Practical Electrics

20 Cents

Over 100 Illustrations

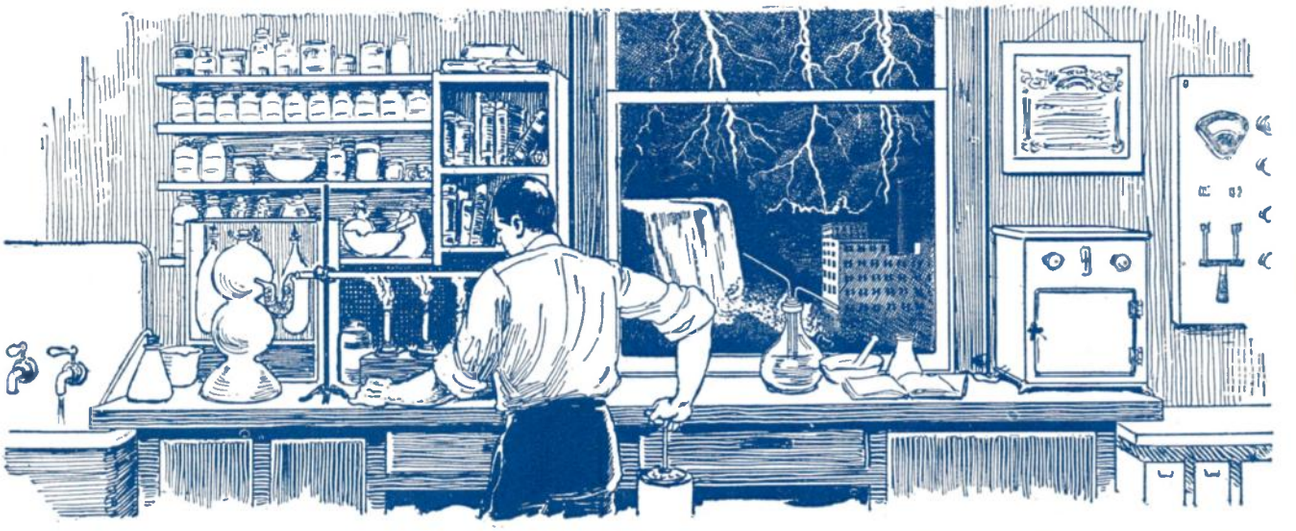
December 1922

Vol 2 No 2

EDITED BY H. GERNSBACK

"Electrical Progress in Plain English"

When the Chemist Harnessed the Thunder-bolt!



MAN and beast react with electric speed to a warning of danger, if the alarm is immediate and personal. Self-preservation is the first law of Nature. Yet subtle perils far more disastrous than any we expect to meet lurk in the shadow of our fancied security. They are the dreaded ogres of Famine and Disease.

A few years ago the world faced a famine more terrible than any in history. Nitrates, the most essential materials for enriching the soil, were being rapidly exhausted, and universal starvation seemed inevitable. Everyone knows that plants must feed, and if the ground is not replenished with the chemicals they have consumed, vegetation will eventually die out. Nature's way of making up the deficit is too slow for our concentrated population, and farmers have resorted to artificial fertilizers for ages. Europeans, always more receptive to the teachings of Chemistry than we, raise more than twice as much grain per acre as Americans, owing to their greater use of fertilizing chemicals.

The principal substance used for this purpose is sodium nitrate, better known as Chile saltpetre, because of the large deposits of it in that country. Millions of tons of this precious chemical were being mined annually, for vast quantities are consumed in making explosives and in other industries, besides that required for agriculture. Chile kept getting richer, but her nitrate beds got continually poorer until their inevitable exhaustion became a grisly prospect. *And there was no other source of supply!*

It was here that electro-chemists stepped in and devised a way of making nitrates from the air! They stole a trick from Nature, using an artificial bolt of lightning, the electric arc, to change the nitrogen and oxygen into nitric acid. This is indeed what happens during a thunder-storm, though to a very slight extent. Other methods followed, and thanks to Chemistry the air-made nitrates can now be sold for less than the saltpetre of Chile. Better still, the supply is unlimited.

Today we are confronted with similar crises. There are impending shortages of other important raw materials. Yet so great is the general confidence in chemistry to solve such problems, little anxiety is felt. A wealth of opportunity awaits the chemist of the present, particularly in the fascinating field of Electro-chemistry. In many industries there are hundreds of chemists employed by a single company. Thousands of concerns have chemists supervising the quality of their output and of the materials they buy. In countless capacities a knowledge of Chemistry is essential.

