acquire and accomplish more in a shorter time at a less cost and be a fully developed, practical electrical man when you finish. Mail the coupon at the right and get complete illustrated and descriptive details of the advantages this school affords. If interested in Electrical Engineering with B.S. degree, check same on coupon. Mail the coupon now.

**You Can Earn While You Learn**

**W**E will provide you with part time employment to help defray your expenses here and give you actual outside experience—without interfering with your class hours—which is fully explained in our catalog. Mail the coupon.

**School of Engineering of Milwaukee**

*An Electrical Technicians' Institute*  
Department of Practical Electricity  
(88) 373 Broadway, Milwaukee, Wis.

**R. O. T. C. UNIT**  
The War Department of the U. S. Government has recently authorized Junior and Senior Reserve Officers' Training Corps Units in this school. Students in courses listed below are entitled to join Junior Unit if they wish to do so. R. O. T. C. membership offers such advantages as: Complete free uniform, equipment, free summer training camp trip, summer uniform outfit and free special technical instruction. Membership and all obligations cancelled on termination of school work.

**MAIL THIS COUPON NOW**

School of Engineering of Milwaukee,  
(88) 373 Broadway, Milwaukee, Wis.

Without obligating me, please furnish details of course (or courses) checked below.  
 Electrician  
 Electro-Technician  
 Electrical Engineer (3 yrs.)

- SPECIAL 6 MONTHS' COURSES**
- Draftsman
  - Electrical Trouble & Lineman
  - Electrical Wireman
  - Electrical Motor Repairman
  - Telephone Trouble & Repairman
  - Electrical Meterman

NAME .....

ADDRESS .....

CITY..... STATE.....

EDUCATION..... AGE.....

**YOU HAVE A BEAUTIFUL FACE BUT YOUR NOSE?**



**BEFORE**  
**AFTER**

**I**N THIS DAY AND AGE attention to your appearance is an absolute necessity if you expect to make the most out of life. Not only should you wish to appear as attractive as possible, for your own self-satisfaction, which is alone well worth your efforts, but you will find the world in general judging you greatly. If not wholly, by your "looks," therefore it pays to "look your best" at all times.

Permit no one to see you looking otherwise; it will injure your welfare! Upon the impression you constantly make rests the failure or success of your life. Which is to be your ultimate destiny? My new *Nose-Shaper*, "TRADOR" (Model 24) corrects now ill-shaped noses without operation, quickly, safely and permanently. Is pleasant and does not interfere with one's daily occupation, being worn at night.

Write today for free booklet, which tells you how to correct ill-shaped noses without cost if not satisfactory.  
**M. TRILETY, Face Specialist**      **1162 Ackerman Bldg., Binghamton, N. Y.**

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

# MURDOCK No. 55



## Pre-War Prices

Complete 2000 Ohm Double Set	Complete 3000 Ohm Double Set
<b>\$400</b>	<b>\$500</b>

Without exception the best radio receiver value in the world.

Positive satisfaction guaranteed. **Fourteen Days' Trial**, and money back if they don't make good. **Get Your Set Now.**

We are prepared to supply promptly your requirements for good radio instruments.

Ask for Bulletin No. 19.

**WM. J. MURDOCK CO.**  
55 Carter St  
Chelsea, Mass.

Pacific Coast Representatives:  
The Keeler White Co.  
221 Second St., San Francisco, Calif.

## RADIO DEPARTMENT

*Continued*

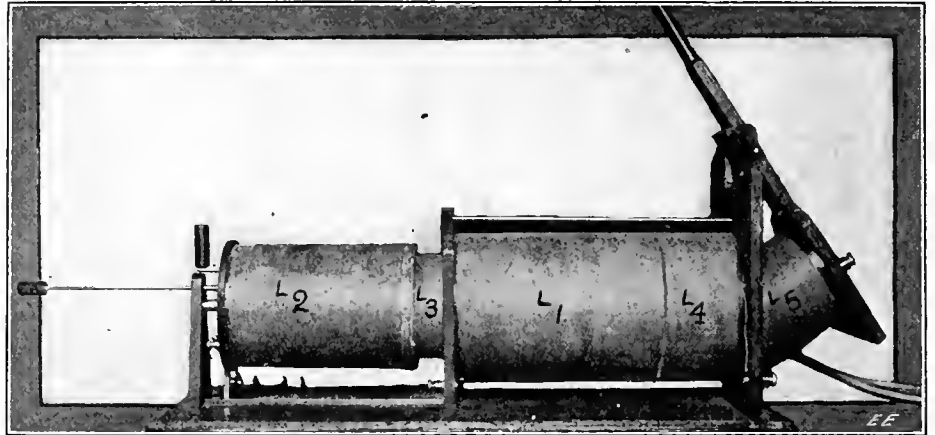
New Regenerative Vacuum Tube Circuits  
(Continued from page 33)

these wave lengths, the proper size inducances are always to be utilized. It is advisable to use this circuit whenever large amplifications are desired at extremely low wave lengths. Tests have been made with this circuit in comparison with other low wave length regenerative circuits, and it was found that the above circuit gave better and more efficient results and that it was possible to produce regeneration in the plate circuit with much greater ease than that obtainable with the usual type of circuit.

A similar but a more complicated circuit is shown in Fig. 5. The radio frequency bridging condensers  $C_3$  and  $C_4$  are used to permit radio frequency currents to pass freely to the plate.

circuit is to amplify the audio frequency currents of the first vacuum tube. This audio amplification is accomplished thru coils  $L_3$  and  $L_4$ , which are mutually coupled with this arrangement, and it is possible to amplify the signals to 1000 or more times their original value. It was possible, in tests, to amplify signals received from a distance of 5000 miles to such a value as to cause the incoming signals to be heard twenty feet away from the telephone receiver. The telephone receiver was equipt with the proper megaphone.

In Fig. 7 is delineated a radio telephone circuit using a vacuum tube for the generation of sustained oscillations. The grid and plate are coupled magnetically thru inductance  $L_2$ , which also energizes the antenna circuit thru inductance  $L_1$ . Condenser  $C$  is used to tune the oscillatory circuit  $CL_2$ . The plate voltage in this work is considerably higher than the plate voltage used in receiving sets and it usually ranges from 300 to 1500 volts. This is usually accomplished by the use of the generator  $G$ . The inductance  $L_3$  which is a choke



Special Form of Loose Coupler Provided with Five Coils, for Use with Regenerative and Wireless Telephone Audion Circuits Here Described.

With all the above circuits so far described, it will be noticed that the regenerative coupling is accomplished in the antenna circuit, thereby amplifying the incoming radio frequency oscillations and therefore producing maximum amplification without the loss of any feeble currents due to coupling in the secondary oscillatory circuits, which means of regeneration of incoming signals is accomplished with present forms of circuits. Thus, it is seen that direct results and better efficiency can be accomplished with the circuits described.

Fig. 6 outlines a circuit similar to Fig. 5 in which the plate of the first vacuum tube is coupled magnetically thru coils  $L_4$  and  $L_5$ . The purpose of another vacuum tube

coil is used to prevent high frequency currents from the plate circuit entering the generator. Modulation is accomplished by shunting a telephone transmitter  $T$ , thru a resistance  $R$  and battery  $B$  across the grid and filament of the tube, as indicated.

Another successful circuit is shown in Fig. 8 and voice modulation in this circuit is accomplished by coupling the telephone transmitter thru an induction coil  $I$ , comprising coils  $L_3$  and  $L_4$ . The primary  $L_4$  is connected to the transmitter and battery  $B$ , as shown. The modulated wave is impressed upon the grid in the vacuum tube, which wave is superimposed upon the main radio frequency oscillations.

(Continued on page 76)

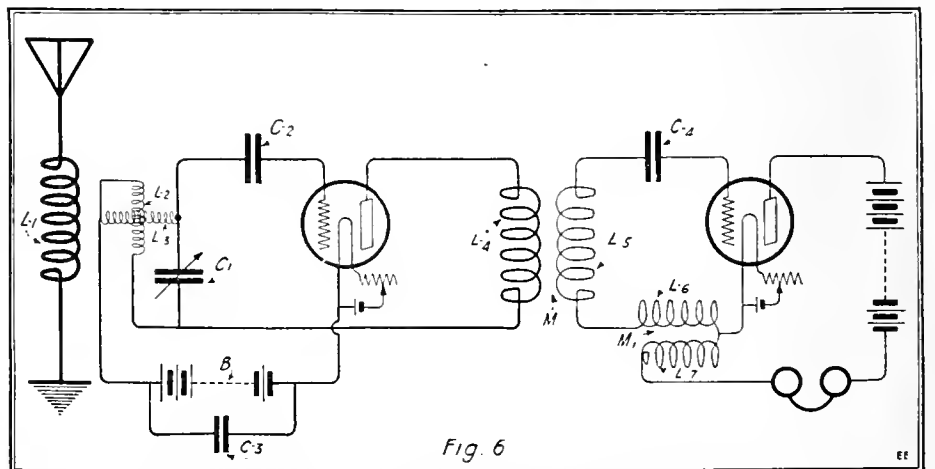
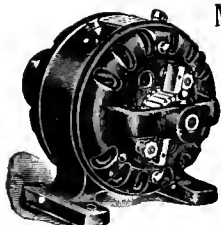


Fig. 6

Two Stage Audion Amplifier, the Circuit of the Second Audion Being Magnetically Coupled to the First Audion Circuit. Amplifying Power 1,000 Times and Better.



## MAKE ELECTRICITY BY HAND

Simply turn the crank and make 110 volts A.C. While they last

**Only \$5.00**

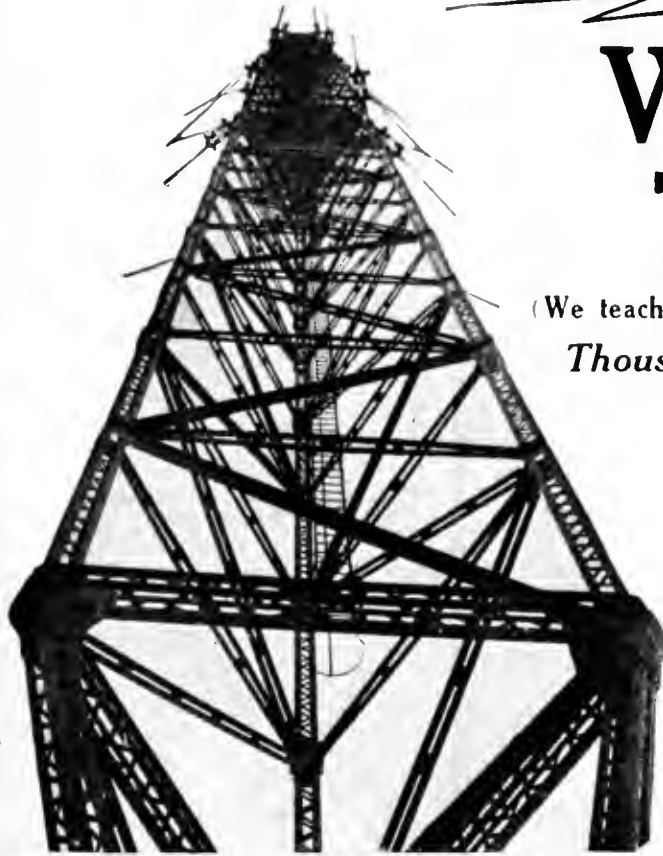
Order from this ad.  
House-Lighting Plants

\$225 to \$2,100. Battery Chargers, Dynamos, Motors, all sizes. State agents with \$500 capital wanted.

WATSON ELECTRIC CO., Dept. 14, Gas Building, Chicago

## WIRELESS IS SIMPLE

when the Summers' theories of wireless are applied to wireless systems, transmitting and receiving apparatus. Will advance the wireless art by leaps and bounds. Get on the right track with your experiments. This booklet should be in every home and school. United States and foreign copyrights. Price \$2.00 registered postpaid to any part of the world. Address **FRANK E. SUMMERS, Memphis, Mo.**



One of the giant wireless towers which keeps us in constant communication with Europe

# Wireless in Ten Weeks

(We teach you in your own home during your spare time)

**Thousands of operators needed for America's Merchant Marine**

The age of wireless is here. The experimental stage has passed. Wireless now equals in importance telegraphy, and telephony. It has assumed its place among the great commercial industries of the earth. So rapid has been the development and growth of wireless in recent years that there has been left in its wake a tremendous shortage of operators. Actually thousands upon thousands are now needed for permanent "peace time" positions offering wonderful opportunities for advancement.

**Earn up to \$200 per month**

In the short period of ten weeks we can make of you a wireless operator, a man with a profession, independent, and not subject to the rise and fall of wages in the labor market. Salaries are as high as \$200 per month. There is a position in the merchant marine, the army, the navy, or a land station, awaiting everyone completing our course. We give you this training at home, by mail, in your spare time. It is not necessary for you to lose any time from your work to take the course.

## Free Instruments—

While a student of our course, we present absolutely FREE to every student enrolling with us a Standard Set of Instruments (the same as used by the Government in testing applicants for first grade commercial licenses). This machine sends and records messages.

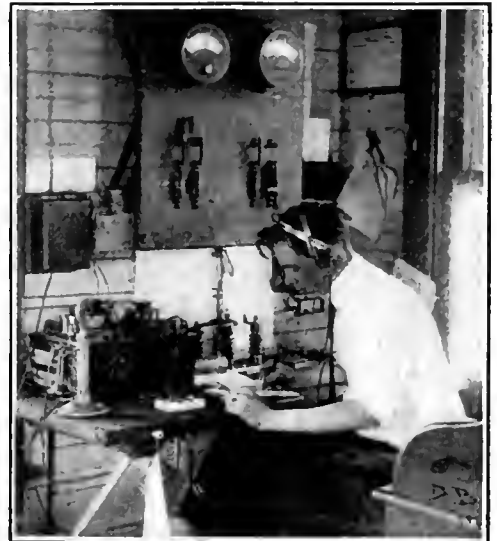
**Travel the world over or locate at a land station in America.**

America is spending billions of dollars on the mightiest navy and merchant marine in the world. Practically all vessels are being equipped with wireless apparatus of the most up to date type. Thousands of operators are needed now. The field affords a wonderful opportunity for the man who starts now to master wireless.

**Our students actually pass the commercial examination in ten weeks or less.**

Get your instruction from the Nation's Capitol. Our course is endorsed by officials of the U. S. Government.

The National Radio Institute, headed by authorities who have been closely allied with governmental training of students, has perfected an easily mastered course in wireless telegraphy whereby students are taught completely in ten weeks, either here in Washington at our large residence school or at home by mail. Many of our students are ready to take up actual wireless work in much less time. The course is founded on actual practice, hence the rapid progress of the student.



### A Valuable Book Free

Our booklet, "Wireless—The Opportunity of Today and the Greatest Field of the Future," gives you complete information in regard to our course, the quick and easy methods by which you can master wireless and other important facts you should know. It is free. Just mail the coupon. No obligation whatever on your part.

-----FREE COUPON-----

NATIONAL RADIO INSTITUTE,  
Dept. W, Washington, D. C.

Send me, free of charge, your booklet "Wireless—The Opportunity of Today and the Greatest Field of the Future," with full particulars regarding your famous 10 weeks' Home Study Course, and your Special Free Instruments Offer.

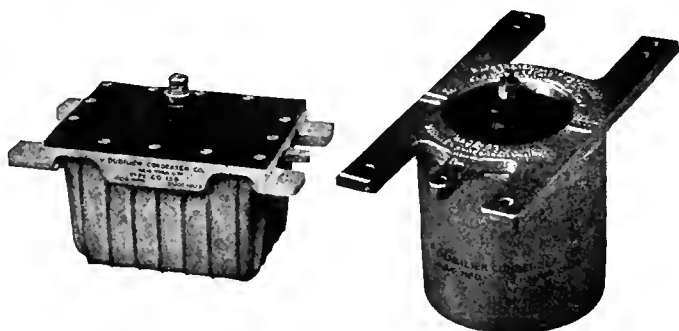
Name .....  
Address .....  
Town ..... State .....

**NATIONAL RADIO INSTITUTE**

Dept. W

14th and U Streets, N. W.

Washington, D. C.



TWO TYPES OF MICA TRANSMITTING CONDENSERS SUITABLE FOR MODERN AMATEUR APPARATUS. 21000 VOLTS. .004 MFD.

## Make Your Wireless Apparatus Send Further Last Longer and Work Better

The wireless amateur and experimenter is once more busy constructing apparatus for use the moment that orders go forward allowing amateur stations to open.

The kind of apparatus you used before the war doubtless answered your purpose nicely, but just consider the tremendous advancement made in the art during the past two years and you will appreciate your modern apparatus must contain several new types of equipment to bring it up to date.

### DUBILIER MICA CONDENSERS

proved their real worth in the Navy, the Signal Corps, and as a part of the equipment of the fighting Airplanes both here and abroad since 1916.

You can now purchase a genuine DUBILIER MICA CONDENSER for your new set for any voltage and capacity. They replace Leyden Jars with greater efficiency and without brush discharge and with negligible losses. They are compact and indestructible.

Made in any capacity and up to 1,000,000 volts. Special condensers supplied for experimental work.

Used in practically every Government installation. DUBILIER MICA CONDENSERS are now ready for your use.

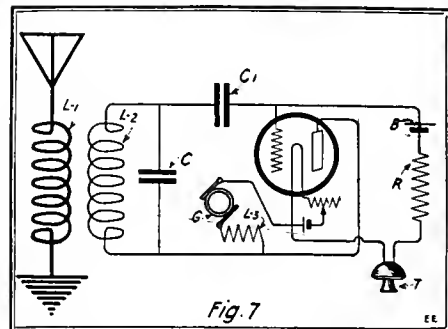
	Type A	Navy Type
.002—21000 volts.....	\$11.00	\$18.00
.004—21000 volts.....	20.00	35.00

DUBILIER CONDENSER CO., Inc., 217 Centre St., New York  
For Great Britain, Address DUBILIER CONDENSER COMPANY, Ltd.,  
1 & 3 Stephen St., London, W. 1., England

## NEW REGENERATIVE VACUUM TUBE CIRCUITS.

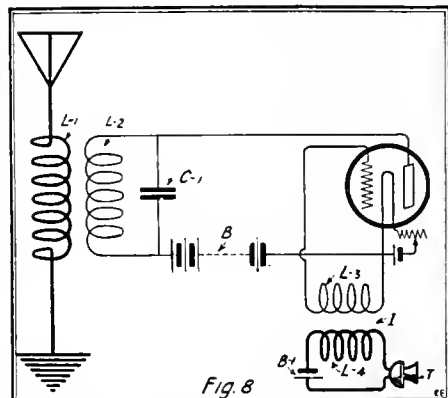
(Continued from page 74)

Another circuit to accomplish the same result as above, is indicated in Fig. 9, in which case the oscillations are started thru the coupling coil M and the voice modulation imprint upon the grid circuit is ac-



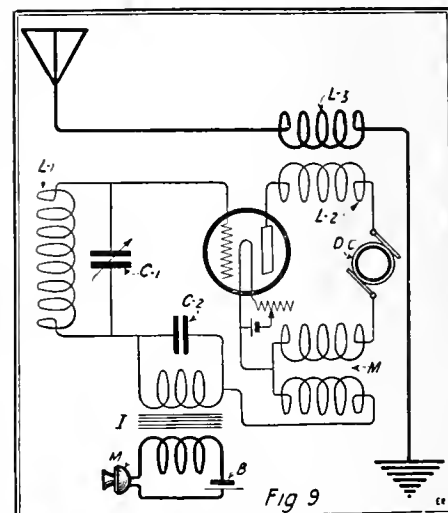
First Form of Radiotelephone Transmitter Circuit, Utilizing an Audion, of Interest to Amateurs.

complished thru the telephone induction coil whose secondary is connected thru the grid and one leg of the coupling coil M, and the other to the main oscillatory coil inductance L<sub>1</sub>. The primary of the induction coil is connected with the microphone and battery as indicated. Tuning is accomplished with condenser C<sub>1</sub>, which is in the oscillatory circuit C<sub>1</sub>L<sub>1</sub>. Energy trans-



Second form of Audion Radiotelephone Transmitter with Magnetically Coupled Modulating Circuit.

ferred to the antenna circuit is accomplished thru the plate inductance L<sub>3</sub>, inductively coupled to the antenna inductance L<sub>3</sub>. To reduce the impedance of the grid circuit due to the high inductance of the secondary of the telephone induction coil, it is necessary to shunt a capacity C<sub>2</sub> of considerable magnitude to overcome this excess impedance.



Third Form of Audion Transmitter for Radiotelephony.

## Boys! You Can Make Your Own Electrical Apparatus with the aid of these wonderful books Home-made Electrical Apparatus

By A. M. Powell



Three wonderful big books, chock full of just the sort of information you have been looking for and at a price within reach of your pocket book. Each volume is printed on heavy paper, contains 75 pages and over 60 illustrations, complete working drawings for making every sort of electrical apparatus. Written so you can understand them. The price is only 25 cents per copy—practically the cost of publication. See partial table of contents below and order now. The supply is limited.

Vol. I Contains working drawings and directions for making all sorts of Static Machines, Static Apparatus, Home-made Batteries, Storage Cells, Transformers, Rectifiers, etc.

Vol. II contains working drawings and directions for all sorts of Voltmeters, Ammeters, Galvanometers, Switches, Rheostats, Telegraph Keys, Sounders, Telephones, Shocking Coils, Spark Coils, Experiments, etc., etc.

Vol. III contains working drawings and directions for making all sorts of Dynamos, Motors, Electric Engines, Miniature Lighting Plants, Wireless Telegraph Apparatus, Tesla Coils, Wireless Telephone, Electroplating, Experiments, etc., etc.

Any of these wonderful books will be sent to you postpaid for 25 cents.

COLE & MORGAN, Inc., Publishers and Booksellers  
P. O. Box 473, C. H. Sta., New York City

## The Breakers

### Atlantic City's Newest Fire-Proof Hotel

Ocean Front. Unusually attractive during the Autumn and Winter seasons.

### American and European Plans

Luxurious lobbies, spacious verandas and sun parlors overlooking the ocean. Charming afternoon musicales and evening concerts. A palatial residence for those seeking rest and recreation. Sea water baths. Fireproof garage. Illustrated booklet sent on request.





**PUTTING IT OVER ON FRITZ.**

(Continued from page 22)

see the sector thus marked out—by triangulation the position of every wireless sender could be ascertained—abandoned. This prediction came true every time, and tho the secret was guarded jealously during the war, it now can be let out, as Germany is harmless, and every other nation knows just how the prophecy was made.

It was not often that the Germans kept Allied brains working overtime on a puzzle. In a single instance, however, the Huns thought up a devilishly clever plan for getting secret information into Germany. This was called for weeks and weeks the "Nauen-Madrid Buzz."

Nauen, of course, was the official German Government wireless station, while in Madrid, Spain, was situated a station capable of sending messages to any part of the German empire in Europe. During all the months of the war in which direct communication between Germany and the outside world was practically severed official war bulletins and "inspired" news came out from Nauen thru Madrid. The latter station sent back neutral news and views of the war.

In the spring of 1917, however, came a queer development. Every now and then Nauen would seem to be badly bothered by "static" or by some imperfection in the sending apparatus. The station would emit an unintelligible buzz, like unto no message known to operators. This was regarded with grave suspicion by the Allied intelligence departments, and when Madrid started the same thing a whole corps of military wireless detectives were assigned to the problem. No one doubted that this was some new form of communication, but what on earth could anyone make out of that continuous buzz?

Weeks past with no light on the question. The two stations had grown bolder and were using the buzz constantly. Valuable information leaked to the enemy, and it was made practically certain that the "buzz" was responsible.

The mystery was solved by the help of a lucky accident. The technique of studying every code wireless message of the enemy had been to take down the sounds of the spark on a cylinder phonograph record; this gave the intelligence officer an accurate reproduction at any time he desired. On the occasion mentioned an officer had been trying to establish some basis of similarity between several of the records without success, when his machine ran down. As the needle grated to a stop on the cylinder the officer sat up suddenly. He thought he detected something that sounded just a little like a message!

He wound the phonograph and turned its speed indicator down so that the record revolved only a few times a minute. Then he applied the needle again. Aha! *There was something there!*

Tho this arrangement gave him insufficient to enable him to solve a code, he had the idea. Next the phonograph cylinder was attached to a motor, revolving at three hundred revolutions a minute, and several records taken at high speed of the peculiar buzz. When these records were re-run at moderate speed it was simple; the messages were decoded in an hour and were found to be questions and answers on topics the Germans were not even supposed to know existed!

The method used by the Germans and by the Madrid operator had been simply to punch in the message on a perforated paper roll. Then running this thru the sending equipment at high speed the message had gone into the ether waves at too rapid a rate to be caught by ordinary methods. At the other end the receiving station used the phonograph equipment to catch and record the message.



Brandes "Superior" Head Set, complete with head band, \$6. A professional set within the means of every amateur. 2000 ohms.

# Five Points of BRANDES Superiority

Brandes wireless headsets score 100% on the five factors that determine the efficiency and value of receivers for both professional and amateur use.

**Sensitiveness:** Brandes receivers do more than make weak signals *audible*; they make them *readable*,—clear and sharp. This is because both receivers are exactly matched in tone.

**Dependability:** Made by hand by an organization which manufactures wireless receivers *only*, carefully measured by a micrometer for exact construction, and tested against a standard receiver—Brandes headsets can be counted upon for absolute dependability under every condition.

**Lightness:** Because Brandes headsets were first designed for professionals, they are so made that they can be worn long hours without discomfort.

**Service:** With ordinary care, Brandes receivers give service indefinitely. Hundreds of owners would not exchange sets several years old for new ones.

**Appearance:** Compact in size, correct in head band design, with an orderly arrangement of cords, and made from the finest materials, Brandes headsets have a handsome, efficient appearance.

Booklet "E" will be sent upon receipt of 4c in stamps.

**C. BRANDES, INC.** 32 UNION SQUARE  
NEW YORK CITY

Complete line of Brandes receivers for those in Western States and Pacific Coast. Catalogue "E" on request.

Balboa Building

FORD KING

San Francisco, Cal.

## Commercial Telegraph Apparatus Bargains

Standard twenty ohm Telegraph Sounders at \$200 each

Standard Telegraph Keys at 125 each

110 Volt A.C. Dynamos

Three Bar . . . . . 175 each

Four Bar . . . . . 225 each

Five Bar . . . . . 275 each

For other bargains see pages 90 & 91

Skinderviken Telephone Equipment Co.

Abbreviated Address

STECO-2118-2136 N. Clark St. CHICAGO

## TELEGRAPHY

Both wire and wireless, and Station Agency taught thoroughly and quickly. **BIG WAGES NOW PAID**, some of our recent graduates procuring \$138.00 per month to start. Great opportunities for advancement. Our school the oldest and largest—annual enrollment 600 students. Endorsed by railway, telegraph, wireless and government officials. Expenses low—chance to earn part. Catalog free. Write. **DODGE' INSTITUTE, 22nd St. Valparaiso, Ind.**



## De Forest's New Catalog

illustrating and describing the very latest and best in

## RADIO APPARATUS

For Discriminating Users

is ready for mailing. Complete information regarding the De Forest "Unit" Set, "Honey Comb" Coils (a radical departure from previous forms of apparatus), variable air and fixed condensers, wavemeters, variometers, detectors, etc., will be sent upon receipt of 10c to defray postage.

**De Forest Radio Tel. & Tel. Co.**

1391 Sedgwick Ave.

New York City

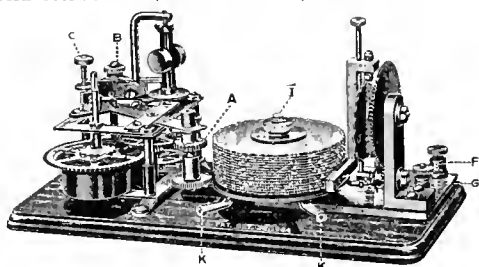
# LEARN TELEGRAPHY WITH THE OMNIGRAPH

## The Omnigraph Went to War-- But It's Home Again

During the war, scarcity of material and orders from the Government and from the leading Universities, Colleges, Telegraph and Technical Schools, closely connected with the Govt. in teaching the Codes, made it impossible for us to make prompt shipments to individuals and to the trade.

We are now filling all orders promptly.

The Omnigraph Automatic Transmitter will teach you the Continental and the Morse Codes, at home, in half the usual time and at the least possible expense.



205 New Jersey Ave.,  
Angelsea, New Jersey,  
Feb. 17th, 1919.

will send you unlimited Wireless or Morse Code messages, by the hour and at any speed you desire. Impossible to anticipate.

We offer the Omnigraph as a positive success and with the strongest of endorsements. It has been adopted by the U. S. Government, Department of Commerce, and is used to test all operators applying for Radio Licenses. Many leading Telegraph Schools use The Omnigraph to send to their students in preference to hand sending. Ask us for their names if you so desire. We have hundreds of unsolicited testimonials and with permission we are publishing one of them.

205 New Jersey Ave.,  
Angelsea, New Jersey,  
Feb. 20th, 1919.

The Omnigraph Mfg. Co.,  
39 Cortlandt St., New York City  
Dear Sirs—Received my Omnigraph No. 2 with a set of Morse and an extra set of Continental Dials and wish to thank you for your prompt shipment.

Five minutes after I had received the box, I had it unpacked and working. I cannot praise it too much and a friend of mine as soon as he heard it said: "Why, man, that sends HERBERT Morse and Wireless." I will give you all the praise that I can. I myself doubted that the machine would do all you stated but it does all you state AND THEN SOME.

Hoping to be of help to you and wishing you the best of success in your business, I remain  
Very truly yours,

(Signed) Thomas W. Braidwood,  
Pres. Cape May County Radio Asso.

If you are a beginner, it will make you an operator in the shortest possible time.  
If you are already an operator, the OMNIGRAPH will make you a better one.

Send for free catalog describing 3 different models—\$9.00 to \$23.00—on order direct through your Electrical Dealer. We sell the Omnigraph under the strongest of guarantees—you must be satisfied or your money back.

**THE OMNIGRAPH MFG. CO., 39 L. Cortlandt St., New York**

How did you learn to talk? By listening.  
JUST LISTEN,—THE OMNIGRAPH WILL DO THE TEACHING

The Omnigraph Mfg. Co.,  
39 Cortlandt St., New York City.

Dear Sirs—In reply to your letter of 19th inst., I am GLAD to give you permission to use my previous letter in any way you see fit.

Two weeks ago I could not receive enough Morse to understand what a person was saying but today I can receive about ten words per minute on my Typewriter when the OMNIGRAPH is sending.

I have a First Grade Commercial Radio Operator's License and am using the OMNIGRAPH to better my receiving and to fit me for land telegraphy.

Wishing you the best of success for the future, I remain,

Very truly yours,  
(Signed) Thomas W. Braidwood, Radio 3 U Z.  
Pres. Cape May County Radio Asso.

# Advertising Talks

NUMBER 2

IF you have ever stopped to figure out the terrific cost involved in publishing a magazine, and the small amount of money that you pay for your issue each month, you probably wonder how a publisher can afford to give you as much as he does. If it were not for the advertising carried, he could not do it. Your 20c would not buy a magazine one-half the size, or quality, of the "Experimenter" unless that magazine were supported by the advertisers who use its columns every month.

The *Electrical Experimenter*, especially, costs a vast sum of money every month to produce. The magnificent wash drawings and expensive cuts that you see in every issue and which have made the "Experimenter" famous are only one of the many items that makes the publishing of your magazine a severe and heavy strain. The price you pay for your copy helps to meet part of this expense, but the advertisers foot the most of the bills. Don't let that fool you, however. They are not doing it for any love of the "Experimenter"—it is a business proposition with them. Each and every one have something that they feel is of interest to you. Perhaps it is a piece of merchandise that they want to sell; a new wireless outfit, a correspondence course that they know will improve your mind and equip you to earn more money; maybe it is a book or a novelty that you would enjoy having; but, whatever it is, they are willing to pay their good money to support the magazine in order that the magazine can print their advertisements.

The more advertisers we have, the more income there is each month, and the publishers of the *Electrical Experimenter* have committed themselves to putting back into the magazine, in enlarging its size, and improving its articles, and its drawings, every penny that comes in through the circulation or advertising. You will notice that with this issue eight more pages of pure text have been added, making this number the biggest ever published. This was made possible by the big increase in advertising during the past few months. You can help the work along and make the magazine still larger and better, if you will purchase what you need and the things you require in your work or for your pleasure, from the advertisers who are helping you. Read what they have to say in every issue, and when you want anything, no matter what it is, look it up in the advertising columns of the "E.E." and send your orders to those firms who are helping give you a magazine that you would not want to do without.

Live concerns that advertise sell better goods and at a cheaper price, *quality considered*, than unknown firms who persist in "hiding their light under a bushel." Next month I will tell you the real reasons why the quality of any advertised article has to be the very best and show you why you should patronize your own advertisers for this one reason, if for no other.

*R. W. Mott*

Advertising Manager.

## DUCK'S BIG 300 PP. Wireless & Electrical



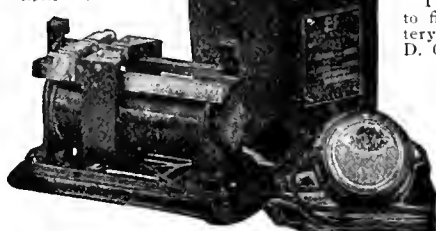
Catalog is now as it always has been, the largest and most complete and dependable Wireless Catalog published. Mailed for 12c in stamps or coin which may be deducted on first order of one dollar. Catalog not sent otherwise. This catalog costs us twice the price of other catalogs.

Everything in wireless worth while is listed in this catalog. The experienced amateur will tell you to see our catalog before buying. You are thereby insured against an unwise purchase. It is the *Beacon Light* to guide you right in the selection of your wireless apparatus. No bigger or better values are obtainable elsewhere. Send for revised price list. It is yours for the asking.

**THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio**

### MAGNETIC RECTIFIER

Patented April 18, 1916



### THE F-F BATTERY BOOSTER For Home Charging and Service Stations

The wireless ban will soon be lifted, and it is time to figure what Rectifier you need to charge your battery. The F-F Outfit is furnished for either S. C. or D. C. current and attaches to any light socket, making a convenient, simple, economical, and reliable home charging situation.

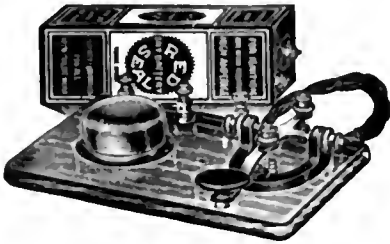
The battery must be charged often to maintain a high point of efficiency and keep the plates above the critical sulphation point. This will prolong indefinitely their life and usefulness.

Write for Bulletin No. 12.

**The France Manufacturing Company**  
Cleveland, Ohio

# Mesco Telegraph Practice Set

For Learning Telegraph Codes

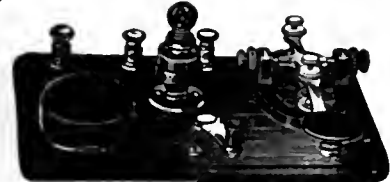


The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes. List No. Price

342 Telegraph Practice Set, with Battery and Cord.....\$3.24  
Weights 4 lbs. packed.  
Price does not include postage.

**MESCO** Combination Practice Set for learning the Morse and Continental Visual and Audible Codes



This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord.....\$4.05  
Weights 4 lbs. packed. Price does not include postage.

## Send for the New Edition of Our Catalog W28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Send for the Catalog Now

**Manhattan Electrical Supply Co., Inc.**

NEW YORK: CHICAGO: ST. LOUIS:  
17 Park Place 114 S. Wells St. 1106 Pine St.  
San Francisco Office: 604 Mission St.



The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the **Lek-Tro-Shav** speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.  
No. 2 Made for use from Dry Battery.  
Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

**VIBRATING ELECTRIC RAZOR CO.**  
Dept. 122. Omaha, Nebr.

## PRACTICAL CHEMICAL EXPERIMENTS

(Continued from page 34)

clean cut, due to the shears. Since new wool is distinctly elastic, there is a certain amount of give to the fibers when subjected to tension. In the case of wool that has been scoured and dyed, the elasticity has somewhat decreased, the fibers becoming considerably firmer. If subjected to tension and rupture, the break has the appearance of a fracture, like a bone.

Referring to Figs. 9 to 18, inclusive, Fig. 9 shows shoddy made from new, fine, blue worsted clips. Notice the great variety of broken ends of fibers, and also the tendency of the fibers to split or tear lengthwise. The fibers showing the side breaks are evidently due to a tearing action of the shoddy machine.

Fig. 10 is a shoddy made from new, fine, black worsted clips. Here again may be noticed their peculiar terminal fractures, where the fiber has been pulled asunder. One of the fibers has a number of *spines* projecting from it. These so-called *spines* are really the fiber cells, which, no doubt, were loosened by the tension on the fibers in the machine. Note that both Figs. 9 and 10 represent new wool that has been simply mechanically reduced to shoddy, and at no time carbonized.

Fig. 11 is shoddy made from carbonized brown serge. Here it may be seen what indicates the brittle character of the fiber, devoid of elasticity. The breaks of the fibers are seen to be quite abrupt.

Fig. 12 is a shoddy made from brown serge that has been carbonized and subsequently stript. The abrupt character of the breaks is plainly noticeable, while at the same time the fibrils comprising the body of the wool fiber are very distinct. Their presence may be attributed to the chemical action of the stripping.

Fig. 13 shows fibers made from blue serge that had been first carbonized, then stript, and afterwards dyed green. Here again we notice the tendency to break longitudinally, and where a terminal break occurs, the fibrils appear distinctly.

Fig. 14 is shoddy from the same batch as that shown in Fig. 12, except that it has been dyed a full red. Here we notice that one of the fibers has been split longitudinally, while the other three fiber terminals show break characteristics that indicate the brittleness of the stock.

Fig. 15 was originally a brown serge that had been carbonized, then stript, afterwards dyed a deep orange, and finally garneted. A great majority of the breaks of fibers in this sample are extremely abrupt. There appears to be no longitudinal ruptures, and this seems to indicate little or no elasticity. Even the fibrils do not show plainly.

Fig. 16 is a shoddy made from brown serge that has been carbonized, stript and dyed an olive shade. Here again we see the abrupt fractures of the fiber and a tendency to longitudinal splitting. The fibrils are entirely wanting.

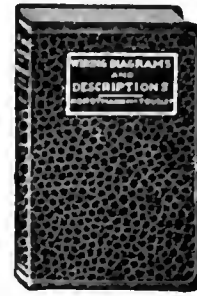
Fig. 17 is a shoddy made from various knit goods of different colors that were first carbonized, then stript, and afterwards dyed blue, producing finished colors of varied hues. The fibers show a rather curious side abrasion; a form of mutilation that appears to be quite common in this lot of shoddy.

Fig. 18 is a shoddy made from serges that were carbonized, stript and dyed a deep maroon. It will be seen that the tendency of some of the fibers is to split longitudinally. The terminal shown is characteristic of a fiber pulled apart lengthwise, when the fibrils have a tendency to separate, forming a brush-like head.

The various characteristics above re-

# Drake's Practical Mechanical Books

For Home Study



Pave the way for the big positions—the fat pay-envelopes. Written in non-technical language—easy to read—easy to understand. We will send any book post paid—keep them five days—if not entirely

satisfied return the books and your money will be refunded in full. Order direct from this page. Use the coupon.

## Electrical Books

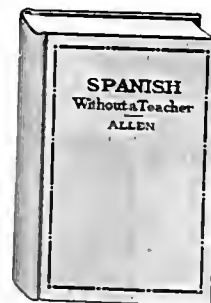
- Electric Motor Control Systems and Methods. Leatherette.....\$1.50
- Electrical Tables and Engineering Data. Leatherette.....1.50
- Motion Picture Operation. Leatherette.. 1.50
- Alternating Current. Leatherette..... 1.50
- Wiring Diagrams and Descriptions. Leatherette.....1.50
- Armature and Magnet Winding. Leatherette.....1.50
- Modern Electric Illumination. Leatherette 1.50
- Modern Electrical Construction. Leatherette.....1.50
- Electricians' Operating and Testing Manual. Leatherette.....1.50
- Drake's Electrical Dictionary. Leatherette 1.50
- Electric Motors, D and A. Leatherette.. 1.50
- Electrical Measurements and Meter Testing. Leatherette.....1.50
- Drake's Telephone Handbook. Leatherette 1.50

## Automobile Books



- Automobile Ignition. Leatherette, \$2.00
- Brookes' Automobile Handbook. Leatherette...\$2.00
- Automobile Starting and Lighting. Leatherette...\$1.50
- Ford Motor Car, Truck and Tractor Attachments. Cloth \$1.00
- Ford Motor Car, Truck and Tractor Attachments. Leatherette...\$1.50
- Automobile Catechism and Repair Manual. Leatherette.....\$1.25
- Gas and Oil Engine Handbook. Cloth... 1.00
- Gas and Oil Engine Handbook. Leatherette.....1.50

## Modern Language Courses



French Without a Teacher, Spanish Without a Teacher, German Without a Teacher. By Professor Philip Schuyler Allen, University of Chicago. An entirely new home series of modern foreign languages. Simplest, easiest-to-master language method ever devised. French, Spanish or German. Pocket size. Each.....\$1.25

Mail the Coupon NOW

Order on our five day money back plan.

FREDERICK J. DRAKE & CO.,  
1009 Nickajack Ave., Chicago, Ill.

Enclosed find (\$.....), for which please send me prepaid the books checked in this adv. (or list attached). It is agreed that I may return same in 5 days if not entirely satisfied, and money will be refunded in full.

Name.....  
Address.....

**414 PAGES**  
**145 ILLUSTRATIONS**  
**I.C.S.**  
**ELECTRICAL ENGINEER'S**  
**HANDBOOK**  
**\$1**  
**ELECTRICITY!**

HERE'S just the book on Electricity that you need to answer your many questions—to solve your knotty problems, to teach you new tricks, to be your memory for tables, rules, formulas and other Electrical and Mechanical facts that some people try to carry in their heads—and fail.

With this "Little Giant" I. C. S. Electrical Engineer's Handbook in your pocket, toolchest, on your work bench, drawing table or desk, an hour or a day need not be lost "digging up" some forgotten rule, some unfamiliar fact; you'll just turn to the very complete index and get it "in a jiffy." Just a few of the subjects treated are:

Electricity and Magnetism; Electrical Symbols; Batteries; Circuits; Magnets; Direct and Alternating Currents; Dynamos and Motors; Belts; Shafting; Electroplating; Electrical Measurements; Meters; Arc and Incandescent Lamps; Mercury Arc Rectifiers; Transformers; Insulation; Electric Cars; Single and Multiple-Unit Control; Transmission; Rail Welding; Tables of Wires—Sizes, Capacities, etc.—Mathematical Rules; Formulas, Symbols; Tables of Constants, Equivalents, Roots, Powers, Reciprocals, Areas, Weights and Measures; Chemistry; Properties of Metals; Principles of Mechanics; First Aid, etc.

The Electrical Engineer's Handbook is one of 22 I. C. S. Handbooks covering 22 Technical, Scientific and Commercial subjects. (See titles in coupon below.) They have the contents of a full-size book condensed into pocket-size ready to go with you anywhere and be at your instant command. Substantially bound in cloth, red edges, goldleaf stamping, printed from new, clear, readable type on good quality book paper and illustrated wherever a picture will help.

**No Risk Money-Back Offer!**

The price of the famous I. C. S. Handbooks, of which more than 2,000,000 have been sold and are in practical everyday use, is \$1 per copy. So confident are we that you will find them exactly what you need for ready reference in your work, that we stand ready to promptly and cheerfully refund your money if for any reason you are not fully satisfied with their value. Simply send a letter or the coupon below, enclosing \$1 for each book wanted. If at any time within 10 days you wish to return the books, your money will be refunded.

INTERNATIONAL CORRESPONDENCE SCHOOLS  
 Box 6187 Scranton, Pa.