You Can Learn Chemistry at Home Dr. T. O'Conor Sloane Will Teach You

Dr. Sloane, Educational Director of the Chemical Institute of New York, is one of this country's foremost authorities on chemistry. He was formerly Treasurer of the American Chemical Society and is a practical chemist with many well-known achievements to his credit. Not only has Dr. Sloane taught chemistry for years, but he was for a long while engaged in commercial chemistry work.

The Chemical Institute of New York was originally founded to fill a long-felt need in the Educational field. Thousands of young men and young women, realizing the wonderful opportunities for the chemist produced by the recent war and the assumption by the United States of world leadership, were keenly anxious to enter this promising field. Many of these prospective students, however, were unable to give up their regular occupations to devote the necessary time to their training. Correspondence study at home was the only solution.

Dr. Sloane will teach you Chemistry in a practical and intensely interesting way. Our home study course written by Dr. Sloane himself is thorough, logical and remarkably fascinating. It is illustrated by so many experiments that are performed right from the start that anyone, no matter how little education he may have, can thoroughly understand every lesson. Dr. Sloane teaches you in your own home with the same individual and painstaking care with which he has already taught thousands in the class room.

The Personal Help of Dr. Sloane

Dr. Sloane will personally examine and correct all of your examination papers, pointing out your mistakes and correcting them for you. He will, in addition, give you any individual help you might need in your studies. This personal training will be of inestimable value to you in your future career.

Easy Monthly Payments

You can pay in small monthly amounts as you go along. The price of our course is very reasonable, and includes everything. There are no textbooks to buy extra, and the chemicals and apparatus used for experiments are supplied to the student *without additional charge*. Our plan places an education in chemistry within the reach of everyone.

Experimental Equipment

Given to Every Student Without Additional Charge

We prepay even the shipping charges on the outfit. It comprises 42 pieces of apparatus and 17 chemicals and reagents. The fitted, heavy wooden case serves not only as a carrying case, but also as a laboratory accessory for performing experiments.

Special 30-Day Offer

For a short period we are making a special offer that will be worth your while to take advantage of. Write for our free book, using the coupon below or simply a postal card. This will not obligate you in the least. Do not wait until tomorrow. Send the coupon now while you think of it, and let us tell you our story.

CHEMICAL INSTITUTE OF NEW YORK, Inc.
Home Extension Division 12,
140-B Liberty St., New York City.

Please send me at once without any obligation on my part, your free Book "Opportunities for Chemists," and full particulars about the Experimental Equipment furnished to every student. Also please tell me about your plan of payment and your special 30 day offer.

NAME.....

ADDRESS.....

CITY.....

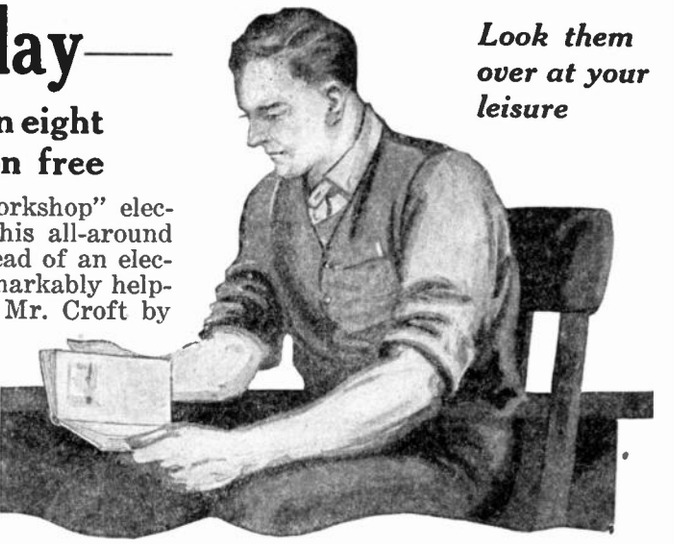
STATE.....
P.E., 12-22

Chemical Institute of New York, Inc.

Home Extension Division 12 — **140-B Liberty Street, New York City**

Less than a dime a day—

A rich electrical experience packed in eight handy volumes—10 days' examination free



Look them over at your leisure

Let Terrell Croft, the author of these famous "workshop" electrical books, take you in hand and lead you through his all-around experience, from an apprentice up to the position of head of an electrical consulting company. He has done this in this remarkably helpful library of electricity. To get the personal aid of Mr. Croft by any other method would mean an expense away out of your reach.