TEAR OUT HERE

**INTERNATIONAL CORRESPONDENCE SCHOOLS**  
 Box 6187, SCRANTON, PA.

I enclose \$\_\_\_\_\_ for which send me postpaid the Handbooks marked X, at \$1.00 each. I may return any or all and get my money back within ten days from receipt:

- |  |   |
|--|---|
| <input type="checkbox"/> Electrical Engineer's           | <input type="checkbox"/> Advertiser's               |
| <input type="checkbox"/> Telegraph and Teleg. Engineer's | <input type="checkbox"/> Business Man's             |
| <input type="checkbox"/> Mechanic's                      | <input type="checkbox"/> Bookkeeper's               |
| <input type="checkbox"/> Steam Engineer's                | <input type="checkbox"/> Steno. and Correspondent's |
| <input type="checkbox"/> Westinghouse Air Brake          | <input type="checkbox"/> Salesman's                 |
| <input type="checkbox"/> Civil Engineer's                | <input type="checkbox"/> Window Trimmer's           |
| <input type="checkbox"/> Coal Miner's                    | <input type="checkbox"/> Textile Worker's           |
| <input type="checkbox"/> Concrete Engineer's             | <input type="checkbox"/> Farmer's                   |
| <input type="checkbox"/> Building Trades                 | <input type="checkbox"/> Poultryman's               |
| <input type="checkbox"/> Plumber's and Fitter's          | <input type="checkbox"/> Mariner's                  |
| <input type="checkbox"/> Chemist's                       | <input type="checkbox"/> Automobiles                |

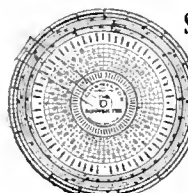
Name \_\_\_\_\_  
 Street and No. \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_

**Telegraph Pictures**  
 BY ELECTRICITY

A complete set of two machines of this marvellous equipment for only \$19.50. Instructive, interesting and useful. This picture of President Wilson was telegraphed by these machines. Will transmit pictures, maps, drawings and hand writing. Picture telegraphing is the coming science. Write today.



J. LEISHMAN CO., Dept. T Ogden, Utah



**SPECIAL KON-VER-TER SLIDE RULE**

"Hamilton" Improved Slide Rule instantly adds, subtracts, divides, multiplies, converts its fractions or decimals of an inch or both. Gives sines, co-sines, versed sines, co versed sines, tangents, co-tangents, secants, co-secants of angles. Square root, cube root, roots to the fifth powers, logarithms, circumferences, areas and diameters of circles. Most complete slide rule of its kind ever made. This rule is five and four-tenths inches in diameter. Instructions with each rule. PLAIN UTILITY RULES \$1.00 SPECIAL DELUXE, white celluloid \$2.50 Postpaid. Agents and dealers everywhere.

J. C. HAMILTON & CO., 7 Water St., Dept. B., Boston, Mass.

ferred to, and illustrated, will serve to draw attention to what one must look for in an examination of cloth that is believed to contain shoddy. In masses of shoddy such as are usually taken for microscopic examination, there will always be found many short fibers due to mechanical breaking of long fibers, but to separate them is an operation of great delicacy, the yielding results of no value.

**THE "BURNING" TEST**

Vegetable fibers may be readily distinguished from animal fibers by burning. Animal fibers, such as Wool and Silk give off the smell of burnt horn. They do not fire like vegetable fibers, but cease to burn when removed from the flame, and the burnt portion curls up, forming a hard cinder at the end of the thread. Vegetable fibers, on the other hand, give off a slight smell of burnt wood when ignited. They burn away very rapidly with a flash, leaving no hard cinder, but a white or gray ash only. The above tests broadly distinguish vegetable from animal fibers, but further chemical examination is necessary to distinguish mixtures of any of them when woven into cloth. (See Fig. 19.)

Referring again to Figs. 1 (Cotton) and 4 (Linen) we can readily distinguish the difference by means of the microscope as shown. If the fabric is without starch, oil makes linen translucent and cotton opaque. The finish must be washed out of highly finished materials before this test can be used.

A test to distinguish between linen and cotton, which only an expert, or at least a person having quite some experience, can perform, consists of what is known as the "tearing" test. The linen weaves in general are more difficult to tear than cotton. The torn ends of the linen threads appear uneven in length and the individual fibers are twisted in every direction. The sound of tearing linen is shrill, and that of cotton dull or muffled.

An easy way to distinguish between the highly-sized and calendered Cotton Damask and true Linen Damask is to boil a sample. After being dried and ironed, if it is cotton it will have a dull and somewhat fuzzy appearance, while the luster and smoothness of real linen will not be affected by this treatment. Mercerized Cotton Damask keeps more luster than untreated cotton, but less than linen.

Since the price of pure, new wool is relatively high, it is the practise of manufacturers to mix other materials with it, the most common of which is "Shoddy." Such goods have many uses, being a full-bodied, but flimsy fabric, it is made chiefly into cheap cloth, table covers, etc. Manufacturers state that the best grade of worsted shoddy—that having long fibers—is superior to a low grade, short staple, new or virgin wool; also that it is impossible to get the texture and finish required for some of the best grade goods without the use of some shoddy. Owing to the fact that shoddy is made from wool fibers, as stated under the heading "Shoddy," it is very difficult to determine its presence by chemical means, owing to the fact that it will respond to the same tests as applied for wool. The microscope is the most accurate means available for determining the presence of shoddy in woolen cloth. It is true that the rough feel and cheap appearance of the fabric gives some idea of the presence of a large percentage of shoddy, but the famous "feeling test" for cotton or shoddy in moderate quantities must give way today to a more scientific analysis, as herein given.

Shoddy is not alone as an adulterant of woollens. Cotton is employed quite extensively. It is a simple matter to detect the presence of cotton, as wool is dissolved in alkalis and not affected by acids while on the other hand cotton is dissolved by acids and not affected by alkalis. Fig. 20 shows

**WANTED**  
**Immediately**

WIRELESS operators are in demand owing to the expansion of our Merchant Marine. Pay has increased to \$110 per month plus all expenses.

THE Y. M. C. A. Radio Schools give thorough practical courses with individual instruction. Our graduates fill responsible positions.

THIS is your opportunity. Classes now forming. Excellent dormitory facilities. Complete laboratory equipment. Write today for illustrated booklet.

**Y. M. C. A.**  
**NEW YORK CITY**

Manhattan Branch: 154 East 86th St. Tel. Lenox 6051  
 Brooklyn Branch: Marcy Ave. Near B'way Tel. W'msbury 3800

**CHEMICALS**  
**for THE EXPERIMENTER**

Send today for FREE Catalogue

DON'T PAY FANCY PRICES for chemicals. Buy highest quality for lowest price. Our unique system of standardization guarantees you at all times the most for your money. Send today for interesting free booklet describing the money-saving, value-giving, N-S plan and listing hundreds of chemicals, chemical glass ware, and apparatus.

THIS RELIABLE MAIL ORDER HOUSE world famed for its wireless telegraph apparatus and experimenters' supplies, has been urged by hundreds of its patrons to establish a chemistry department. In answer we offer what we believe to be the most complete amateur experimental chemistry in the U. S. Buy where you are always assured of Standard Quality, Standard Quantity, Standard Packing, Standard Price.

THE NEWMAN-STERN CO. CLEVELAND, O.

**The Newman-Stern System**

WIRELESS apparatus, Raw Materials, Magnet wires, motors, experimenters' needs, novelties listed in our Catalogue C-3. Assure yourself of prompt service and right prices by buying from this world famed, reliable, experimenters' Supply House.

The Newman-Stern Co., Cleveland, O.

**"The Livest Catalog in America"**

Our big, new electrical cyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 150 Big Pages, 500 illustrations, 300 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedic No. 20 measures 7x5 1/4". Weight 1/2 lb. Beautiful stiff covers. Send 6 cents in stamps or coin for which we will send our latest Cyclopedic Catalog No. 20 as described.

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

**Send To-day for the**  
**"Electrical Worker's Friend"**

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. Special at \$3.50

Or write for full particulars of this valuable book.

**SMITH & SMITH**  
 1524 LOWRIE ST., N.S., PITTSBURGH, PA.



**110-V. TRANSFORMERS**  
**8 Volt Secondary**



Consumes so little current will not move ordinary meter

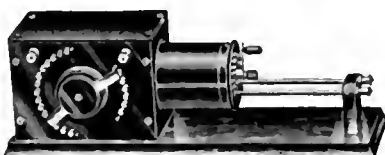
**\$1.00**  
 Postpaid

Only \$1.00

No. 10 gives 3 currents — 6, 12 and 18 volts secondary. Ideal for experimental work. A standard transformer, guaranteed complete with plug, \$2.00 postpaid. Order from this ad.

**NATIONAL TRANSFORMER CO.,**  
 Dept. 13, 3124 No. California Ave., Chicago

**ARNOLD NAVY MODEL LOOSE COUPLER**



This coupler did real work and "mado good". Ask the fellow "in Radio Service". Order your instrument NOW for future delivery. Later there is bound to be a rush, result: delay. A small deposit will insure delivery when you want it.

**J. F. ARNOLD**  
 2082 Lexington Ave., near 125th St., N. Y.  
 Established 1910

**Not Toys But Real Apparatus**  
 the same as used by all operating companies. You had better send us your order immediately to insure prompt delivery, as this equipment will not last long at these prices.

110 Volt Hand Generators... 3 bars, each \$3.00  
 4 bars, each 4.00  
 5 or 6 bars, each 5.00

Telephone transmitters with arms, each... .75  
 Good ringers complete with bells, each... .50  
 Telephone receivers, each... .75  
 Condensers, 1/2 to 2 M.F., each... .50  
 Induction coils, each... .50  
 Relays, each... 1.50  
 Repeating coils, each... 2.00  
 Real complete C.B. wall type telephone... 4.50  
 Slightly used dry cells, per dozen... 1.25

Please send money-order or cash with your order

**ELECTRICAL SPECIALTY COMPANY**  
 Dept. E, 48-50 So. Front St., Columbus, Ohio  
 Dept. E, 128 So. 11th St., Philadelphia, Pa.

???????

**Will Your Station Be Ready**  
 ????????

ALL AMATEURS WILL CELEBRATE OPENING NIGHT. OVERHAUL YOUR STATION NOW. DON'T DELAY. WRITE FOR DESCRIPTIVE BULLETIN and proposition on supersensitive receiving apparatus, smooth running rheostats, knobs, levers, switches, contacts, etc.

**Audiotron Sales Co.**  
 1940 Leavenworth St. San Francisco

**MARKO**  
**STORAGE BATTERIES**  
 ARE GOOD—TRY ONE

**Paul M. Marko & Co., Inc.**  
 1402-1412 Atlantic Ave.  
 Brooklyn, N. Y.

**WIRELESS TELEGRAPHY**

Our 14 weeks course prepares you for **MERCHANT MARINE** paying \$110 per month and expenses. **RADIO INSPECTORS** receive \$1,200 to \$3,500 per year. Our instructors are licensed by U. S. government; school fully equipped and largest of its kind in America. Tuition small and payable weekly. We guarantee to qualify you. Board and room in Washington at reasonable rates while taking the course. Particulars on request. **SERVICE RADIO SCHOOL.**  
 902 Pa. Ave. N. W., Washington, D. C.

a convenient method of testing for cotton and wool. One glass contains a solution of Caustic Potash or Caustic Soda into which is immersed a sample of the wool to be tested. A precipitate indicates the relative amount of cotton and other substances present. Likewise when cotton is immersed in an acid, the precipitate will show the relative amount of adulterants. See Fig. 7.

It is easy to determine heavily-weighted silk material by burning a small sample. Pure silk burns rapidly, smells like wool, and produces a small amount of brittle, curled-up ash. Material which is heavily-weighted will have an ash which is stiff and which often holds the shape of the sample. Cotton is frequently mixed with silk. It is easy to detect cotton in silk by the microscope, as the fibers of silk are round and smooth, while the cotton fibers are ribbon-like and fuzzy. See Fig. 8. Cheap but heavy silks are usually loaded with lead in granular form. A chemical test for lead will readily reveal its presence.

**QUESTIONS AND ANSWERS**

Ques. No. 5. Edward J. Walsh, Lexington, Ky., wants to know how he can remove lodin stains from light clothing.

Ans. You fail to state whether the material from which you desire to remove the stains is starched or unstarched. This is an important factor. Stains which are present in unstarched material produce a brown or yellow stain. Whereas on starched ma-



Fig. 21. Removing Iodin Stains from Light or Other Colored Cloths By Application of Ammonia. The Ammonia May Be Applied With a Glass Rod or Sponge, and Should Be Immediately Washed Out as Soon as the Iodin Stain is Removed.

terials, the presence of starch causes the stain to become deep blue or black.

For unstarched stains, sponging with Ammonia, or alcohol, the latter being frequently used on materials which water would injure. See Fig. 21.

Starch, such as prepared for laundry purposes may be used for washable materials. Immerse the stained parts in the starch and boil. It first turns blue and then disappears. Flour may be used in the same manner as the starch.

For starched materials, the stains may be immersed in a dilute solution of Sodium thiosulfate (known photographically as "Hypo") and then rinsed thoroly. Sodium sulfite (not sulfate) may be used in the same manner as the thiosulfate. Another method is to soak the stains in dilute ammonia (sp. gr. 0.95) until they disappear.

**LISTEN TO ME!**



**Be A CERTIFICATED ELECTRICIAN**

**THIS IS YOUR CHANCE OF A LIFE TIME**

I am Chief Engineer of the great Chicago Engineering Works. I am in close official touch with the electrical world. I know how badly we need trained electricians who can take charge of important work as experts. Right now there is such a need for executive electricians that I am making a special effort to help meet the demand. I am publishing this special announcement to secure a certain number of ambitious men whom I will personally train by mail for the wonderful opportunities that are open.

**I WILL MAKE YOU a Trained Electrician**

I don't care how young or old you are, just as long as you can read and write and have a spark of ambition. I don't care where you live or what you do. I don't care if you don't know a blessed thing about electricity. Just give me a little of your spare time for a short period and I'll show you the quick way to success in electricity. You can qualify to earn **\$36 to \$100 a week** with opportunities for greater earnings.

**I Train You by Mail!**

Your spare time will do. No interference with your regular duties. I understand just what you must know and I have devised a wonderful way of instructing by mail. I positively guarantee your satisfaction.

**Free Wonderful Electrical Outfit**

Absolutely free. Not a penny cost to you now or later. To those who act at once I will give a wonderful set of Electrical Equipment with my compliments. Write me at once. I have only a limited number of sets to be given free. Drop me a post card or letter.

**Write!** You will have to act quick to get in on this opportunity. Write me today for full particulars. Drop me a post card. **Write Now.**

**CHIEF ENGINEER COOKE,**  
 Chicago Engineering Works,  
 Dept. 525  
 441 Cass Street, Chicago, Illinois

**Super-Sensitive Microphone** ONLY \$7.50  
 This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.



**Detectograph, \$15**  
 This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.



Send for One Today and Commence Yourself.

**THE \$15' MICROPHONE DEAF-PHONE**  
 is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any \$35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

WRITE TODAY FOR FREE BOOKLET

**G. BOISSONNAULT CO.**  
 26 CORTLANDT STREET NEW YORK  
 Makers of Super-Sensitive Microphone Apparatus

**Experimenters — Manufacturers!**  
**BASES — INSULATION**



Fine black composition base suitable for detector, fixed condenser, etc. The bottom has a cavity 3" x 1 1/2" x 3/8". Over all dimensions 4 1/4" x 2" x 1/2". Two holes for binding posts and two for fastening down to table. Post paid.....30c



An excellent Base for detectors. Has binding post holes and holes for mounting detector parts. Black composition 3 1/4" x 2" x 1/2". Post paid, 32c

Manufacturers Send for Discounts in Quantity.

Bakelite panels, about	
9 x 19 x 1/4 Black XX.....	\$4.00
19 x 19 x 1/4 Black XX.....	8.00
9 x 19 x 3/16 Black XX.....	3.00
19 x 19 x 3/16 Black XX.....	6.00

**A. H. CORWIN & CO.**  
 5 Kirk Place Newark, N. J.

**TELEGRAPHY AND RADIO**  
 DAY AND EVENING CLASSES  
 SEND FOR PROSPECTUS  
 IN SUBJECT INTERESTED

**EASTERN RADIO INSTITUTE**  
 899-B Baylston St. Boston, Mass.

**WIRELESS BOOKS** Send for CATALOGUE and Save a Dollar

PRactical WIRELESS TELEGRAPHY By E. E. Bucher and THE WIRELESS AGE for one year, \$2.75. Regular price, \$3.75.

**WIRELESS PRESS, INC., 33 ELM ST., NEW YORK.**

**AMATEURS ATTENTION!**  
 With our No. 5A receiving set, consisting of double slide tuner, galena detector, fixed condenser, switch and binding posts for aerial, ground and receivers mounted on beautifully finished quartered oak base, shore stations and ships at sea come in with surprising clearness. Price \$4.50. Receivers 75c up. Send 25c for set of 3 rubber knobs 1" dia, suitable for loose-coupler switch knobs, detector handles, etc. 5c in stamps brings copy of code.

**McMAHON & ST. JOHN,**  
 56 West Ave., So. Norwalk, Conn.

**Printing Cheap**  
 Cards, circulars, labels, book, paper. Press \$6. Larger \$20. Job press \$85 up. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE cards, paper. **THE PRESS CO., D-47 Meriden, Conn.**

**HOW THE FRENCH LOCATED SUBMARINES.**  
 (Continued from page 9)

major problems, if not indeed the predominant one, to be met with in working out a more selective and accurate form of submarine listening device was that, whatever its form, it should be susceptible of operating and functioning on any vessel while it was under full headway, and further, that the indications given by the instrument of the direction of such sounds should be sufficiently accurate to permit the commander of the vessel on which it was installed to set a straight course for the indicated spot where the submarine lay in wait for its prey. Contrary to general opinion, many authentic instances are on record where submarines were surprised in this way during the war and sent to the bottom, sometimes by armed merchantmen or converted yachts, and again by fast destroyers or submarines. The English in particular seem to have obtained very gratifying results in fighting the U-Boats with their own submarines.

Lieut. Walsler designed his apparatus after first carefully studying a well known, yet heretofore overlooked, principle of physics, viz: that sound, identical to light, upon passing thru one medium into another, is refracted. The orthodox theory concerning the complex light beam or ray from a given object states that they comprise a number of component waves, which may be considered as parallel when their source is situated a sufficient distance, and which parallelism is upset only when an obstruction is placed in their path, when they are thus caused to enter a new medium having a density of a different value from that in which they were propagated. Lieut. Walsler had the forethought to perceive that sound waves must follow the same theory. To prove his theory, he interposed in the path of sound waves a device which would respond to various vibrations, and which formed what we might term an *acoustic lens*. As has been found in explaining the theory of light transmission, a similar effect takes place in sound transmission thru the air or water and other mediums, and the result of thus interposing such an acoustic lens or vibrating member causes the individual waves composing the complex wave propagated from a given source to come to a focus. This has the two-fold effect of intensifying the individual waves and also of isolating them precisely from other sounds emanating from the sources foreign to the one being localized. Naturally, the different sources of sound will create a corresponding number of foci, of which the geometric focus can be ascertained by mathematical computation. In a similar manner from the position of the sound focus which corresponds to any individual source of sound, the definite direction of that source can be readily estimated.

The accompanying illustrations show the "Walsler submarine detector" gear as installed on French vessels, and the detail view shows how the sound detecting lenses, which are fitted into large steel bulges or "blisters", secured to the hull of the vessel, are connected to two trumpets, which may be traversed in a circle above them, so as to accurately localize the various sounds heard from different vibrating diaphragms comprising the lenses. One trumpet picks up and localizes the sounds from the *port* lens, and the other the sounds picked up and intensified by the *starboard* lens. The spherical segments supporting the multiplicity of lenses is indicated by *A* in the detail figure. This segment is provided with a circular series of openings, *B*, each of which contains a sensitive vibrating diaphragm, *C*. The general effect of this arrangement is to focus all of the sounds picked up, the focal points all lying on a circle, *I*. As aforementioned, the vessel fitted with this apparatus has two of these lenses, one to *port*

**Just to Get Acquainted**  
 we will mail you 4 issues of

**THE PHOTO-PLAY WORLD**

The one by which all others are governed - for \$1.00

The Photo-Play World contains only the best pictures—Stories and Articles. Has a Staff of America's Foremost Writers.

Subscribe Now  
 35c a Copy \$3.50 a Year

**THE PHOTO-PLAY WORLD**  
 Bulletin Bldg. Dept. E. E. Philadelphia, Pa.

**Yankee Wireless 50c**  
 The only dependable wireless set at a low price. It is not a toy and with little practice you can send and receive clear messages anywhere as quick as a flash.

**THE YANKEE**  
 is for two complete stations—with Morse code and instructions for operating. We will also include our picture code attachment, which will enable the operator to send and receive pictures and photographs by wireless. The complete Yankee Wireless set can be obtained only from us. All charges paid for 50c money order.

**A. & B. MFG. CO., 1305 Peoria St., Chicago, Ill.**

**CLEARTONE PHONOGRAPHS**  
 \$4.00 to \$200.00 Retail

Needles 45c per thousand in lots of 500,000  
 Motors \$1.35 to \$14.75 each. Tune Arms and Reproducers \$1.30 to \$5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our \$4 page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

**LUCKY 13 PHONOGRAPH COMPANY**  
 EXPORT Dept. 46B E. 12th St., N. Y., U.S.A.

**DENINGER WILL SAVE**  
**\$40 BIG MONEY SAVINGS FOR YOU**

Used and rebuilt motorcycles, single and twin, \$25 to \$100. Used bicycles, \$5.00; tandems, \$10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, \$3.00. Complete line of parts and supplies.

Send for our catalog **Deninger Cycle Co., Rochester, N. Y.**

**YOU 25 TO 50 DOLLARS**

**Electricians**  
 Get up-to-date in HOUSE WIRING! Save TIME, MONEY, LABOR and MATERIAL by using our 98 GENUINE BLUE PRINT DRAWINGS, containing all the latest diagrams and connections known in house wiring—every diagram and connection up-to-the-minute as used by first class electricians for wiring BELLS, BURGALAR ALARMS, LIGHTS, ANNUNCIATORS, FIRE ALARMS and ELECTRIC GAS LIGHTING. These drawings are bound in the form of a flexible book (9 x 12) for convenience in using on the job. Send for them, and if they don't make you more efficient as a wireman and save you many times their cost as a contractor, return them and money will be refunded—you can't afford to be without them. ONE DOLLAR postpaid. Send for circulars on other sets of drawings.

**PATENT SPECIALTY COMPANY**  
 P. O. Box No. 583 San Francisco, Cal.

**Combination A. C. and D. C. Eight Inch DESK FAN**

detachable plug and 8 ft. of cord. Will operate on A.C. or D.C. current, 100 to 125 volts, 30 to 60 cycles; weight 10 lbs.; black enamel finish; height 11 1/2 in. A real fan—not a toy. Price \$6.50. Agents wanted.

**THE TEWNO CO.**  
 150 Chambers St., New York

**MATHEMATICS MADE EASY**

The Aracose—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.

**Dept. S. L. J. LEISHMAN CO., Ogden, Utah**

**GET ON THE VAUDEVILLE STAGE**

I tell you how. Fascinating profession for either sex. Big salaries. Experience unnecessary. Splendid engagements always waiting. Opportunity for travel. Theatrical agents and authorities endorse my methods. Thirty years' experience as manager and performer. Illustrated book "All About Vaudeville" sent FREE.

**Frederick La Delle, Sta. 49, Jackson, Mich.**



# Tobacco Habit BANISHED in 48 to 72 Hours

No craving for tobacco in any form when you begin taking Tobacco Redeemer. Don't try to quit the tobacco habit unaided. It's a losing fight against heavy odds and means a serious shock to the nervous system. Let the tobacco habit quit YOU. It will quit you, if you will just take Tobacco Redeemer, according to directions for two or three days. It is a most marvelously quick and thoroughly reliable remedy for the tobacco habit.

## Not a Substitute

Tobacco Redeemer contains no habit-forming drugs of any kind. It is in no sense a substitute for tobacco. After finishing the treatment you have absolutely no desire to use tobacco again or to continue the use of the remedy. It makes not a particle of difference how long you have been using tobacco, how much you use or in what form you use it—whether you smoke cigars, cigarettes, pipe, chew plug or fine cut or use snuff. Tobacco Redeemer will positively banish every trace of desire in from 48 to 72 hours. This we absolutely guarantee in every case or money refunded.

Write today for our free booklet showing the deadly effect of tobacco upon the human system and positive proof that Tobacco Redeemer will quickly free you of the habit.

Newell Pharmaceutical Company, Dept. 521 St. Louis, Mo.

# A-K TABLETS FOR All Pain

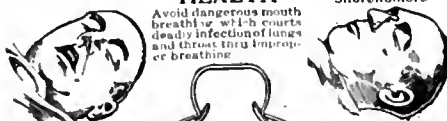
Headaches  
Neuralgias  
Colds and La Grippe  
Women's Aches and Ills  
Rheumatic and Sciatic Pains

Ask Your Druggist for A-K Tablets (If he cannot supply you, write us)

Small Size 10c Dozen Size 25c

See Monogram **A-K** on the Genuine The Antikemoia Remedy Company, St. Louis, Mo. Write for Free Samples

## LEARN HOW TO BREATHE-RITE FOR HEALTH



Avoid dangerous mouth breathing which courts deadly infection of lungs and throat thru improper breathing. Mouth breathers inhale virulent germs, and are in constant peril. At Best Supply Houses or sent direct for \$2.00. BREATHE-RITE CO., Dept. 2, Ann Arbor, Mich.

## PHOTO CRAFT

THE NEW PHOTOGRAPHIC JOURNAL Devoted to the Art of Picture Taking and Nature Work with the Camera. Four Competitions with Valuable Cash Prizes Leading to a Fifth. Send 10c for three months' trial subscription. Photo Craft Magazine, Ann Arbor, Mich.

and one to starboard of the keel. Just over these two lenses, there is built a specially solid sound-proof room or cabin, in which the operator of the submarine detector is located. The arrangement of the apparatus is such that the operator can sit in the center of the cabin with the listening helmet on his head, and by means of two ear trumpets, *D*, in the diagram, any sounds passing thru the lenses can be quickly picked up and localized for direction. One trumpet takes care of the sounds from the port lens and the other the starboard lens.

By means of the large rotating drum, which appears just to the right of the operator, the edge of said drum being calibrated, so that as the handle of the drum is turned the trumpets over the lenses are rotated about the respective focal circles of any sounds received. The control drum, which is manipulated by the operator, revolves the trumpets, *D*, which are pivoted on a fork, *E*, thru the movement, *H*. *J* represents the counterweight, which by means of cord, *K*, maintains the trumpet in such a position that its axis is always pointed toward the center of the spherical lenses. The function of the counterweight, *L*, is to maintain the balance of the movable arm on which the trumpet is supported, while the weights, *M*, *M'*, cause this arm to oscillate about the pivots, *N*, *N'*, in such a way that the rolling of the vessel is counterbalanced, thus tending to keep the mouth of the trumpet in the same horizontal plane at all times. The complete apparatus is carried by the metal frame marked *O*.

With the apparatus in use, the operator hears the sound with the greatest intensity and sharpness when the trumpet axis is in line with the focus of that particular sound. He can also hear a certain sound when the trumpet is anywhere in the vicinity of the focal point. The operator proceeds in any event to explore the various foci by manipulating the central control drum, which revolves the trumpets around the focal circles. This centralized control drum having been calibrated beforehand, it becomes a simple matter for the observer to accurately locate the direction of a certain sound, or more strictly speaking,—its origin, as soon as he has manipulated the trumpet to the proper focal setting, so as to hear the received sound with the greatest intensity and clarity. By a quick calculation based upon the value of the minimum intensity of the sound received, the range of the submarine can be approximately calculated. It is then a comparatively simple matter to steer a straight course for this spot, and if the object of the search turns out to be a submarine, then the destroyer will pass over it and discharge depth bombs upon it.

Of course the wisacre will say, it is all very well to locate a submarine and then steering a course so indicated for the object of dropping several carloads of "ash cans" (depth bombs, in navy vernacular) upon it, but what about the movements of the U-Boat, which may have paddled off a mile or so from the spot so dear to the heart of the naval officer. This problem would seem to be solved by the fact that contrary to the usual apparatus utilized for such purposes heretofore, the operator may keep right on taking the soundings of the submarine, while the vessel is under full headway and moving toward it. The sensations experienced by the submarine detection officer located in his steel-bound cubby-hole down near the keel of the on-rushing vessel, as the sound of the submarine's engines and propellers pound louder and louder in his ear trumpets, probably can be better imagined than described, for the submarine commander may have a "card up his sleeve" and be just about scrappy and clever enough to lay for the on-coming destroyer or war vessel and discharge a torpedo at it or open up with a broadside from some nifty "seven inchers."



## ASK YOUR BOSS "Does it Pay to Train?"

Put it up to the man who employs you. Don't hesitate. He'll respect and appreciate your interest. He knows the value of training—and will gladly tell you how much more you would be worth to him as a trained worker. If you're in doubt ASK THE BOSS. Ask him anyway.

**A Bigger Job** The position in your factory you'd like most in your factory is not beyond your reach. You can get that position any time you will fit yourself for it. Aim as high as you like and you will find that American School training will enable you to qualify for the job you want. KNOWING HOW doubles and trebles your earning power. If you don't think so—ASK THE BOSS.

## Why Not Try This Guaranteed Training

The American School training is so thorough, complete and up-to-the-minute that it absolutely guarantees satisfaction or your money back. In other words, you can take ten full examinations in the Course you select. Then, if you feel you are not progressing—that the instruction will not enable you to advance—you simply notify us and your money will be refunded in full. The success of our thousands of students warrants this confidence in our ability to fit you for a better paid and more congenial position.

## TRAINING Decides Your Pay

Make sure of this: the men who get more money in your factory than you do know more. Your position and pay at all times, and in any job, is governed simply by what you can DO. And that depends on what you KNOW. Make some of your spare time bring SUCCESS to you. Study in idle moments with GUARANTEED TRAINING. Make your start TODAY for a better job by checking and mailing the coupon. Free Bulletin and full details will be promptly mailed you without any obligation.

## AMERICAN SCHOOL OF CORRESPONDENCE

Dept. G-7445 CHICAGO, U. S. A.

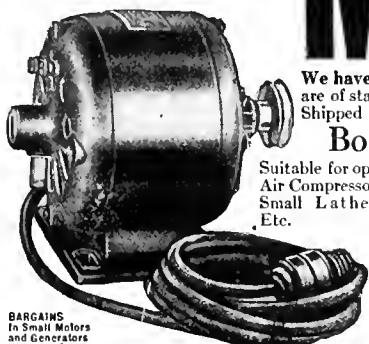
TRAINING THE KEY TO SUCCESS Explain how I can qualify for the position checked. **ASL**

- .....High School Graduate
- .....Electrical Engineer
- .....Elec. Light & Power Supt.
- .....Hydroelectric Engineer
- .....Telephone Engineer
- .....Telegraph Engineer
- .....Wireless Operator
- .....Architect
- .....Building Contractor
- .....Civil Engineer
- .....Structural Engineer
- .....Mechanical Engineer
- .....Shop Superintendent
- .....Steam Engineer
- .....Draftsman and Designer
- .....Lawyer
- .....Business Manager
- .....Certified Public Accountant
- .....Accountant and Auditor
- .....Bookkeeper
- .....Stenographer
- .....Fire Insurance Expert
- .....Sanitary Engineer
- .....Master Plumber
- .....Heating and Vent. Engineer
- .....Automobile Engineer
- .....Automobile Repairman
- .....Airplane Mechanic
- .....General Education Course
- .....Common School Branches

Name .....

Address .....

**1/4 H.P., 110 volts, A.C.  
60 cycle, single  
phase, 1750 R.P.M.**



**BARGAINS**  
In Small Motors  
and Generators.  
Write for Catalogue.

# MOTORS

We have 1000 NEW WASHING MACHINE MOTORS. These are of standard manufacture and carry the regular factory guarantee. Shipped in original boxes. Complete as cut.

**Bought from Bankruptcy Stock**

Suitable for operating Coffee Grinders, Cream Separators, Bottle Washers, Air Compressors, Small Lathes, Etc.

Mail \$3.00 cash or Money Order. We will send C.O.D. subject to full examination.  
**MONEY BACK GUARANTEE**

\$18.50

**EACH**  
Special Quantity Prices Regular Value \$34

MANUFACTURERS' DISTRIBUTER

**CHAS. H. JOHNSTON - West End - Pittsburgh, Pa.**

## THE THOUGHT RECORDER

(Continued from page 12)

ent upon wave motion, it should not be surprising therefore that thoughts or active thinking should give rise to wave motion as well.

This theory is greatly strengthened by the fact that it has been proven beyond doubt that active thinking necessitates an expenditure of energy. If you sit perfectly quiet in a chair without expending any visible muscular energy, and if you concentrate very hard upon a certain problem, it is not infrequent that perspiration appears on your forehead from the simple effort of thinking. Of course, this is rather a complex phenomenon, as the perspiration is not produced directly, but rather indirectly by the nerve centers working upon the human organs, principally the heart. Nevertheless, we know that thinking proper calls for an expenditure of energy in the brain itself. That this energy is considerable can also be shown experimentally.

It therefore cannot come as a surprise that the act of thinking should give rise to a direct wave motion, sending out from the brain certain waves in an analogous manner, to the spoken word which produces sound waves of a certain wave length. It is quite probable, however, that thought waves are simply another form of ether waves, the same as radio waves or light waves. Just as light rays traverse thru a thick glass pane without suffering any appreciable loss, just so will thought waves probably pass readily thru the human skull. If once we admit this theory it follows that it should be possible to detect such waves, and the only thing we need to know about them are the wave length and other important characteristics. We may take it for granted that the human brain, sensitive as it is, probably is not at all sensitive to these waves, and that by suitable apparatus it should become possible to detect such waves.

Just what apparatus are necessary to detect thought waves, or the effects therefrom, the writer does not venture to predict, but there is no doubt that the apparatus will be eventually found. Very little is known about the emission of the thought waves, and as a matter of fact the entire mechanism which produces thoughts is practically an unknown quantity, but every effect can be translated and recorded if once we understand its fundamentals.

Thus, fifty years ago the recording of the voice would have appeared just as fantastic as the recording of thought appears today. People then rightly said, how could it be possible to hold the spoken word; it goes into the air and vanishes instantly. But once acoustics were better understood, it became a simple matter for the inventor of the phonograph to record the voice. Similarly, the day will come when thoughts will be recorded in an analogous manner. All that is necessary, as stated above, is suitable apparatus, and this should be easy to find.

The writer, in suggesting the audion as a thought-wave detector, does not do so because he thinks that it is suitable in all respects, or even feasible. His main idea is to set the stone rolling, and get other people to think about the problem, when sooner or later something surely will emerge. The writer has suggested the audion because it is known as one of the most sensitive electrical detecting apparatus for wave motion which we have today. If thoughts give rise to electrical waves, then by winding a few turns of wire on a headband and slipping it over the head, it should be possible to detect the presence of thought waves in the audion. On the other hand, too, the audion is enormously sensitive to capacity effects,

## 4 Famous Books!



WIRELESS COURSE



EXPERIMENTAL ELECTRICITY COURSE



HOW TO MAKE WIRELESS SENDING APPARATUS



HOW TO MAKE WIRELESS RECEIVING APPARATUS

EACH ONE A BIG SUCCESS!

THE BOOKS YOU MUST HAVE

**Wireless Course in 20 Lessons**

By S. Gernsback, A. Lescaurba and H. W. Secor, E. E.

A course that tells you everything you can possibly want to know about "Wireless" starting off in lesson No. 1 by explaining the Principles of Electricity. The second and third lessons are devoted to magnetism, motors, generators and wiring. And then, by simple, easy stages, this wonderful Course takes you into "Wireless". The mysteries of "Wireless" are unfolded to you by the use of such simple language so skillfully used that of necessity you must understand every word. The subject is not treated superficially, however, for there is a whole lesson devoted to the Theory and Mathematics of this epoch marking subject. To lend charm to the Course, the last lesson (No. 20) is devoted to a history of Wireless and the men who developed it.

Size of book is 7 x 10 1/4 in., 160 pages, 350 illustrations, 30 tables.

Flexible cloth cover.....per copy \$ 50  
Stiff cloth cover.....per copy 1.00

Postpaid

**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 Experimenters. This is undoubtedly one of the most complete and comprehensive treatises of this special subject ever published. The book is written by the same authors as the famous "Wireless Course in 20 Lessons".

Every phase of experimental electricity is treated comprehensively in plain English. It is a book not only for the beginner but for every experimenter and student of Electricity. New Experiments are described and explained and nearly every application of Electricity in modern life is given in simple language.

The book contains 198 pages and more than 400 illustrations.

Flexible cloth cover.....per copy \$ 50  
Stiff cloth cover.....per copy 1.00

Postpaid

**No. 1. How to Make Wireless Sending Apparatus**

**No. 2. How to Make Wireless Receiving Apparatus**

By 20 Radio Experts.

**Two Remarkable Books**

Book No. 1 contains 100 pages, size 7 x 5 in., and 88 illustrations, paper bound.

Book No. 2 contains 100 pages, size 7 x 5 in., and 90 illustrations, paper bound.

These two books have been written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. They contain more information on how to make it than any other books we know of. Only strictly modern radio apparatus are described in these books and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments.

Book No. 1—How to make Wireless Sending Apparatus ..... 25c  
Book No. 2—How to make Wireless Receiving Apparatus ..... 25c

Postpaid

THE EXPERIMENTER PUBL. CO. Book Dept. 233 Fulton St., New York



as is well known. Thus, for instance, an oscillating audion is so sensitive that when the human hand is approached to it at a distance of even two feet, the presence of the hand will be heard plainly in the telephone receiver. If this is the case, the disturbance created in the mind should certainly make its presence felt in the audion, for thinking being first of a chemical nature, the act certainly must give rise to capacity effects. But let us assume that active thinking does not give rise to waves, electrical or otherwise, then the mere chemical action (and resulting capacity effects) should produce a disturbing influence upon the audion. These variations, if ever so slight, could then be amplified by the use of an audion or other amplifier, and the resultant effect be sent into an Einthoven string galvanometer. The small mirror attached to the string of the galvanometer will send its luminous pencil upon a light-sensitive paper tape which moves at a certain rate of speed in front of the mirror. The result will be a wavy line traced upon the paper tape in the well-known manner. The paper tape traveling on will pass thru its fixing tank, and from there will emerge from the outside of the machine after it has past thru a small drying chamber heated by electrical coils.

From this, it will be understood that a man sitting in front of his Thought Recorder will be able to actually see on a tape his recorded thoughts, the same as the telegrapher working on a trans-Atlantic cable watches his tape and its wavy line produced by the Syphon recorder, emerging from the latter. Of course, it will be necessary for everyone to learn the "thought alphabet" just as the stenographer today must learn the various characters, or as the child is taught how to read and write, and as the cable operator must learn how to read the Syphon recorder "alphabet." All this, however, is simple, and is only an educational feature once the apparatus has been invented.

The objection naturally comes to the mind immediately that even if we have a machine to record the thoughts, all we will get on the tape will be a jumble of confused thoughts, and we might get a lot of things on the tape that were not meant for recording or registering at all. Such criticism, of course, is beyond controversy for the simple reason that when you write a letter by hand or on the typewriter, you have also at first a lot of confused thoughts, but you do not record such thoughts even by hand or by machine. It often happens after you have written down certain thoughts that you must change them. The same is true of the thought recorder, of course.

Here the man who is doing the recording has a push button in his hand, shown at A in our illustration; if he does not press the button nothing is recorded. Once he wishes to record his thoughts in an orderly manner, he pushes the button and the tape begins moving simultaneously—he will begin thinking in an orderly and slow manner the subject he wishes to record. He will think just as hard and just the same as if he were to pen down his thoughts by hand. The machine will then do the rest. If he thinks the wrong thoughts, naturally the wrong thoughts will be recorded, exactly the same as if he had written them by hand. There is no difference. In our illustration, our artist has endeavored to show what will happen in the future business office when the thought recorder comes into universal use. The business man of tomorrow will dictate his correspondence on the thought recorder, while his stenographer, who is perfectly familiar with his "thought writing," will type out the correspondence from the tape, which is kept moving by electric motors, in front of her eyes. A foot pedal stops or starts the motor, and there is also a reversing attachment so the tape will run backwards should she wish to re-read a certain portion of the tape.



Make All This Come True Your Own Office—Your Own Hours

# Become a Doctor of Chiropractic

Advanced Science of Spinal Adjustment

Here is your opportunity to prepare yourself to enter the profession of Chiropractic—the modern science of relieving ills and ailments through spinal adjustment. No matter where you live or what you are now doing, you can enter this unrecorded profession—a profession of good incomes. Some of our graduates report they are making \$3,000 to \$5,000 and more a year. We teach you by mail or in class.

## FREE 22 Complete Charts in Drugless Healing

As an extra inducement to quickly secure new students we will give you, absolutely free, our 72-page book and 8 Anatomical Charts, beautifully lithographed in lifelike colors, that regularly sell for \$15, also complete set of colored Nerve, Pain Area, Concussion and other Charts that regularly sell for \$16.50.

Don't miss this liberal offer. Get these free charts by all means. See how you may qualify as a Doctor of Chiropractic and what splendid opportunities this profession offers you for gaining an independence. Never before has the demand been so great for Doctors of Chiropractic. To meet this demand, we must have more students immediately. Write today.

**Our Lessons Teach You**

- how to make Spinal Adjustments for speedy relief of
- Headache
- Indigestion
- Lumbago
- Epilepsy
- Pleurisy
- Constipation
- Rheumatism
- Asthma
- Neuralgia
- Neuritis
- Catarrh
- Fevers
- Jandice
- Dyspepsia
- Paralysis
- Etc., Etc.

Learn At Home To Be a

# CHIROPRACTOR

No special talent or advanced education necessary. If you have common school education, the way is open to you. This institution trains you either by mail or in class. Learn in your own home in your spare moments to be a Doctor of Chiropractic. It offers you a profession of dignity and prestige. Let us prove how YOU can make a good income. Makes no difference where you live or what you do now, you should be able to qualify rapidly for this great work.

## Mail Free Coupon at Once

No obligation to you whatever. Put your name and address on the free coupon or letter or postcard and get the story of Chiropractic. You will be amazed, fascinated by the facts gathered together in our free book. Be sure to write at once if you want the free charts. Mail the free coupon or a postal today, right NOW!

**AMERICAN UNIVERSITY**  
Mannierre Bldg. Dept. 487 Chicago

Mail Coupon Today

## FREE CHARTS

**AMERICAN UNIVERSITY,**  
Mannierre Bldg., Dept. 487 Chicago  
Gentlemen:—Without cost or obligation, send me by mail, your best illustrated, 72-page book and your Free Charts Offer.

Name.....  
Address.....  
City.....

## What 15¢ will bring You from the Nation's Capital

Washington, the home of the Pathfinder, is the nerve center of civilization; history is being made at this world capital. The Pathfinder's illustrated weekly review gives you a clear, impartial and correct diagnosis of public affairs during these strenuous, epoch-making days.

which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, fairly, briefly—here it is. Send 15¢ to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15¢ does not repay us, but we are glad to invest in our friends. The Pathfinder, Box 876, Washington, D. C.

The little matter of 15¢ in stamps or coin will bring you the Pathfinder 13 weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth, now in its 26th year. This paper fills the bill without emptying the purse; it costs but \$1 a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home The Pathfinder is yours. If you would appreciate a paper which puts everything clearly, fairly, briefly—here it is. Send 15¢ to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15¢ does not repay us, but we are glad to invest in our friends. The Pathfinder, Box 876, Washington, D. C.



## Long Distance Phones \$1

At last a real low priced telephone scientifically made in the Alrams Laboratories. It is not a toy and has all the features of the high priced telephones. You can have a corking good time with it. For instance, if you want to call your friend simply lift the phone off the hook and it will automatically signal and connect you with the next station. Then you can talk with your friend over the phone as long as you like. You will have your own private telephone and calling system with no operators to bother you or listen to your conversation. You can easily set up these long distance telephones from your home to the house of your friend wherever it may be located, across the street, next door or next block, or further, and you can talk as long as you want. There is no expense in operating these telephones. They are so scientifically constructed that no batteries are required. The phones supply their own current by means of a patented cable. This cable is framed for lifetime without renewing. Each set of telephones are packed complete in a box containing 2 telephones, wires and complete instructions for installing and operating. Post-paid for \$1.00. Satisfaction guaranteed. **The Alrams Co., The House of Quality** Peoria & 13th St., Chicago

# FREE TO YOU!

## Read this Remarkable Offer!



### OFFER No. 1 Wireless Course

The most comprehensive Wireless Course ever printed. Contains 160 pages, 350 illustrations. Size of book 6 3/4" x 10". Very fine flexible cloth cover.  
FREE with a year's subscription.  
Add 5c for postage

### OFFER No. 2 Experimental Electricity Course

This masterpiece contains 160 pages, 400 illustrations. Size of book 5" x 9". Printed on extra thin paper, so book can be slipped into pocket. Handsome flexible cloth cover.  
FREE with a year's subscription. Add 5c postage

### OFFER No. 3 How to Make Wireless Sending Apparatus By 20 Radio Experts How to Make Wireless Receiving Apparatus By 20 Radio Constructors

These books are by far the most successful wireless books on the market. Size of each book 5" x 7", well bound on good book paper. Covers in two colors. We really cannot praise these books too highly. Each book contains 100 pages and from 88 to 90 illustrations. BOTH books FREE with a year's subscription. Add 5c for postage

This is a very limited offer. It may be withdrawn at any time, due to the tremendous cost of paper, which IS JUST DOUBLE WHAT IT WAS ONE YEAR AGO. We have only a limited supply of these fine books on hand; after they are gone we cannot reprint the books until conditions become normal again. Now is your chance.