The wonderful expansion of the electrical field is making it more necessary than ever for you to have a broad knowledge — if you are to climb to better-paying work. You really can't afford not to know the answers to the hundreds of practical problems that these volumes cover with the plainest explanations and the fullest illustration.

The man who gets ahead today is the man who knows—not the man who has to go to somebody else for help every time a question a little out of the ordinary duties of the day comes up.

In what class are you—the man who has prepared himself by spare-hour reading of the Croft books to work the thing out for himself, or the man who has to shake his head in perplexity and let somebody else get the credit for being informed?

The Croft Library of Practical Electricity Paves the Way to Bigger Pay for You

Thos. A. Edison, the great electrical inventor, writing to Terrell Croft, said:

"Your method of explaining by analogy with things everyone knows, and the simple illustrations, make your work one of the best that I have yet seen."

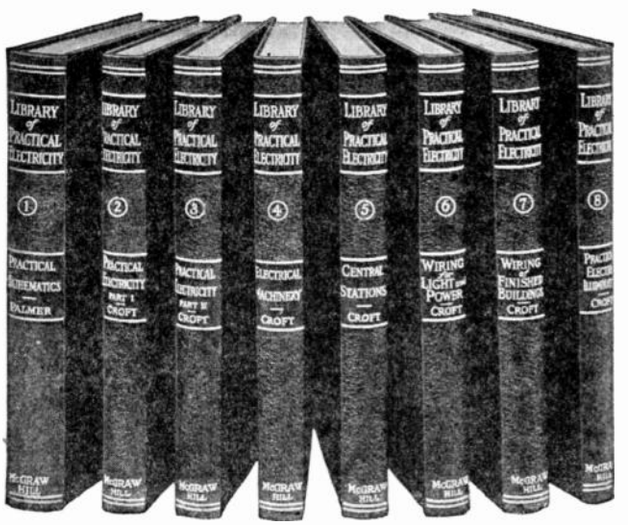
In the Croft books you will find complete, detailed and up-to-the-minute information on electricity, from the simplest principles to complete and economical operation of a central station. You will be told the things you need to know about motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems—electrical machinery of every type, installation, operation and repair—wiring for light and power—how to do it mechanically perfect in accordance with the National Electrical Code—wiring of finished buildings—underwriters' and municipal requirements —how to do the complete job, from estimating it to completion—illumination in its every phase—the latest and most improved methods of lighting—lamps and lighting effects, etc.

Send for your set of these pay-increasing books today and judge their value for yourself. Don't wait. You can make every evening hour worth real money to you.

McGRAW-HILL BOOK CO., Inc.
370 Seventh Ave., New York

7 Reasons for Owning the Croft Library

1. Every page of this 3000-page Library is taken from every-day electrical practice. Croft deals only with the kind of problems you meet in your daily work.
2. The author's knowledge of electricity has been obtained through actual shirt-sleeve practice. Beginning as an apprentice lineman, he went through the various stages of wireman, draftsman, etc., until he attained the position of electrical engineer with one of the big electrical manufacturing companies. Now he heads his own consulting company.
3. Seven years of thought, time and effort were put into these great books. In them you will find all the essentials of modern electrical practice. Their thoroughness makes them the standard electrical reference books of today.
4. The books contain nothing but live, practical material. They are kept up to the minute by periodical revisions by the author. Every electrical worker will appreciate the value of this.
5. Everything in the library is clearly written—clearly illustrated. Every man able to read and write can understand and use them. Yet they are neither elementary nor amateurish.
6. The flexible keratol binding of the Croft books makes them ideal for either workshop or home library. They are easy to handle—and they will last.
7. The worth of any set of books is usually indicated by its sale. Over 30,000 electrical workers — experts as well as beginners — are now using the Croft books. There's a sound reason for this popularity.



Free Examination Coupon

McGraw-Hill Book Co., Inc.
370 Seventh Ave., New York.

Gentlemen—Please send me the CROFT LIBRARY OF PRACTICAL ELECTRICITY (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $1.50 in ten days and $2 per month until $19.50 has been paid. If not wanted, I will write you for return shipping instructions. (Write plainly and fill in all lines.)

Name.....