The publishers of this journal have earned an enviable reputation of giving more than 100 cents' worth for each dollar spent with them. Profit by this liberal opportunity NOW; it may never be made again.

## HERE'S THE OFFER

Subscribe to the ELECTRICAL EXPERIMENTER for one year, at the regular subscription price of \$2.00 per year (Canada, foreign and N. Y. C. \$2.50) and we will send you either books shown in one of the above offers. If you subscribe for two years, two offers will be given, etc.

If you are a subscriber at present take advantage of this wonderful opportunity anyway. If you do, we will extend your present subscription.

*This Offer Limited.*

*Act Now.*

**EXPERIMENTER PUB. CO.**  
223 FULTON STREET  
NEW YORK CITY

5-19  
Gentlemen:  
Please enter my subscription to the ELECTRICAL EXPERIMENTER for the term of ..... year, for which I enclose herewith \$..... You will also send me at once FREE your book..... as per offer No.....  
Name.....  
Address.....  
FILL IN - TEAR OUT - AND MAIL

**The True Wireless**  
By Nikola Tesla  
(Continued from page 63)

greatly from the intensity of the received impulses because the electric nivan between the mountains is raised, as I have explained in connection with my lightning protector in the EXPERIMENTER of February.

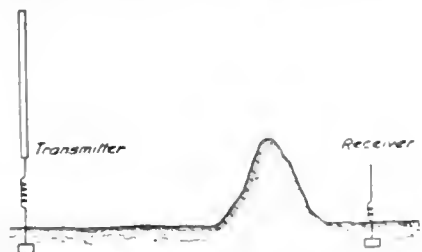


Fig. 17. Illustrating Influence of Obstacle in the Path of Transmission as Evidence Against the Hertz-wave Theory.

Again in Fig. 19 two transmitting circuits, one grounded directly and the other thru an air gap, are shown. It is a common observation that the former is far

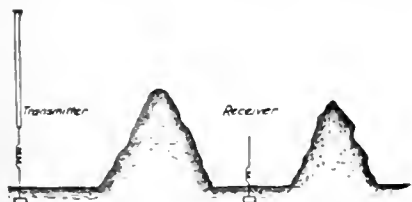


Fig. 18. Showing Effect of Two Hills as Further Proof Against the Hertz-wave Theory.

more effective, which could not be the case in a transmission with Hertz radiations. In like manner if two grounded circuits are

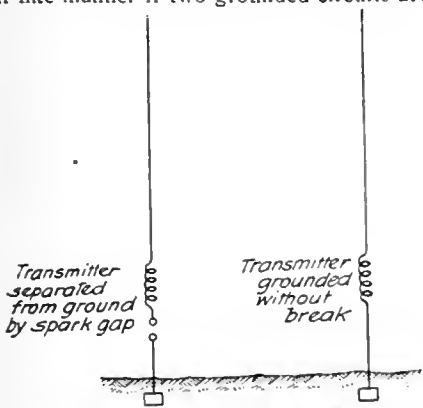


Fig. 19. Comparing the Actions of Two Forms of Transmitter as Bearing Out the Fallacy of the Hertz-wave Theory.

observed from day to day the effect is found to increase greatly with the dampness of the ground, and for the same reason

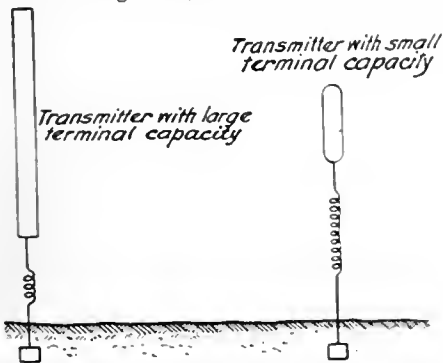


Fig. 20. Disproving the Hertz-wave Theory by Two Transmitters, One of Great and the Other of Small Energy.

also the transmission thru sea-water is more efficient.

An illuminating experiment is indicated in Fig. 20 in which two grounded transmitters are shown, one with a large and the other with a small terminal capacity. Suppose that the latter be 1/10 of the former but that it is charged to 10 times the potential and let the frequency of the two circuits and therefore the currents in both antennas be exactly the same. The circuit with the smaller capacity will then have 10 times the energy of the other but the effects on the receiver will be in no wise proportionate.

The same conclusions will be reached by transmitting and receiving circuits with wires buried underground. In each case the actions carefully investigated will be found to be due to earth currents. Numerous other proofs might be cited which can be easily verified. So for example oscillations of low frequency are ever so much more effective in the transmission which is inconsistent with the prevailing idea. My observations in 1900 and the recent transmissions of signals to very great distances are another emphatic disproval.

The Hertz wave theory of wireless transmission may be kept up for a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history.

**TO ALL RADIO AMATEURS**

We have received many thousands of communications from radio amateurs for the past few months asking us about the status of their radio stations, and when they will be allowed to operate them again.

Inasmuch as there has been no official information as to the reopening of amateur stations, during the armistice, we can only say that in all likelihood, amateurs will not be allowed to operate until actual peace has been signed. In his executive order of April the 6th, 1917, President Wilson closed all radio stations in the United States by an act approved in the Radio Law of August 13, 1912.

Such a measure, according to law, is only for the duration of the war, there being at present no legislation which prevents any station, amateur or otherwise, from operating after peace has actually been declared. Therefore, the minute newspapers announce that peace between the United States and the Central Powers has been signed, all amateur stations automatically revert to their former status, and amateurs need not wait for permission to operate their stations, once peace has been declared.

EDITOR.

**WRINKLES, RECIPES & FORMULAS.**

(Continued from page 42)

If carbon dioxid is to be generated, fill tube A with marble chips and tube B with dilute hydrochloric acid.

It is evident that the parts of the generator can be easily cleaned and new chemicals put in. The completed apparatus is shown in Fig. 3.

Contributed by S. WEISINGER, JR.



**Strengthen Your EYES!**

**Preserve Your Most Precious Possession**

Your sight is your most precious gift. Weak eyesight means weak power of observation, eye strain, eye disease, and untold inconvenience. Take no chances with your eyes—you cannot get along without them. Make them stronger every day instead of weaker. Let us send you Bernarr Macfadden's wonderful new Course in "Strengthening the Eyes." Send no money—just mail coupon.

**Glasses Do Not Remove the Cause of Eye Trouble**

Instead, the eyes come to depend on them more every day. Glasses are eye crutches! They simply bolster up the eyes—they do not strengthen them. It has been definitely proven that practically all defects of the eyes can be cured without glasses. Most people now wearing glasses can be freed from the inconvenience, and expense of constant breakages, by strengthening and correcting their vision through the simple, yet effective eye educational exercises recommended by Mr. Macfadden.

**Eye Defects Removed**

This remarkable new Course teaches you how to use your eyes without strain at all distances—how to do without glasses—how to remedy cross eyes or squint eyes—how to restore the normal sight—how to restore perfect control to eye nerves and muscles.

**Beneficial Results at Once**

No drugs, medicines or operations. The Course includes a simple, yet thoroughly scientific system of eye educational exercises which strengthen the eyes exactly as the muscles of the body can be strengthened through body exercises. Results are immediate, and improvement continues daily. One woman writes: "I notice a great improvement in my eyes since learning to use them right." Another user says, "Your Eye Strengthening Course is fine. My eyes are already improving." Still another writes, "Words cannot express my great gratitude for these excellent books." (Names on request.)

**Send No Money**

Let us send you this new Course "Strengthening the Eyes" on five days' approval. There are twenty-eight simple little lessons which will show you the way to strengthen and preserve your sight—the gift of the gods! Try the exercise, then return the Course if not satisfied and you will owe nothing. If, however, you feel that the Course will help your eyes wonderfully, send only \$5.00.

**Mail Coupon!**

If you value your eyes, if you wear glasses and want to get rid of them, if your eyes are weak or strained, or if you want to insure freedom from eye troubles, mail coupon now and investigate this new Course "Strengthening the Eyes." Send no money—but mail coupon now, as this offer may never appear again.

**Physical Culture Publishing Company**  
Dept. 5605  
119 West 40th Street  
N. Y. C.

**Physical Culture Pub. Co.**  
Dept. 5605  
119 W. 40th St.  
New York City

Gentlemen:  
Send me your Course "Strengthening the Eyes" which I will return in 5 days or send you \$5 in payment for the course.

Name .....

Address .....



**WANTED — Railway Mail Clerks**

Age 18 to 35  
\$1100 to \$2000 Year  
Common Education Sufficient  
Sure pay.  
Life job.  
Pull unnecessary.

Franklin Institute  
Dept. E101  
Rochester, N. Y.

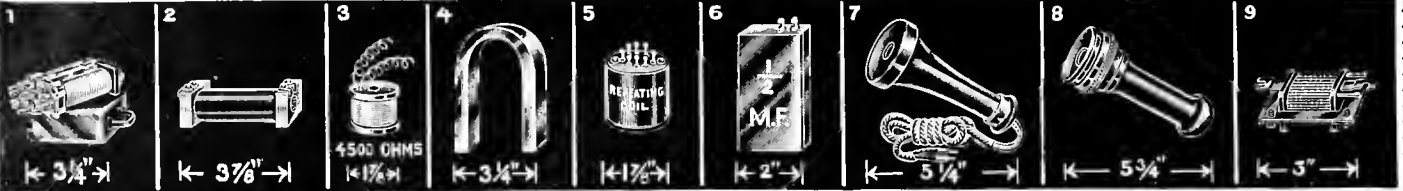
Sirs: Send me, without charge, (1) sample Railway Mail Clerk Examination questions; (2) schedule showing places of all U. S. Government coming examinations; (3) list of other government jobs now open, and (4) free book describing them.

NAME .....

ADDRESS .....



# FOR EXPERIMENTERS ONLY!!



WE have in the past held many extraordinary sales, but we believe that the present one eclipses all by the wonderful values we are offering. The goods which we offer on this page are all standard telephone apparatus. Every piece we are offering is equipment that for one reason or another was discontinued by the telephone companies. If you wanted to buy any of the pieces which we offer herewith, from the manufacturers, the price would at least be ten times what we are asking for it. You can readily ascertain this for yourself by looking over our wonderful prices.

We have bought a large block of these goods and have a large quantity of every item on hand. Immediate shipment can be made on all of the goods in practically any quantity within reason. Shipment within twenty-four hours will be made if you use the coupon at the bottom of this page. This coupon saves you several days and your order will then be considered a rush order. We guarantee every piece to be as represented, and we will refund the money if goods are not exactly as claimed by us.

**NO. 1 TELEPHONE RELAY**, 1500 ohms—has two silver-contact springs and is very sensitive. Can be used wherever a sensitive relay is needed. It is adjustable and can be used for a variety of purposes. No. 1 Relay—shipping weight, 2 lbs. Price..... **\$1.50**

**NO. 2 STANDARD TELEPHONE Induction Coil**, primary 1 ohm, secondary 55 ohms. Can be used wherever you need a good induction coil. Has primary and secondary and iron wire core; fibre heads. No. 2 Induction Coil as described—shipping weight, 2 lbs. Price..... **\$0.50**

**NO. 3 STANDARD RESISTANCE** wound with German silver wire—4,500 ohms. can be used as a choke or plain resistance, and has many other uses that readily suggest themselves to the experimenter. No. 3 Standard Resistance as described—shipping weight, 4 oz. Price..... **\$0.40**

**NO. 4 HORSESHOE MAGNET**, size 3 3/4 inches wide x 5 inches high. Will lift about 1 lb. Quality such as used on magnets, which means the best. No. 4 Horseshoe Magnet—shipping weight, 2 lbs. Price..... **\$0.30**

**NO. 5 REPEATING COIL (Transformer)**. This is a standard small repeating coil and is used by all telephone companies. It has 4 different windings and eight contacts. Entirely enclosed in iron. The resistance being respectively 72 and 120 ohms, and 90 and 100 ohms. Diagram is furnished. Can be used for wireless, for boosting signals, etc. No. 5 Repeating Coil—shipping weight, 2 lbs. Price..... **\$0.50**

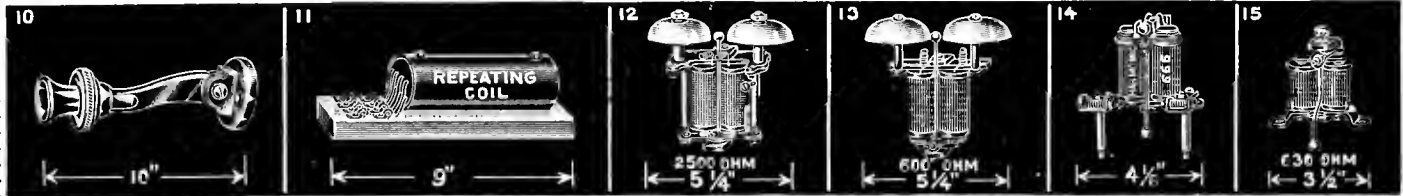
**NO. 6 1/2 M.F. CONDENSER**. This is a standard telephone condenser and has 1/2 microfarads. Condenser comes in neat metal casing. This condenser is used in connection with spark coil, to absorb the vibrator spark. Invaluable for test buzzers to absorb spark and make the sound of buzzer more steady. Is also used by every experimenter in connection with wireless where a fixed capacity is needed. Several of these condensers should be in every experimenter's laboratory. No. 6 Condenser, 1/2 M.F.—shipping weight, 1 lb. Price..... **\$0.50**

**NO. 7 DOUBLE POLE BELL TELEPHONE RECEIVER**—hard rubber casing with 4 ft. cord and tips. Standard 75 ohms—very powerful magnets. This receiver can be used in connection with any ordinary

telephone work, and you will even find it sensitive enough for short distance wireless work. No. 7 Bell Telephone Receiver—shipping weight, 3 lbs. Price..... **\$0.80**

**NO. 8 STANDARD TELEPHONE RECEIVER** with Metal Head. This receiver is made by Stromberg Carlson Co., with genuine hard rubber handle and ear cap. A very good fool-proof as well as sensitive receiver that cannot be put out of order if you try. Used for the same purpose as No. 7 Telephone Receiver. No. 8 Standard Telephone Receiver—shipping weight, 3 lbs. Price..... **\$0.75**

**NO. 9 IMPEDANCE COIL (Close Core Transformer)**. This is a very fine little transformer and is used extensively in connection with telephone work. It is in reality an A.C. transformer for which you would pay \$5.00 if you had it made to order. The primary has 0.15 ohms, secondary 2000 ohms. It can be used for a variety of purposes that will suggest themselves to every experimenter. Can be used successfully to boost wireless signals. Also in connection with audions, etc. An A-1 instrument. Size 3 x 3 inches. No. 9 Impedance Coil—shipping weight, 2 lbs. Price..... **\$0.65**



**NO. 10 MICROPHONE AND BRACKET**. An A-1 sensitive microphone of the carbon grain type. Has hard rubber mouthpiece and enameled steel bracket, the instrument being 10 inches long. This microphone, in connection with our No. 7 or 8 Receiver and No. 16 Ringer Box, will constitute a complete telephone outfit, good to speak 50 miles or more, at a remarkably low price. No. 10 Microphone and Bracket—shipping weight, 5 lbs. Price..... **\$1.00**

**NO. 11 REPEATING COIL (Transformer)**. A standard repeating coil used for telephonic work. The coil windings are encased in an iron tube 2 1/4 inches in diameter. There are eight terminals for the four windings to connect to and the instrument is invaluable in connection with radio work to boost up signals, audion work, etc. Many interesting uses will be found for this coil. Resistances are: 100, 120, 145, 175 ohms. No. 11 Repeating Coil—shipping weight, 8 lbs. Price..... **\$2.00**

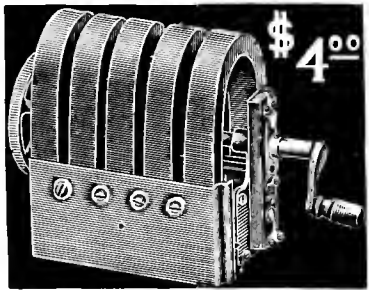
**NO. 12 POLARIZED RINGER** with Bells. The resistance of the two coils is 1250 ohms each. The armature is perfectly adjustable. Bell will work on any magnet. We also furnish blue print with ringer showing how a first class polarized relay can be made by anyone using only a few pieces of metal and screws. No. 12 Polarized Ringer with Bells—shipping weight, 2 lbs. Price..... **\$1.50**

**NO. 13 POLARIZED RINGER** with Bells. This is the same kind of ringer as the No. 12, except that it is not adjustable and that the resistance is less. First class in all respects. Blue print furnished with this to make polarized relay same as with No. 12. Solenoids on this ringer are worth more than the price we ask for the entire ringer, and do not forget a powerful magnet that goes with it. No. 13 Polarized Ringer with Bells—shipping weight, 2 lbs. Price..... **\$1.00**

**NO. 14 HARMONIC RINGER**. This ringer is also

polarized and has a powerful magnet. It works on 60-65 cycles and any magnet will operate it if run at a certain speed. A very finely built instrument. Resistance of each coil being 200 ohms. Can be converted into a polarized relay by substituting a very fine leaf spring inside the heavy one furnished. A most interesting instrument with which to experiment. No. 14 Harmonic Ringer—shipping weight, 4 lbs. Price..... **\$1.60**

**NO. 15 RINGER** without Bells—630 ohms. This also is a polarized ringer and has an adjustable armature. The adjustment is done by means of the top screw. A beautiful little instrument. With this instrument, too, we furnish a blue print showing how a polarized relay can be built. You should have several of these beautiful little instruments. They are worth their weight in gold; the powerful magnet alone being worth more than the price we ask for the entire instrument. No. 15 Ringer—shipping weight, 2 lbs. Price..... **\$0.80**



## No. 55 5-bar magneto, 110 Volt A. C. Generator

This is one of the most powerful magnetos ever built, when manufacturers could afford to put good stuff into them; equip with transmission, make and break etc. Transmission wheels are all brass, crank handle furnished. This magneto, as well as the other ones listed below, will light a 110-volt lamp merely by turning the crank handle slowly. While this magneto gives alternating current only, it can be rewound so it will light up a number of four, six and 10-volt lamps, all depending upon the thickness of the wire you wind on the armature. As we furnish these magnetos, they will give a powerful alternating current and you will not be able to stand the current when grasping hold of the terminals. This makes an ideal shocking machine. All our generators can be transformed into a direct current machine by equipping it with a home-made commutator. Those experimenters should have one of them in his shop.

Machines are A-1 in all respects and every experimenter should have one of them in his shop. Many other experiments which can be performed with this machine will readily suggest themselves to any experimenter. The magnetos furnished with these generators are very powerful, each one being able to lift one pound easily.

**NO. 55 5-BAR MAGNETO GENERATOR** as described—shipping weight, 25 lbs. Price..... **\$4.00**

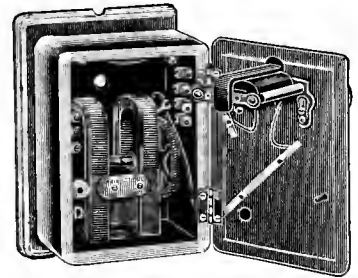
**NO. 33 3-BAR GENERATOR**, same as described above except that it has only 3 bars, and is somewhat smaller. No. 33 3-bar Generator—shipping weight, 10 lbs. Price..... **\$2.00**

**NO. 44 4-BAR GENERATOR**, same as No. 55 except that it has 4 bars, and is somewhat smaller. No. 44 4-bar Generator—shipping weight, 15 lbs. Price..... **\$3.00**

**NO. 66 6-BAR GENERATOR** same as No. 55 except that it has one more magnet and the armature is somewhat larger and more powerful. This is the biggest type made and is extremely powerful. No. 66 6-bar Generator—shipping weight, 30 lbs. Price..... **\$4.50**

## No. 16 Western Electric Ringer Box

complete with 2500 ohm polarized ringer, bells in front of cabinet. The magneto furnished is of the two-bar type, brass gear transmission to drive it, and crank on the outside of the cabinet. The cabinet is of polished oak, piano finish and if you mount our No. 10 microphone and bracket in front of the cabinet and use our No. 7 or 8 receiver, and then use a switch to break the current you have a first-class telephone outfit at a ridiculously low price. This ringer box is one of the greatest bargains that has ever been put out. Even if you do not need it for telephonic work, you should have it as the instruments themselves are worth much more money than we ask for the entire outfit.



No. 16 Western Electric Ringer Box—shipping weight, 15 lbs. Price..... **\$4.50**

### "The Livest Catalog in America"

Our big, new electrical encyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 176 Big Pages, 400 illustrations, 300 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy," 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons, FREE Encyclopedia No. 20 measures 7x5 1/4". Weight 1/2 lb. Beautiful stiff covers.

## RUSH

Cut out and attach to your order. It will leave us within 24 Hours.



**ELECTRO IMPORTING CO.,** 231 Fulton Street NEW YORK

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

I enclose herewith 6 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedic Catalog No. 20 as described.

NAME.....  
ADDRESS.....  
STATE..... E. E. 5-19





# SKINDERVIKEN TRANSMITTER BUTTON

## Transmitting Violin Music

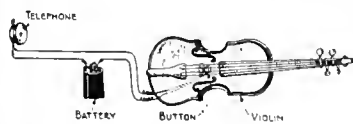


Fig. 1

Fig. 1 shows how the music of a violin can be transmitted by means of the Skinderviken button. The button may be attached to any part of the violin and if it is not desired to drill a hole into the violin which may be valuable, there are numerous places where the button can be attached by means of a small nut, or if this is not desired a small lump of sealing wax into which the thread part of the button is quickly prest before it cools, will do nicely. Music can thus be transmitted from one room to another.

## Transmitting Piano Music

Fig. 2 shows how to transmit piano music at a distance. The button is attached to the front sounding board by drilling a very fine hole into the panel, or should this not be desired, it can be attached by sealing wax as described under Fig. 1. The wire can, of course, be concealed as desired. An interesting stunt can be performed by interposing a battery into the line, and the receiver shown in our diagram can then be the ordinary house telephone receiver. Piano music can then be transmitted to your friend who may be hundreds of miles distant, and the music will be absolutely clear. The same stunt can also be performed, of course, with the violin as shown in Fig. 1.

## A Loud Talker

Fig. 3 shows how an ordinary telephone receiver can be made into a loud talker. Very often it is desired to have a telephone conversation come in so loud that every one in the room can hear it clearly. Our illustration shows how this can be done. The telephone receiver connected to the incoming line is attached to the top of the base board as shown. The only alterations will be as follows: The cap is unscrewed and its hole is enlarged somewhat to take the Skinderviken button as shown. A thin iron nut is then attached, necessary on account of the pull exerted upon it by the telephone receiver. If the telephone receiver is a single pole type, the arrangement as shown in diagram is O. K. If a double pole receiver is used, a small iron plate instead of the nut must be used, as otherwise the pulling effect will not be so good, altho still appreciable. It is important that the nut does not touch the telephone pole piece, as otherwise the transmission will not take place. It will be necessary to underlay the diaphragm with a few paper washers in order to raise it sufficiently. After the Skinderviken button has been attached, it is necessary to enclose it in a sort of sound-proof box as shown in illustration. This box may be a

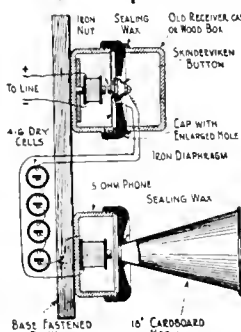


Fig. 3

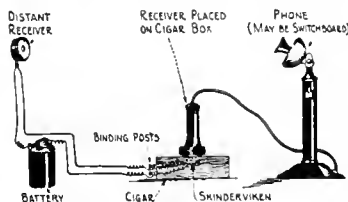


Fig. 4

turned wooden box, but an old telephone receiver shell will do nicely. It should be attached by means of sealing wax as shown, making it entirely sound-proof. The two transmitter wires are then connected to a loud talking receiver

which may be an ordinary pony telephone receiver (single pole), which must be wound to *five ohms* or otherwise the results will not be satisfactory. By winding the receiver spool full and evenly with No. 26 enamel wire, you will get about five ohms. The battery between the standard receiver and the 5 ohm receiver must be ascertained by experiment, usually from four to six volts and sometimes as high as ten volts are required. It should be noted that the Skinderviken button does not easily burn out and can stand about one ampere continuously. The more battery current put on, the louder the voice. The important part now to consider is the transmitter horn, which must be made of white bristol board, the same as used on visiting cards. Buy it at any stationery store. The horn may be from 14 to 30 inches long, and the opening at the small end should be about  $\frac{1}{2}$  inch. It can be attached by means of sealing wax to the receiver cap. On the loud talker, the ordinary receiver diaphragm will do, altho one a trifle heavier works better. No magnet is used in this receiver as the pull on the diaphragm is electro-magnetic as well as the transmission of the voice. This device talks very loud.

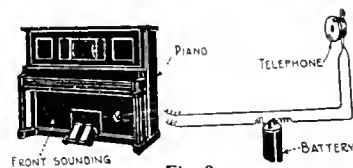


Fig. 2

## How to Make a Telephone Extension

Fig. 4 shows how you can make a telephone extension to an existing telephone system. Suppose you are a telephone subscriber and you wish to have another extra phone somewhere in the building for someone else to listen in: all you need is a Skinderviken button mounted on a cigar box as shown. When the receiver is taken off the hook, it is placed on top of the cigar box directly over the transmitter button and from there the usual line runs thru a battery to the receiver. The distant party can then hear what is being said. If it is desired to have him reply also, in that case it will be necessary for him to talk into a Skinderviken transmitter and an extra line with a telephone receiver near the house phone. The party who makes the connection would then naturally have to take the receiver and place it over the mouthpiece so that the party at the other end of the wire could hear what is said. This arrangement is not shown in the diagram, but it is self-evident.

## "Howler," and Telegraph Practice Set

Fig. 5 shows an interesting instrument called "Howler". It is used in connection with telegraph practice instruments. It gives a loud clear musical tone every time the telegraph key is depressed. From two to three dry cells are used. The construction is somewhat similar as explained in No. 4 and the illustration is self-explanatory. The underlying idea is that the single pole telephone receiver works the Skinderviken transmitter which in turn again operates the telephone receiver, giving rise to a clear note; the same as if you take an ordinary telephone receiver of your house phone and place it over the transmitter mouthpiece, only you will find that the tone of the device described above is much better and clearer. This instrument probably constitutes one of the best and simplest learner's outfits. It can, of course, also be used as a radio test buzzer, simply by connecting one of the transmitter wires to the detector. It works very well indeed.

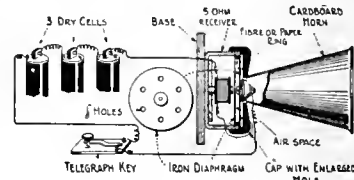


Fig. 5

SKINDERVIKEN BUTTON COMPLETE \$1.00 PREPAID

Skinderviken Telephone Equipment Co. Address us as STECO, 2118-2136 N. Clark St., Chicago, Ill. or New York City, N. Y.

# SKINDERVIKEN TRANSMITTER BUTTON

**\$1<sup>00</sup>**  
ppd.

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves.

You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *Our outfit was used by secret service operatives during the War. It is being used on the stage.* So much for its commercial adaptations! You can procure apparatus of the same type.

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position



Fig. 4

you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. In figures 3, 4 and 5 are shown some unusual and practical methods. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

Full directions for connecting up the button for use as a detectophone are given in booklet No. 4 which is sent with each button. Figures 1 and 2 of this advertisement, two of the many illustrations in booklet No. 4, show the circuit connections of the detectophone.

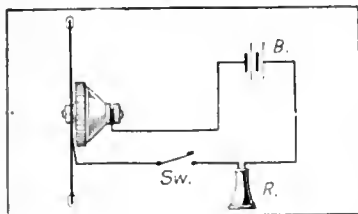


Fig. 1  
Transmitter Button mounted on Diagram. Simplest circuit.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.



Actual size



Fig. 3



Fig. 6

## BARGAINS

These prices are very low

All equipment is GUARANTEED. The apparatus is the same as sold by us to large telephone companies. 110 volt telephone generators.

3 bar.....	\$1.75	Weight 6½ lbs.
4 bar.....	2.25	" 8 lbs.
5 bar.....	2.75	" 10 lbs.
Ringers 80 ohm....	.35	" 1 lb.
" 1000 ohm....	.75	" 1 lb.
Silk cords, 6 ft. 3 cond. .20		" 3 oz.
" " 6 ft. 4 cond. .20		" 3 oz.
" " 3 ft. 2 cond. .10		" 1 oz.

Transmitters complete with  
Steco transmitter button.....\$1.50 12 oz.  
Induction coils......35 6 oz.

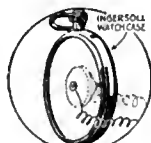


Fig. 5



Fig. 8

is being played, the sounds produced are transformed by the Skinderviken Transmitter Button into a varying electrical current. The receiver, which is located in another room, reproduces the music at that point.

Figures 7 and 8 illustrate the methods of transmitting sound by means of the vibrations in a body while speaking. Speech will be reproduced by the receiver just the same as if the experimenter had spoken into a transmitter. In these experiments the Skinderviken Transmitter Button is mounted on a small iron disc.

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

We have the utmost faith in our transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys—Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?

Send a 3c stamp for a copy of Booklet No. 4.

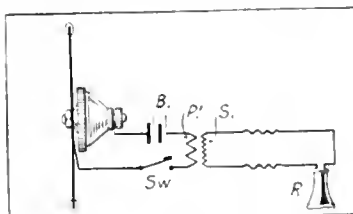


Fig. 2  
Transmitter Button mounted the same but with Induction Coil.

AMONG electrical experimenters the button has created a sensation. It is not uncommon to receive unsolicited letters like these: "I received transmitter button today and I wish to inform you that it works great and is

**\$1<sup>00</sup>**  
ppd.

*the best I have ever seen or heard of for the price. I will certainly recommend it to my friends. I wish to thank you for your good service."*

"I have been using one of your transmitter buttons, and it has proved to be worth more than its value in my experimenting." "I received one (Transmitter Button) some time ago, and they are just O. K. for experimental work and it certainly lives up to all you say for it and then some."

Mr. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In writer's opinion, obtained by actual elaborate tests, your Transmitter Button is probably most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

Figures 6, 7 and 8 suggest some very interesting experiments. That of reproducing music at a point far removed from the phonograph is very popular with experimenters. The Skinderviken Transmitter Button is mounted in a very small hole in the under side of the sound arm. (Note: This hole will not injure the quality of the music.) When the phonograph

is being played, the sounds produced are transformed by the Skinderviken Transmitter Button into a varying electrical current. The receiver, which is located in another room, reproduces the music at that point.

Figures 7 and 8 illustrate the methods of transmitting sound by means of the vibrations in a body while speaking. Speech will be reproduced by the receiver just the same as if the experimenter had spoken into a transmitter. In these experiments the Skinderviken Transmitter Button is mounted on a small iron disc.

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

We have the utmost faith in our transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys—Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?

Send a 3c stamp for a copy of Booklet No. 4.

## USE THIS COUPON

STECO, 2134 North Clark St., Chicago, Illinois, or New York City, N. Y.  
Gentlemen:—Please enter an order for

- [ ] Skinderviken transmitter buttons..... @ \$1.00 prepaid
- [ ] 110 volt generators..... bars..... @ ..... Wt. .... lbs.
- [ ] Ringers..... ohms..... @ ..... Wt. .... lbs.
- [ ] Cords..... conductor..... ft..... @ ..... Wt. .... lbs.
- [ ] Induction coils..... @ .35 Wt. .... lbs.
- [ ] Transmitters with T. Button..... @ 1.50 Wt. .... lbs.
- [ ] Telegraph Keys..... @ 1.25 prepaid

(Use Pencil)  
Enclose sufficient postage for mailing

E. E. 5-19

Ship to.....  
.....  
.....  
Send Booklet No. 4. [ ]

## Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section seven cents a word for each insertion. No advertisement for less than 50c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the June issue must reach us not later than April 22.

The Circulation of the Experimenter is over 100,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

### Automobile Accessories.

**Liquid Silk** Automobile Polish, finish lasts as long as new car, or money back. Sample 25c. Prepaid. Liquid Silk Mfg. Co., Delanson, N. Y.

**Ford power Mechanical Products** greatly increase ability Ford Cars, Sedans, Trucks, Tractors, Racers, "4 Speed Forward Auxiliary Transmission"; "Double Power, High, Low, Reverse; Powerful Motor Brake descending hills; "Absolute Neutral." Easy winter cranking. "Full-power" "16-Valve Cylinder Head," 20%-64% Power increase, government test. Other Ford Power Devices coming. Opportunity agent, dealer, owner. Send for trial plan K. Victor-Ford Trans. Mfrs., 246-248 W. 54th, New York.

**Fords** run 34 miles per gallon with our 1919 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days trial. Air-Friction Carburetor Co., 270 Madison St., Dayton, Ohio.

### Aeronautics.

**Flies 2,000 Feet**—Manhattan Racer, 26" wing spread, made finest materials, strictly a speed and distance aeroplane for amateurs. Great for spring and summer outdoor sport. Complete materials, knockdown, carved propellers, assembling and flying instructions, \$3.50 Postpaid in U. S. Blueprint only, 35c. Postpaid. Blueprint Bleriot racer, guaranteed 600 foot flyer, 35c. Postpaid. Hec Aeroplane Co., 6 West 48th Street, New York City, N. Y.

### Motorcycles.

**Motorcycles from \$25 up**—New and second-hand. Easy terms, large list to choose from, all makes. Send 4c. stamp for Bulletin "A." Peerless Motorcycle Co., Watertown, Mass.

### Telegraphy.

**Telegraphy** (both Morse and wireless) and Railway Accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 7th St., Valparaiso, Ind.

### Stamps and Coins.

**100 Different Stamps 10c., 200, 25c** Michaels, 5600 Prairie, Chicago.

**Free**—Packet Valuable Stamps to Applicants 50% Approval. Benj. Forbes, 160 Devilliers, Pittsburgh, Pa.

**300 Different Stamps, 35c;** 100 different U. S. 2c. C. Reitter, Box 1054, Detroit, Mich.

**78 Different Stamps** to approval applicants. Enclose 5c. Harland Burgett, 419 Spring St., Lima, Ohio.

**For Sale**—Twenty large American cents, all different dates, for only \$1.55. Old coins bought up to 1916. Catalogue, 10c. Savage, 436 Melville St., Rochester, N. Y.

**Stamps—61 all different free.** Postage, 3c Mention paper. Quaker Stamp Co., Toledo, Ohio.

**Stamps**—Send 25c. for our collection. Some fine ones. Facastenz, 425 LaGrave, Grand Rapids, Mich.

**California Gold**, Quarter size, 27c.; Half-dollar size, 53c.; Dollar size, \$1.10; Large cent, 1820, and catalogue, 10c. Norman Shultz, Kings City, Mo.

**500 Finely Mixed** United States or Foreign Stamps, 12c. Philatelic Star, Madison, N. Y.

### Old Money Wanted.

**We Buy and Sell Old Coins.** \$2 to \$500 each paid. Keep All Old Money; you may have valuable coins. Send 10c. for New Illustrated Coin Value Book, 4 x 6. Guaranteed prices. Get posted. Clarke Coin Co., Box 110, Le Roy, N. Y.

### Tricks, Puzzles and Games.

**Magic-Card Tricks**—Sensational Escapes—Jokes—Novelties. Everything in the amusement line. Large illustrated catalog of a thousand tricks free. Write today. Largest amusement goods manufacturers in the world. Heaney Magic Co., Desk 200, Berlin, Wisconsin.

**Leading Magical Magazine!** All magicians like it! You will, too! Why? The value is there. Sample, 10c.; three months, 25c.; year, \$1.00. Eagle Magician, Dept. E, Minneapolis, Minn.

**Black Art Hindoo Experiments**, 1919 Edition, 25c. Invisible Ink. Free Trick. Catalogue each order. Linhorst Magic X Shop, St. Louis.

**1000 Stage Tricks** with 500 illustrations. Catalogue 10c.; small catalogue free. Hornmann Magic Co., Sta. 6, 170 Eighth Avenue, New York.

**Tricks, Puzzles, Jokes, Toys, Games, Novelties, Doll and Cane Racks, Plays, Wigs, Stage Supplies, Escapes and Illusions.** Large 1917 catalog free. Oakes Magical Co., Dept. 549, Oshkosh, Wis.

**100 Kinds Wire and Steel Puzzles.** Catalog and leader, 10c.; postpaid. Western Puzzle Works, St. Paul, Minn.

77 S. Spencer Street,  
Aurora, Ill.  
Feb. 6, 1919.

Editor E. E.

Dear Sir—The small ad I had in the February issue is surely bringing some great results, about six letters each day from all over the United States and Canada.

I would like to know the price of one insertion of the one-inch ad I am including also cost of six insertions.

Please answer quickly.

Yours truly,

HOWELL RANG.

### Exchange Ads.

**For Sale**—Single barrel shotgun, 110 v. Portable electric heater, Hawkins' Guides, Zeno chewing gum vending machine, and other articles. For description and prices, send three-cent stamp. Earl Brown, 514 Virginia Ave., Martinsburg, W. Va.

**Wanted**—Small motion picture machine for home, price about \$10. Donald Porter, Frazee, Minnesota.

**Sell**—Motorcycle engine; telescope; chemicals; electric motor. Shank, 521 Jefferson St., Dayton, Ohio.

**For Sale**—1 K.W. Packard transformer, round detector and amplifier bulbs. Will buy old type General Electric Induction Fan Motor. Harry Weber, 113 Walnut St., Dover, Ohio.

**Wanted**—Rifle telescope sight and Kraig rifle or carbine. A. L. Chamberlin, Box 132, Davenport, Iowa.

**Bargains**—Cyclopedia Applied Electricity, \$15.00; Popular Science Library, \$10.00; Excellent condition. First money order takes same prepaid. T. H. Blacknull, Box 107, Raleigh, North Carolina.

**Sale**—Regenerative Receiver, Storage Battery, other apparatus. Write for description. Thompson, 36 John St., Worcester, Mass.

**For Sale**—Twin Motorcycle, or engine, New Sayville Rotary spark gap, \$7.00. Two Portable Wireless Sets, spark coils, wireless and electrical instruments. H. Gary, 600 Main St., Aurora, Ill.

**Wanted**—Smith motor wheels. Johnston, 9 Rutherford, Binghamton, N. Y.

**Wanted**—Small Graflex camera. A. Hofman, P. O. Box 809, City Hall Sta., N. Y.

**For Sale**—Wireless instruments. Vincent Natalish, 68 West 56th St., New York City.

**Head Set**—New Brandes distance phone—3,000 Ohm, \$13.50, sell \$8.00. Send stamp, large list Receiving Electrical apparatus. Dare, 94 Clinton Ave., Brooklyn, N. Y.

**For Sale**—Omnigraph five dials clock driven wireless code, quenched gap, polarized relay 5 ohms, stepup transformer. Will accept no less than \$25 for outfit. Pastime Theatre, Union Hill, N. J.

### Exchange Ads.—Continued.

**Sell**—Variety of articles, apparatus, etc. Write wants. Send stamped envelope. Vernon Palen, Sparta, Wisconsin.

**"Multi-Audi-Fone"**, brand new, \$15. Try this with your Audion or any detector. C. Francis, Box 1504, Providence, R. I.

**Wanted—Quick!** Volumes 1, 2, and 3 "Electrical Experimenter" either bound separate or any odd copies purchased. Good prices offered. Write for particulars and price to Box 70, Care Electrical Experimenter.

**For Sale**—Receiving set \$10.85; consists of 15 and 7 inch double slider coupler, cat-whisker, detector, 14 point loading coil 17 and 3 inch. Have other wireless things. Send for list quick. George Faunce, 5 Green Street, Millville, N. J.

**Cheap**—Cyclopedia Applied Electricity. Stamps, Coins, junk. Howorth, University, Miss.

**Exchange**—Cycle-car for Smith Motor Wheel or bicycle engine or \$50. Send stamp for particulars. Carl Mayo, Orleans, Mass.

**Wanted**—Whimshurst Static Machine. All letters answered. J. Picucci, 670 57th St., Brooklyn, N. Y.

**For Sale**—Shaw Motor attachment, \$20. Harold Lambert, Haverstraw, N. Y.

**Typewriter**—Like new—For sale or exchange. John Galbreath, Rogers, Ohio.

**For Sale**—25 Watt Dynamo parts, \$10. 1/2 K.W. Transformer Coil, \$5. Electro Oscillation Transformer, \$5. Loose Coupler, \$2. Navy Receiving Transformer, \$15. Blitzen Variable Condenser, \$3. Murdock Variable Condenser, \$3. Variable Condenser, \$2. Ground Switch, \$1.50. 2000 ohm phones, \$2.50. Home Medical Apparatus, \$3.50. Post Card Projector, \$3.50. Bell Ringing Transformer, \$1.50. \$30 Mecanuo, \$20. All in good order. First draft or money order takes them. Burrows Rogers, Cainsville, Mo.

**Sell or Exchange**—Ford Gray & Davis Starting and Lighting system; Shaw bicycle motor attachment. Want Dynamo 1/2 K.W. or larger, 24 to 60 volts direct current, or screw cutting lathe 8" swing or larger. Frank Pantel, Muscatine, Iowa.

**For Sale**—Blueprints of motor windings, see ad under Blueprints, etc., this issue. Charles L. Chittenden, 811 West 181 St., Kansas City, Mo.

**I have** wireless apparatus and other things for sale. Write for list now. George Sharp, 73 Everett Ave., Providence, R. I.

**Sale**—Send stamp for list of wireless instruments, all bargains. Geo. Sprouls, 5624 Palethorpe St., Philadelphia, Pa.

**Sell**—New \$50 Phonograph, \$25. C. Gillespie, 72 Woodward, Buffalo, N. Y.

**Sell**—Motorcycle engine, \$10.00; Magneto, \$3.00; Spark coils, \$1.50; Generator, \$1.25; Motor, 75c. Harley-Davidson Motorcycle, \$30.00. Ruben Hillborn, Brown City, Michigan.

**Wanted**—1/2 K.W. transformer, Packard or Thorderson. Clyde Stream, 2537 Elmwood, Kansas City, Mo.

**Boys!** Big mechanical Engineering Set. Contains three motors. All for \$75.00, cost a lot more. Send cash in registered letter. Russell McQuilkin, Millport, Col. Co., Ohio.

**Pocket Tester** for electricians, trouble-shooters and maintenance men. For use in place of lamps on 90 to 500 volt lines for locating shorts, grounds, opens and blown fuses. Size 2 1/2" x 5", in neat leather case with leads for testing. \$1.50 postpaid. Falls Electric Shop, Cuyahoga Falls, Ohio.

**Sell**—White Cross Vibrator. Almost new, half price. Write Wm. Waldrip, Atico, Ind.

**Sale—Swop.** Whole Laboratory! Electrical Bargains. Write for list. All answered. Chas. Derrick, Grampian, Pa.

**For Sale**—\$60.00 Regina Vacuum Cleaver with attachments, \$25.00. P. Crawford, 13 Ten Broeck St., Albany, N. Y.

**Sell**—5 H.P. 2 cylinder gasoline engine, \$46. Will exchange for screw cutting lathe. Herbert Sicklesteel, 802 12th St., Detroit, Mich.

### Scenery for Hire.

**Collapsible Scenery** for all Plays. Amelia Grain, Philadelphia, Pennsylvania.



**Agents Wanted**

**Easy, Pleasant Work** for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Nuvelty Cutlery Co., 308 Bar St., Canton, Ohio.

**Insyde Tyres**, inner armor for automobile tires, double mileage and prevent punctures and blow-outs. Quickly applied. Costs little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

**Mechanical Novelty for Old and Young.** Barrel of Laughs—Amusement and Fun. Everybody possible customer. Samples with particulars, 25c. Rullet Co., Hartford, Conn.

**Klean-Rite** Marvelous Washing Compound. Whirlwind seller, Great Repeater. Big Profits. Shipments prepaid. Special offer and samples free. Bestever Products Co., 246-L5 Polk St., Chicago, Ill.

**\$10 Daily** refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Av. D, Decatur, Ill.

**Miracle Motor-Gas** amazes motorists, 3c. worth equals gallon gasoline. Eliminates carbon, 300% profit. Isom, Idaho, wires: "Ship 500 packages. Made \$70 yesterday." Samples free. Chas. A. Butler, Sec'y, Dept. 70, Toledo, Ohio.

**"History of the World War,"** by Francis A. March, brother of General March. Authentic, complete—750 pages—illustrated—official photographs. Freight paid—credit given. Agents making fortunes. Free Outfit. Victory Publishing Company, 649 Manhattan Bldg., Chicago, Illinois.

**Install Farm Lighting Plants.** Big Profits. Get our Agency Plans at once. Wolke Co., Louisville, Ky.

**Cameras, Supplies—Photo Developing.**

**Kodakers:** How would you like to get a 9 x 11 enlargement of your best negatives free? Drop us a card right now asking about it. Films developed at 10c. per roll, prints 3c., 4c. and 5c. each. Satisfaction guaranteed. Ford's Foto Studio, Ellensburg, Washington.

**Mail Us 15c** with any size film for development and 6 velvet prints. Or send 6 negatives any size and 15c. for 6 prints, 8 x 10" mounted enlargements 35c. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

**Frane's Brownatone 25c.** Tones 250 pictures beautiful brown; easy as washing prints. Frane, Eureka, Ill.

**Special Trial Offer.** Your next Kodak film developed, 5c. Prints 2c. each. Moser & Son, 1910 St. James Ave., Cincinnati, O.

**Clean, Neat, Perfect Kodak Finishing** at the lowest prices. Work returned the same day received. Send film for sample print and copy of Catalog on Developing, Printing, Enlarging and Hand Coloring, also copy of Photo Craft Magazine, which will help you make better pictures. Photo Craft Co., Box 69, Ann Arbor, Mich.

**Make real mystic photos** without camera or plates by using Star Photo Papers. No experience necessary. Complete outfit for making 15 pictures, 25c. Abrams Co., 1305 Peoria St., Chicago.

**Any six or eight exposure film** up to Post Card size developed and printed, 10c. or enlargement, 8 x 10, your favorite negative, 20c. Special introductory offer to show high quality work. Associated Photo Co., Dept. 12, Cincinnati, Sta. A.

**Chemicals.**

**Chemicals and Laboratory Apparatus** for analysis and experimenting. April list 5c. Frane, Eureka, Ill.

**Chemicals** or chemical apparatus—We have just what you need. Our lists are without end. State your requirements. We also make up experimental sets of any value. The particulars of our standard sets will be furnished upon request. Zeigler Experimental Laboratory, Rochester, N. Y.

**Stammering.**

**Stammering** permanently eradicated at home. Cure positively guaranteed. Particulars free. Cheshire Training System, Keene, N. H.

**For Advertisers.**

**Unheard-of Trial Offer!** Inch display or 30-word classified advertisement ten weeks, \$1.00. Record Advertiser, Box 2E, Houston, Va.

**"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America";** A little story of results told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 30th St., New York.

**Business Opportunities.**

**Make Die-Castings.** Sketch, Sample, Booklet, and Proposition, 12c. Byrd & Blair, Box 227E, Erie, Pa.

**Why Sell Perfumes and Toilet Goods** for others? Make your own; get all the profits. Particulars, Laboratory Box 1316-X—Memphis, Tenn.

**Manufacturer** desires electrical specialties. Devices or supplies having possibilities of large sales wanted. What have you? North Phila., Pa., P. O. Box 9801.

**Earn Money at Home.** "The Reliable Plan" tells how. Ten cents. Edw. C. Maher, Dover, New Jersey.

**Victory—Mechanical Toy Soldier** window attraction, 30 inches high. Salutes, turns head, points with finger, etc., as set. Well made, nicely dressed officers, privates, Uncle Sam, etc. Electrically operated. Does some stunt every half minute or oftener as set and will salute soldier and pay no attention to other if desired. Representative wanted in each city and town. Write for prices. The John M. Biggs Co., Box 324, Chattanooga, Tenn.

**Dollars Yearly in Your Back Yard.** No gun-seng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

**Enter a new business.** Earn \$3,000 to \$6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

**Build Up an Income in Oil** Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan now—it may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. K, Houston, Texas.

**\$30.00 a week evenings.** I made it with a small mail order business; continued my regular job daytime. Free Booklet tells how, 2 cents postage. Albert W. Scott, Cohoes, N. Y.

**Patents for sale.** To buy or sell patents address Patent News-11, Washington, D. C., only inventors' newspaper published.

**Install Farm Lighting Plants.** Big Profits Get our Agency Plans at once. Wolke Co., Louisville, Ky.

**"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America";** A little story of results, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet, which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 30th Street, New York.

**Are you in search of a formula** to produce a certain preparation? If so, perhaps we can help you. We are ever on the alert and closely following the development of the industrial arts in all its branches. Our standard price for each formula or process issued is thirty-five cents. Let us hear from you. Industrial Methods Bureau, 320 Fifth Ave., New York City.

**Iceless Refrigerators.** Particulars for stamp. Bachman, Box 57, Fullerton, Penn.

**Hurry: Our First Issue.** Plans and specifications for building National Advertising Weather Service. Sales talk picture of finished machine, etc. Profit \$150.00 for manufacturer. Protected territory. Descriptive literature, terms and picture 25 cents. None free. National Sales Co., Box 421, Lima, Ohio.

**Start a profitable business** manufacturing "Puffed Crisp". Delicious confection. Whirlwind money-maker. Machine, instructions complete \$6.50. Samples 10c. Bestever Products Co., 246-E5 Polk St., Chicago.

**Want to make \$30 a week** in spare time? Particulars, 20c. Walker, Box 465, Dayton, Ohio.

**Opportunity—I have a comprehensive, electrical idea;** available for development, that should revolutionize a certain industry. Interesting research is here afforded experimenters and inventors in something new, useful and worthwhile for amateur and experienced electrical people. Postpaid three dollars. Roy Y. Hughes, Electrician, Mitchell, South Dakota.

**Big possibilities in new profession.** Easy to learn in comparatively short time. Field of practice unlimited. Many so engaged earning \$2,500.00 to \$10,000.00 a year. Exceptional opportunities for women. Write to Howard College, 527 S. Ashland Blvd., Chicago, Illinois.

**Collections.**

**How to Collect Accounts;** also Exposure of Membership and Contract Collection Agencies. Booklet 25c. Smith Mercantile Agency, Jefferson, Ohio.

**For Men.**

**Razor Blades** sharpened right. Single edge 2 cents, double edge 3 1/2 cents. Knowledge Shop, 7 South 10th, Philadelphia, Pa.

**Help Wanted.**

**30 Men-Women, 18 or over,** wanted immediately. U. S. Government positions. Commence \$42 month. Vacations. Common education sufficient. Hundreds Permanent Peace Positions. Write immediately for list. Franklin Institute, Dept. E 26, Rochester, N. Y.

**Wanted Ambitious Workers** to start Collection Bureaus. Be independent—make big income yearly. We train and refer business to you "Scientific Facts" free. National Collection Bureau, Dept. 29, 65 Maynard, Columbus, O.

**Dollars Saved—Used** correspondence courses, bought and sold. MacMichael Educational Bureau, Victor, N. Y.

**Be a Detective.** Good income. Excellent opportunities to travel. Particulars free. Write American School of Criminology, Dept. E, Detroit, Mich.

**Make Die-castings.** Sketch, Sample, Booklet and Proposition, 12c. Byrd & Blair, Box 227E, Erie, Pa.

**Books.**

**Books for Real Live People.** Lists free. J. E. Sheridan, 417 E. 151st St., New York.

**Dear Reader—If Occult, New-Thought and Scientific** books appeal to you, send for my catalog, it's free. I have books on Personal Magnetism, Concentration, Spiritualism, Clairvoyance, Seer-ship, Will, Mind, Hypnotism, Mesmerism, Character Reading, Healing, Mysticism, Success, Salesmanship, Mechanics, Entertainment, etc. A. W. Martens, J-49, Burlington, Iowa.

**24 Money-Making Formulas, 25c.** \$15 course in candy making—6 complete lessons for 50c. Both books 60c. Alton Studio, Alton, Iowa.

**Where to Buy Right; How to Advertise;** no expense 2—25c. Box 115, San Francisco, Calif.

**Invisible Inks—30 formulas,** 15c. Horton P. Jones, Perry, Ia.

**"Nature Book"** facts every married and engaged person should know, 35c. Central Company, 509 Ninth Avenue, New York.

**World-Romic System, Masterkey to All Languages.** Six Textbooks, \$1.44. French Chart, 37c; Spanish, 37c; Aviation Dictionary, \$1.50. French-English Aviation Dictionary, 61c. Languages, 143 West 47th, New York.

**To Get Better Pictures:** Read the Amateur Photographers' Weekly; illustrated; weekly prize competitions; print criticisms; many unique features; \$1.50 per year; three months' trial subscription 25c. Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

**Old E. E. Back Numbers:** We have some valuable old E. E. back numbers on hand as follows: 1915—Jan., March, April, May, June, July, Aug., Sept., Oct., Nov., Dec., price each 35c. 1916—Jan., Feb., March, May, June, Sept., Dec., price each 35c. 1917—Jan., April, May, Aug., Nov., Dec., each 35c. 1918—Jan., Mar., May, 35c; 1918—June, July, Aug., Sept., Oct., Nov., Dec., each 20c. 1919—Jan., Feb., Mar., Apr., 20c. We can fill orders at once upon receipt of your remittance, and if you have not these numbers already, now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

**Health.**

**Tobacco or Snuff Habit Cured** or no pay; \$1.00 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

**Pyorrhea—H. E. Kely,** D. D. S., M. D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea. Purifying, healing, preventative. Full month's treatment and booklet \$1.00. Circular free. Dr. H. E. Kely, 106 Gladwin Ave., Leonia, N. J.

**Cigarette, pipe or chewing habit conquered.** Nature's method. Guaranteed. Write for free brochure. Edw. J. Woods, T.A. 300, Station F, New York.

**Formulas.**

**500 Formulas,** Resilvering Mirrors, Renewing Dry Batteries, Luminous Paint, Mechanics' Soap, 25c. Catalogue 2c. Ideal, 5501-E North Robey, Chicago, Ill.

**20,000 Formulas, \$1.00 postpaid.** List 4c. Oscar C. Hanson, Mentor, Minn.

**Consult Us** when in need of definite and reliable data concerning any trade formula or industrial process. Our standard price for each formula or process issued is Thirty-five cents. Write us now. Industrial Methods Bureau, 320 Fifth Ave., New York City, N. Y.

**News Correspondents.**

**Earn \$25 Weekly,** spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Continued on page 94

## For Inventors.

**Inventors.** Protect your Idea before exposing it. Advice Free. Inventor's Patent Service, Park Row Building, New York City.

**600 Mechanical Movements**, also illustrations and explanations of 50 perpetual motions. My book, *Inventors' Universal Educator*, 4th edition, tells how to procure and sell a patent for your new invention. Government and other costs. Covers the matter from A to Z. 140 pages elegantly bound. Contains noted Court decisions on Patent cases. Mechanical Movements greatly assist inventors—suggest new ideas that might prove of great aid in perfecting inventions. Tells how to select an attorney. Has valuable information regarding Patent Sharks, Selling Agents and Brokers. Price \$1. Postage free. Fred G. Dietrich, 603 Ouray Building, Washington, D. C.

**Inventions Commercialized.** Cash or royalty. Adam Fisher Mfg. Co., 205 St. Louis, Mo.

**Inventors** join National Institute of Inventors, World Building, New York City; membership society 1,000 strong; will help protect, develop, finance and market your invention. Absolutely no charge. Write for booklet.

## Patent Attorneys.

**Patents Procured—Trade Marks Registered**—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Bldg., Washington, D. C., or 2278-T Woolworth Bldg., New York.

**M. F. Miller**, Ouray Building, Washington, D. C. Patent Attorney, Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

**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. American Industries, Inc., 212 Patent Dept., Washington, D. C.

**Inventions Patented.** Trade-marks Registered, Labels, Prints and Publications Copyrighted, reasonable fees; correspondence solicited; detailed information free; booklets. Jaynes & Jaynes, 702 Kellogg, Washington, D. C.

**Protect Your Invention.** Personal Service. Send sketch for honest advice. J. Reaney Kelly, 732 C, Woodward Bldg., Washington, D. C.

**Patent Your Own Inventions.** Save attorney's fees; we prepare applications; furnish full instructions and give satisfaction. Free information. Carl Larsen Co., Park Row Building, New York City.

**James N. Lyles**—Patents, trade-marks, copyrights. 734-D Eighth St., N. W., Washington, D. C.

**Patents**—My fee payable in monthly installments. Send sketch for advice. Booklet free. Frank Fuller, Washington, D. C.

**John M. McLachlen**, Atty. at Law, Patents, Trade Marks, Copyrights, 410 McLachlen Bldg., Washington, D. C.

**Patent Attorney**, Electrical Engineer, Mechanical Expert; Thorough Personal Service. Frank Ledermann, 21 Park Row, New York.

## Printing.

**100 Quality Printed Envelopes**, size 6 1/2 x 5 1/2. Postpaid. Name cards same price. R. Wiese, Atlantic, Iowa.

**100 Engraved Style Visiting Cards** 50c; 100 Emblem Cards 70c. H. Gregory, Warwick, N. Y.

## Wireless.

**Complete receiving sets** \$8.50, \$9.50 and up. Instruments, parts, minerals. Circular for stamp. Inquiries invited. Jenkins, 923 Purchase Street, New Bedford, Mass.

**Switch Points.** Binding Posts, Switch Levers, and small parts, send 2c for catalogue describing these and other goods. A. W. Bowman & Co., 23 Church St., (Harvard Square), Cambridge, Mass.

**Before you build** that new set get our free circular on switches and contact points. Hard rubber knobs used. Eureka Secondary Co., 6939 S. May St., Chicago, Ill.

**Radio Apparatus of Quality**—Manufactured to your own specifications. Radio Engineering Company, Baltimore, Md.

**Bargains**—3/4" Wireless Coils complete, guaranteed, 90c., except postage. Also Wireless coils without vibrators, 45c., except postage. A. Dubbs, 1534 Pitkin Ave., Brooklyn, N. Y.

**Our Universal Radio Receiving, Detector, and Transmitting apparatus.** The best that science and skill can manufacture. If interested write for catalogue. Universal Radio Mfg. Corporation, Elmira, N. Y.

**Amateurs!** Drop us a postal and receive interesting information that is of vital importance to you and future amateur radio. American Institute of Radio Engineering, Omaha, Nebr.

**Gold Catwhisker** is best for mineral detectors. Hard drawn 18 Kt. Gold Wire 26 B. & S. 3 1/2 inches, 50c. Sterling silver, 15c. Geo. Schuler, Jr., 126 W. 46th St., New York City.

## Patents for Sale.

**Automobile Direction Indicator**, Electrically operated. Just Patented. Manufacturing cost low. Ability to Finance means money. Royalty or contract. Investigate. L. A. & A. A. Ownbey, 1210 East 5th St., Chattanooga, Tenn.

## Miscellaneous.

**Wanted**—Small Gasoline and Steam Engines. Cash paid for 1 to 4 cylinder light weight Motors. 14 to 10 H.P. Johnston, West End, Pittsburgh, Pa.

**Blacksmith, Listen!** Prepare for big wages in Navy and Arsenal with Toy's Modern Methods doing hard jobs easy. Forging and making solid welds, hardening and tempering to a standard, with colored tempering charts. All for one dollar. Sample free. W. M. Toy, Sidney, Ohio.

**Snow Plow.** Removes snow from sidewalks, etc. Easy to raise or lower. Thoroughly tested. (Can also be used as toy. A. H. Tallyn, Benson, Ill.)

**Be a Top Notcher**—Get into the 100% Class. Be Prosperous, Powerful, Happy. Our system has shown thousands HOW. It can show YOU. No guesswork. Proved. A true-to-life Personality Sketch and first lesson on Happier Living for you and birthdate. Thomson-Heywood Co., Dept. 350, Chronicle Bldg., San Francisco, Cal.

**For Sale**—Choice Silver Black breeding foxes. Reid Bros., Bothwell, Ont., Canada.

**Julian's Liquid Fishing Lure.** Doubles your catch. Trial bottle, One Dollar. George Julian, Albany Building, Boston, Mass.

**Special**—Cardboard tubing, impregnated, 5" diameter. 20c per foot. Postage extra. Maier, 335 East 93d St., New York.

**Plastography** Instruction with model or mould, \$2.00. Success awaits you. P. B. Spahr, York, Penn.

**Fancy Mice**—30 Varieties; send stamp for list, or 50c for book giving full information on varieties, housing, breeding, etc. Holman's Mousery, Dedham, Mass.

**Music** composed to words. Bauer Bros. (formerly of Sousa's Band), Oshkosh, Wis.

**Marvelous!** Send for our time-saving multiplication table. Products of any amounts readily calculated. Handy pocket size card. Price to cents (coin) by mail. Remittance with orders. Tabulated Information Card Co., 2040 Chestnut St., Philadelphia, Pa.

**"Opportunity Adlets"** bring quick results. Our 100,000 circulation, net. Other firms are making money—50c can you. For proof address Classified Department, Electrical Experimenter, 233 Fulton St., New York City.

## Motors, Engines and Dynamos.

**Small Motors and Generators:** 1000 New Motors and Generators from Bankruptcy Stock, 1/4 H. P. A. C. \$18.50 each; 1/2 H. P. \$30.00. Battery Charging Sets—Robbins & Myers new outfits, all sizes, \$30.00 each and up. Charging, Lighting and Moving Picture Arc Generators, \$10.00 each and up. Motors for all phases of current. Immediate delivery. Less than 1/2 regular prices. Write for late bulletin. Johnston, West End, Pittsburgh, Penna.

**For Sale**—Motors, all sizes. Write your wants. We have them. E. Billstone, Jamestown, N. Y.

**Gas Engines** for every purpose. Marine, row-boat, stationary and motorcycle. Engines from \$10 up. Guaranteed one year. Write United Motor Repair & Supply Co., 305-309 Broadway, New York.

**500 Watt Motors**, Modern. Efficient, cost me \$12. Investigate! Duplicate! Clark, Barnes Road, Newton, Mass.

**50-H.P. Gasoline Engine**, 4 cylinders, aluminum, cost \$1,500. Will take \$450. Geo. B. Boutelle, 324 N. Eutaw St., Baltimore, Md.

**10 Volt, 20 Ampere Dynamo**, brand new, under half price. Call Saturday evening, 354 Convent Ave., New York.

## Novelties.

**Latest Fad, \$1.00.** Blanket flag sofa pillow. Covered with 24 flags, 8 shield of arms, satine lined. Fletcher & Fletcher, 1711 S. Oregon Ave., St. Louis, Mo. Agents write for particulars.

**Snappy girl pictures.** You will like them and want more; 20 for 25c. Write today. Smith's Novelty, (Dept. 5) 6735 Elizabeth, Chicago, Ill.

## For the Hair.

**I was Bald.** Obtained hair growth by an Indian's ointment containing genuine bear oil and rare plant juices. Many others have good hair-growing results. Will send box, postpaid, with recipe, 10c. John Hart Brittain, 150 E. 32nd St., B.A. 300. New York.

## Personal.

**Are you self-conscious**—embarrassed in company—lacking in self-control? These troubles overcome. C. E. Veritas, 1400 Broadway, New York City, N. Y.

## Electrical Supplies &amp; Appliances.

**Make Your Own Transformers.** Costs a few cents to make. Will ring bells, buzzers, etc. No batteries required. Guaranteed, instructions, 25c. Abrams Co., 1305 Peoria St., Chicago.

**Install Farm Lighting Plants.** Big Profits. Get our Agency Plans at once. Wolke Co., Louisville, Ky.

**Repairing and rebuilding Galvanometers, Voltmeters, Ammeters** on any electrical instruments. V. W. Bradbury, Winnsboro, La.

**Propellers for Air Propulsion.** Practice and Professional blades made to order. Crawford Motor and Aeroplane Manufacturing Co., Pittsburgh, Pa.; New Orleans, La.

**Inventors' and Manufacturers'** Experimental work, models, tools, instruments, light machinery. Over twenty years' specialized experience working from samples, blue prints, rough sketches, explanations. Customers' supervision in machine shop permitted. Manufacturers' and Inventors' Electric Co., 20D Gold St., New York.

**Get the proper apparatus** for your experiments. Coils, Electro-magnets, Solenoids, Resistances, Inductances and Condensers, designed and constructed to your order. J. E. Fast, 5840 W. Erie St., Chicago, Ill.

**Problems and advice** in Radio, Mathematics, Electricity, Chemistry, etc., answered by experts for \$1.00 and up. Paragon Technical Bureau, 329 East Fifth Street, New York City.

**10 Security Ford Locks**, new, at \$3.50 each, regular \$5.00 locks; 100 ampere combination Ford Locks for switch at \$2.00 each, new, regular price \$3.50; one Palor Cut 6" Electric Fan, new, at \$4.25; one telephone, new, 50c.; one Premo Camera, No. 1—3/4 x 4 1/4 Second-Hand at \$6.00. Electrical, Optical and Technical Supplies. H. C. Hancock, Bogota, N. J.

**Look! Save Money!** Heavy aluminum 10 x 12 sheets, fifty cents; inch strip, 12c. ft. Heavy 1 1/2 inch brass strip, 18c. ft.; 3/4 inch, 10c. ft. Postpaid. Robert Duffield, Detroit, Mich.

**25c. in coin** will answer that question on Storage Batteries. Henry G. Oakes, 81 Triangle St., Buffalo, N. Y.

**Look!** Penlites exact representation of fountain pens, 65c.; 6 1/2" tubular flashlight, \$1.05. Postage 5c. extra on either. Extra batteries sold. J. McLardie, 424 Edgewater, Dayton, Ohio.

**Will buy and sell** anything electrical, chemical or mechanical. Send for list and send in list and prices. Box 255, North Bennington, Vermont.

**24 Dry Cells Recharged** for 4c. Instructions, 10c. Walker, Box 465, Dayton, Ohio.

## Blue Prints.

**Blue Prints of Motor windings.** 108 A.C. connections, 132 D.C. armature windings, complete 240 diagrams \$5.00 cash. Send 25c. for 12 samples or write for particulars. Charles L. Chittenden, 811 West 18th Street, Kansas City, Mo.

**Blue Prints:** 1/2 H.P. Gas Engine, 30c; 1/4 H.P. Steam Engine, 50c; 1/8 H.P. Boiler and Engine, 70c; all 3 for \$1.00. Circulars on Castings and Engines for stamp. Universal Gas Motor Co., 364 Monadnock, Chicago.

## Instruction.

**Typewriting** learned easily and quickly at home by Modern Fingering Gymnastic Method. New discovery by long experienced typewriting instructor makes expert typists. Demand increased salary. Complete course, twelve lessons, five dollars. Guaranteed. Enroll today. School of Modern Method Typewriting, Warren, Ohio.

**Over 100 Branches**, thoroughly taught by mail. For "Free Tuition", apply Carnegie College, Rogers, Ohio.

## Song Poems Wanted.

**Write the Words for a Song.** We write music and guarantee publisher's acceptance. Submit poems on war, love, or any subject. Chester Music Co., 918 So. Michigan Ave., Room 265, Chicago.

**You Write the Words for a Song**—Submit poems on war, love, or any subject. Chester Music write music, guarantee copyright and assist in securing publisher. Metropolitan Studios, Room 113, Morton Bldg., Chicago, Ill.

## Phonographs.

**Build Your Phonograph.** "Perfection" high-quality spring and electric Motors, Tone Arms, Reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Indiana.

**Build Your Own Phonographs** and manufacture them for profit. Drawing instructions, Parts, Price List, Blue Prints, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E-1, Cincinnati, Ohio.

## Letter Specialists.

**Letters That Land Orders and Money Orders**—written for \$4.00; three for \$10.00. Guaranteed. Criterion Service, Dept. 3, West New York, New Jersey.

### GREATEST TOY SENSATION OF THE DAY! FIGHTING DREADNAUGHT

Here is a model of Uncle Sam's Fighting Dreadnaught. Eight big guns, each of which flashes, at correct intervals, from twelve to twenty times. Extra ammunition always obtainable. Absolutely harmless. Can be operated indoors or out. Now boys! Here's your chance to see a battleship in action. Instead of it being on the ship and around the ship, you are in the ship itself. By having ten more battleships, you can arrange FIGHTING NAVAL BATTLES in your own home. Price a shape box \$1.50 postpaid. Extra ammunition, 5 cents per box.

### TOOTH-ACHE STOP

Shows the Pain, Stops the Tooth. Stomach aches, Stomach in trouble. Use Aches, Stomach in trouble. Stomach aches, Stomach in trouble. Use Aches, Stomach in trouble. Stomach aches, Stomach in trouble. Use Aches, Stomach in trouble.

### "SAFETY IS" PINS

Refuse to let a child play with pins. Refuse to let a child play with pins. Refuse to let a child play with pins. Refuse to let a child play with pins. Refuse to let a child play with pins.

### INKLESS PEN

Writes with WATER. Writes with WATER. Writes with WATER. Writes with WATER. Writes with WATER. Writes with WATER. Writes with WATER. Writes with WATER.

### SIMPLEX TYPEWRITER

Only \$2.50. Cheap But Good. So Simple a Child Can Use It. We Guarantee the Writing. So simple a child can use it. We guarantee the writing. So simple a child can use it. We guarantee the writing.

### SQUIRT RING

Wonderful X-Ray Tube. A wonderful X-Ray tube. A wonderful X-Ray tube. A wonderful X-Ray tube. A wonderful X-Ray tube. A wonderful X-Ray tube. A wonderful X-Ray tube. A wonderful X-Ray tube.

### Sneezing Powder

Small amount of powder. Small amount of powder. Small amount of powder. Small amount of powder. Small amount of powder. Small amount of powder. Small amount of powder.

### NEW BOOK ON ROPE SPLICING

Useful knots, hitches, splices, etc. Useful knots, hitches, splices, etc. Useful knots, hitches, splices, etc. Useful knots, hitches, splices, etc. Useful knots, hitches, splices, etc.

### LUMINOUS PAINT

Make your watches, clocks, etc., visible by night. Make your watches, clocks, etc., visible by night. Make your watches, clocks, etc., visible by night. Make your watches, clocks, etc., visible by night.

### MUSICAL KAZOO MAGIC FLUTE

With the Musical Kazoo. With the Musical Kazoo. With the Musical Kazoo. With the Musical Kazoo. With the Musical Kazoo. With the Musical Kazoo. With the Musical Kazoo.

### All the Latest Sprung and Joke Novelties

Johnson Smith & Co., Dept. E, 7, 3224 N. Halsted St., Chicago. Johnson Smith & Co., Dept. E, 7, 3224 N. Halsted St., Chicago. Johnson Smith & Co., Dept. E, 7, 3224 N. Halsted St., Chicago.

### Boys, you can have Movies at your own home with this latest model MOVING PICTURE MACHINE

Uses Standard Films same as the larger machines. Very easily managed. Simple to operate. Good variety of Films always obtainable. PRICE Complete \$2.50 Postpaid anywhere including Two Films Extra Films, 15c each postpaid.

THIS IS A GENUINE MOVING PICTURE MACHINE and the motion pictures are clear, sharp and distinct. The Moving Picture Machine is finely constructed, and carefully put together by skilled craftsmen. It is made of Russian Metal, has a beautiful finish, and is operated by a finely constructed mechanism. The projecting lenses are carefully ground and adjusted, triple louvered, standard double lens projector, throwing a ray of light many feet, and enlarging the picture on the screen up to three or four feet in area. The light is produced by a safety carbide generator, such as is used on the largest automobiles. This throws a dazzling white light on the screen.

### JOHNSON SMITH & CO. Dept. E 7 3224 N. HALSTED ST., CHICAGO

### ANARCHIST BOMBS

Consists of a little glass vial containing a liquid form a chemical which will produce a most horrible explosion. One dropped in a room full of people will cause them to scatter in all directions. The bomb will explode in a short time. It is shipped by express only with a dollar's worth of other merchandise.

### ITCHING POWDER

This is another good practical use of the latest discovery of our chemists. It is a most effective remedy for itching. It is a most effective remedy for itching. It is a most effective remedy for itching. It is a most effective remedy for itching.

### INVISIBLE INK

The most confidential message ever written. The most confidential message ever written. The most confidential message ever written. The most confidential message ever written. The most confidential message ever written.

### LOVE LETTER INK

Writing written with this remarkable ink vanishes entirely in a few weeks (sooner if the ink is rubbed). QUITE BLANK. 15c p. pd.

### MULTIPLYING BILLIARD BALLS

The Best Feet of its Kind. This trick is an effective one. This trick is an effective one. This trick is an effective one. This trick is an effective one. This trick is an effective one.

### GOOD LUCK RING

Guarantee that it contains a very rare ring. Guarantee that it contains a very rare ring. Guarantee that it contains a very rare ring. Guarantee that it contains a very rare ring. Guarantee that it contains a very rare ring.

### LOADED CIGARETTES

Each box contains 12 Eggs. Each box contains 12 Eggs. Each box contains 12 Eggs. Each box contains 12 Eggs. Each box contains 12 Eggs.

### THE "LITTLE GIANT" TYPEWRITER

A First Class Writing Machine For \$1.25. A first class writing machine. A first class writing machine. A first class writing machine. A first class writing machine. A first class writing machine.

### SERPENT'S EGGS MYSTIC SKELETON

Each box contains 12 Eggs. Each box contains 12 Eggs. Each box contains 12 Eggs. Each box contains 12 Eggs. Each box contains 12 Eggs.

### CIGARETTE ROLLER

Very neat and handy. Very neat and handy. Very neat and handy. Very neat and handy. Very neat and handy. Very neat and handy. Very neat and handy.

### MIDGET ILLUSTRATED BIBLE

A Great Curiosity. A Great Curiosity. A Great Curiosity. A Great Curiosity. A Great Curiosity. A Great Curiosity. A Great Curiosity.

### SHARPEN-M-ALL SAFETY RAZOR

Sharpen's the Gillette and Duham Safety razor blades at one time. Sharpen's the Gillette and Duham Safety razor blades at one time. Sharpen's the Gillette and Duham Safety razor blades at one time.

### The CONJURER'S CASKET

Apparatus and Directions for a Number of Mystical Tricks. Apparatus and Directions for a Number of Mystical Tricks. Apparatus and Directions for a Number of Mystical Tricks. Apparatus and Directions for a Number of Mystical Tricks.

### Butter Bean

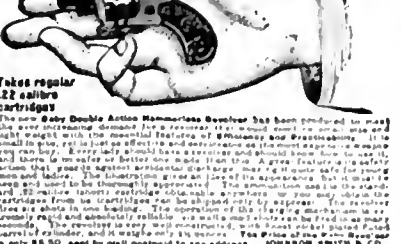
The New Edible Vegetable Wonder. The New Edible Vegetable Wonder. The New Edible Vegetable Wonder. The New Edible Vegetable Wonder. The New Edible Vegetable Wonder.

### The Newest Novelty Aerial Balloon

Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate. Level Rate.

### "The Baby" Double Action Hammerless Revolver

A HANDSOME AND MOST EFFECTIVE WEAPON. \$5.50. Measure but 4 1/2 inches long.



### THE EXPO WATCH CAMERA

The most wonderful and ingenious Camera made. It is but little larger than a watch, which is closely resembling it. It is but little larger than a watch, which is closely resembling it.

### QUICK AS A FLASH

Time and Instantaneous photography. Time and Instantaneous photography. Time and Instantaneous photography. Time and Instantaneous photography. Time and Instantaneous photography.

### Trim Your Own Hair With the Utility Safety Hair Cutter

Cuts the Hair Any Length, Short or Long - Saves It - Cost First Time Used. Price Only 35c. Extra blades to suit.

### PIANO PLAYING MADE EASY

Persons having completed their Musical Education. Persons having completed their Musical Education. Persons having completed their Musical Education. Persons having completed their Musical Education.

### New Vamping Card

Surprisingly Simple System. Surprisingly Simple System. Surprisingly Simple System. Surprisingly Simple System. Surprisingly Simple System.

### Butter Bean

The New Edible Vegetable Wonder. The New Edible Vegetable Wonder. The New Edible Vegetable Wonder. The New Edible Vegetable Wonder. The New Edible Vegetable Wonder.

### SHARPEN-M-ALL SAFETY RAZOR

Sharpen's the Gillette and Duham Safety razor blades at one time. Sharpen's the Gillette and Duham Safety razor blades at one time. Sharpen's the Gillette and Duham Safety razor blades at one time.

### Potmend Stops a headache in minutes

The finest medicine for Headache, Migraine, Neuralgia, and all other pains. The finest medicine for Headache, Migraine, Neuralgia, and all other pains. The finest medicine for Headache, Migraine, Neuralgia, and all other pains.



Now made simple and perfectly safe



TREAT YOURSELF With The Wonderful Health Restorer

VIOLET RAY

You Can Have Bodily Vigor, Success-Attaining Energy, Attractive, Healthful Beauty

All at practically no cost—The great benefits of the Violet Ray treatments heretofore only procurable at big expense from physicians and beauty specialists are now available in your own home. Look over list of treatments below. Send for particulars.

How Violet Ray Benefits

Painless Electricity

Electricity from your light socket is transformed into health and beauty-giving Violet Ray—powerfully effective, yet gentle, soothing, perfectly safe. Voltage is raised from ordinary lighting current to thousands of volts, giving tremendous penetrative force.

Science has modified electricity that the weakest may stand its force without fear or pain. Every tissue and fibre is saturated, patient experiencing only a sensation of relief, as if standing in a ray of sunshine. Violet Ray high frequency has no comparison with old, crude, electrical batteries and shocking current. Every jar and shock is removed. The effects are marvelously rapid. Relief can be given in one or more treatments. Often cures are accomplished in that time. It is positive and certain in action. If you value your health, and want to keep or restore your good looks and gain vitality, throw away medicine bottles—take this sensible, scientific means. Violet Rays work with nature. Every day's delay makes relief more difficult.

The irresistible, revitalizing powers of Renulife Violet Ray are carried at once to every nerve cell, fibre and part of body. Blood is enriched and purified by a flood of oxygen, giving added vitality and strength. Assimilation and digestion improved—functions restored to normal—extra supply of fresh blood quickly brought to area treated, removing congestion and supplying nourishment. While relieving pains and aches, the manifest results of disorders, it removes the deep-seated cause; combines the benefits of electricity, vibration, exercise, stimulation and oxidation.

Renulife Violet Ray HIGH FREQUENCY GENERATORS

Renulife Electric Co. Abbreviated Treatment Chart Using Electrode No. 1. Includes diagrams of human figures and a list of ailments with treatment instructions.

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO., 636 Marquette Bldg., Detroit, Mich.

Please send without obligation, your book "Health" explaining Violet Ray treatments with Renulife Generators; also give full particulars as to its application for ailments checked below

TREATS SUCCESSFULLY

- .. Abscesses .. Anemia .. Asthma .. Arteriosclerosis .. Baldness .. Blackheads .. Brain Fog .. Bronchitis .. Bunions .. Bruises .. Catarrh .. Colds .. Chills .. Dandruff .. Deafness and Ear Diseases .. Eczema .. Enlarged Prostate .. Facial Neuralgia .. Falling Hair .. Female Complaints .. Gout .. Haemorrhoids .. Hay Fever .. Infantile Paralysis .. Insomnia .. Lame ness .. Locomotor Ataxia .. Lumbago .. Nervous Affections .. Neuritis .. Obesity .. Pain in Abdomen and Chest .. Paralysis .. Piles .. Pimples .. Pyorrhea .. Rheumatism .. Scars .. Sclerotic .. Skin Diseases .. Sore Throat and Throat Diseases .. Sprains .. Toothache .. Weak Eyes .. Wrinkles .. Warts and Moles

Name..... Address.....

Offered on a Most Liberal TRIAL PLAN Learn the Wonderful Benefits by Actual Use

RENULIFE ELECTRIC CO., 636 Marquette Bldg., Detroit, Mich.

CANADIAN RENULIFE ELECTRIC CO. 236 Netting Bldg., Windsor, Ont.

SALES REPRESENTATIVES WANTED



Unequaled for scalp and hair



Brings beauty parlor to your home

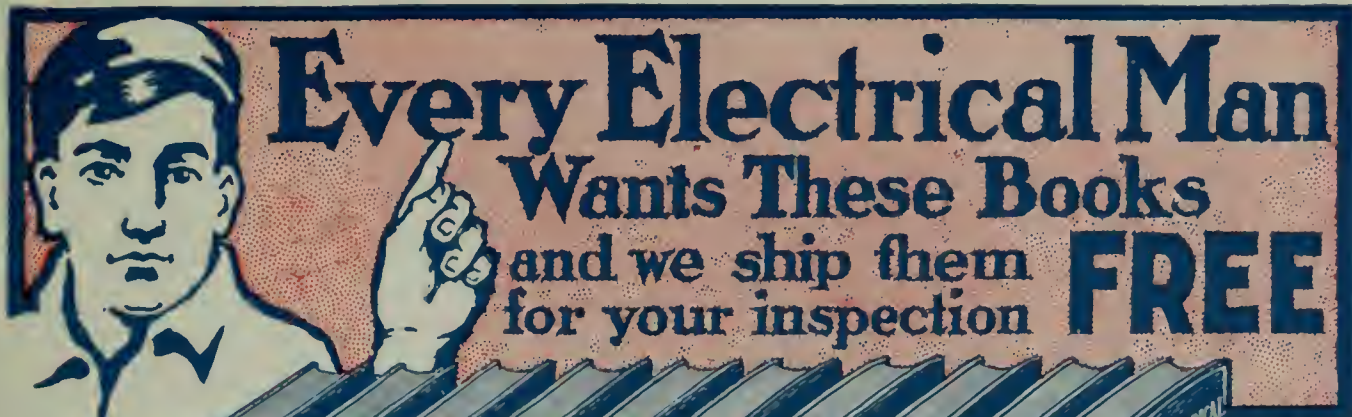


Inhaling ozone. For Catarrh, throat and lungs. Marvelous local results with general tonic effect



Treatment for general debility, nervousness, etc.





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—clock 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.

### 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.



### 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—lighting 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..... E. E. May

### 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.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.





# These Are The Hours That Count

**M**OST of your time is mortgaged to work, meals and sleep. But the hours after supper are yours, and your whole future depends on how you spend them. You can fritter them away on profitless pleasure, or you can make those hours bring you position, money, power, *real success* in life. Thousands of splendid, good-paying positions are waiting in every field of work for men *trained to fill them*. There is a big job waiting for you—in your present work or any line you choose. Get ready for it! You can do it without losing a minute from work or a wink of sleep, without hurrying a single meal, and with plenty of time left for recreation. You can do it in one hour after supper each night, right at home, through the International Correspondence Schools.

## Yes—You Can Win Success in an Hour a Day

Hundreds of thousands have proved it. The designer of the Packard "Twin Six" and hundreds of other Engineers, climbed to success through I.C.S. help. The builder of the great Equitable Building, and hundreds of Architects and Contractors, won their way to the top through I.C.S. spare-time study. Many of this country's foremost Advertising and Sales Managers prepared for their present positions in spare hours under I.C.S. instruction.

For 28 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I.C.S. Over 100,000 men are getting ready *right now* in the I.C.S. way for the bigger jobs ahead.

TEAR OUT HERE

### INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 6186, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> ADVERTISING                 | <input type="checkbox"/> ELECTRICAL ENGINEER        | <input type="checkbox"/> MECHANICAL ENGINEER                                |
| <input type="checkbox"/> SALESMANSHIP                | <input type="checkbox"/> Electrician                | <input type="checkbox"/> Mechanical Draftsman                               |
| <input type="checkbox"/> Traffic Management          | <input type="checkbox"/> Electric Wiring            | <input type="checkbox"/> Machine Designer                                   |
| <input type="checkbox"/> BUSINESS (complete)         | <input type="checkbox"/> Electric Lighting          | <input type="checkbox"/> Machine Shop Practice                              |
| <input type="checkbox"/> Commercial Law              | <input type="checkbox"/> Electric Car Running       | <input type="checkbox"/> Boilermaker or Designer                            |
| <input type="checkbox"/> Certified Public Accountant | <input type="checkbox"/> Heavy Electric Tractor     | <input type="checkbox"/> Patternmaker                                       |
| <input type="checkbox"/> Higher Accounting           | <input type="checkbox"/> Electrical Draftsman       | <input type="checkbox"/> Toolmaker  |
| <input type="checkbox"/> Railway Accountant          | <input type="checkbox"/> Electric Machine Designer  | <input type="checkbox"/> Foundry Work                                       |
| <input type="checkbox"/> BOOKKEEPER                  | <input type="checkbox"/> Telegraph Engineer         | <input type="checkbox"/> Blacksmith   |
| <input type="checkbox"/> Stenographer & Typist       | <input type="checkbox"/> Telephone Work             | <input type="checkbox"/> Sheet-Metal Worker                                 |
| <input type="checkbox"/> Good English                | <input type="checkbox"/> ARCHITECT                  | <input type="checkbox"/> STEAM ENGINEER                                     |
| <input type="checkbox"/> Window Trimmer              | <input type="checkbox"/> Architectural Draftsman    | <input type="checkbox"/> Stationary Fireman                                 |
| <input type="checkbox"/> Show-Card Writer            | <input type="checkbox"/> Contractor and Builder     | <input type="checkbox"/> MARINE ENGINEER                                    |
| <input type="checkbox"/> Sign Painter                | <input type="checkbox"/> Building Foreman           | <input type="checkbox"/> GAS ENGINE OPERATING                               |
| <input type="checkbox"/> CIVIL SERVICE               | <input type="checkbox"/> Carpenter                  | <input type="checkbox"/> Refrigeration Engineer                             |
| <input type="checkbox"/> Railway Mail Clerk          | <input type="checkbox"/> Concrete Builder           | <input type="checkbox"/> CIVIL ENGINEER                                     |
| <input type="checkbox"/> Mail Carrier                | <input type="checkbox"/> PUMPER & STEAM FITTER      | <input type="checkbox"/> Surveying and Mapping                              |
| <input type="checkbox"/> CARTOONIST                  | <input type="checkbox"/> Heating and Ventilation    | <input type="checkbox"/> R. R. Construction                                 |
| <input type="checkbox"/> Illustrator                 | <input type="checkbox"/> Plumber Inspector          | <input type="checkbox"/> Bridge Engineer                                    |
| <input type="checkbox"/> Perspective Drawing         | <input type="checkbox"/> Foreman Plumber            | <input type="checkbox"/> SHIP DRAFTSMAN                                     |
| <input type="checkbox"/> Carpet Designer             | <input type="checkbox"/> CHEMIST                    | <input type="checkbox"/> Structural Draftsman                               |
| <input type="checkbox"/> Wallpaper Designer          | <input type="checkbox"/> Analytical Chemist         | <input type="checkbox"/> Municipal Engineer                                 |
| <input type="checkbox"/> Bookcover Designer          | <input type="checkbox"/> MINE FOREMAN OR ENGINEER   | <input type="checkbox"/> NAVIGATION <input type="checkbox"/> Spanish        |
| <input type="checkbox"/> TEACHER                     | <input type="checkbox"/> Coal Mining                | <input type="checkbox"/> Motor Boat Runners <input type="checkbox"/> French |
| <input type="checkbox"/> Common School Subjects      | <input type="checkbox"/> Metal Mining               | <input type="checkbox"/> AGRICULTURE <input type="checkbox"/> Italian       |
| <input type="checkbox"/> High School Subjects        | <input type="checkbox"/> Metallurgist or Prospector | <input type="checkbox"/> Fruit Growing                                      |
| <input type="checkbox"/> Mathematics                 | <input type="checkbox"/> Assayer                    | <input type="checkbox"/> Vegetable Growing                                  |
| <input type="checkbox"/> AUTOMOBILE OPERATING        | <input type="checkbox"/> TEXTILE OVERSEER OR SUPT.  | <input type="checkbox"/> Live Stock and Dairying                            |
| <input type="checkbox"/> Automobile Repairing        | <input type="checkbox"/> Cotton Manufacturing       | <input type="checkbox"/> POULTRY RAISING                                    |
| <input type="checkbox"/> Auto. Electrical Work       | <input type="checkbox"/> Woolen Manufacturing       |   |

Name \_\_\_\_\_  
 Occupation \_\_\_\_\_ Employer \_\_\_\_\_  
 Street and No. \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_

Canadians may send this Coupon to  
 International Correspondence Schools, Montreal, Can.

## Your Chance Is Here!

No matter where you live, the I.C.S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter how limited your previous education, the simply written, wonderfully illustrated I.C.S. textbooks make it easy to learn. No matter what career you may choose, some one of the 280 I.C.S. Courses will surely suit your needs.

## Make Your Start Now!

When everything has been made easy for you—when one hour a day spent with the I.C.S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means, can you afford to let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you.

**Just Mark  
and Mail This Coupon**