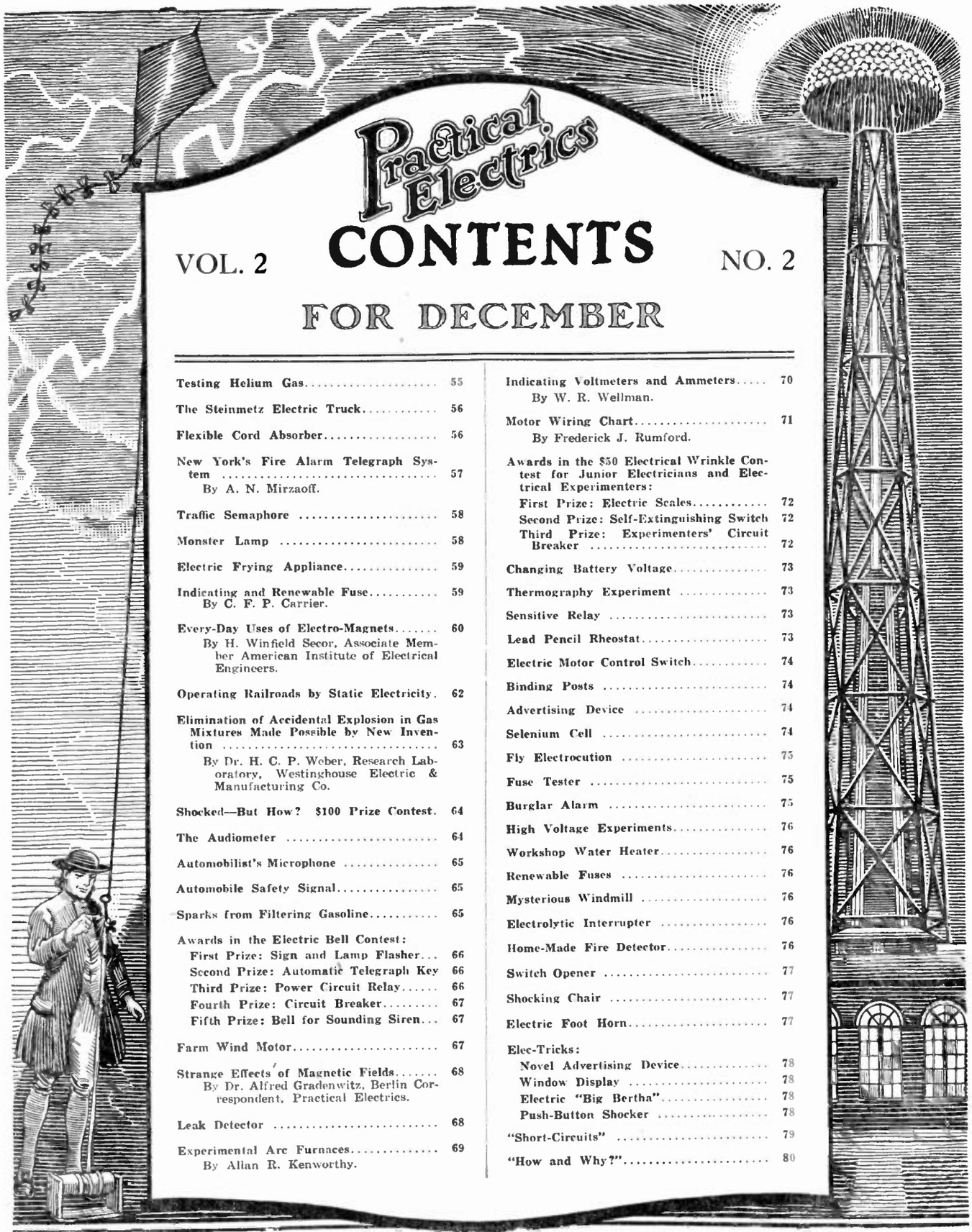
Home Address.....

City and State.....

Firm or Employer.....

Occupation.....

P. E.—12-22



Practical Electrics

CONTENTS

VOL. 2 NO. 2

FOR DECEMBER

PRACTICAL ELECTRICS is published on the 15th of each month at 238 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 coin or stamps). Single copies 20 cents each. A sample will be sent gratis on request. Checks and money orders should be drawn to order of PRACTICAL ELECTRICS CO. If you change your address, notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addressed to: Editor, PRACTICAL ELECTRICS, 53 Park Place, New York. Unaccepted contributions cannot be returned unless full postage has been included. All accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable. PRACTICAL ELECTRICS, MONTHLY Entered as second-class matter October 14, 1921, at the New York Post Office under Act of Congress of March 3, 1879, Title registered at the Patent Office, Copyright, 1922, by PRACTICAL ELECTRICS COMPANY, INC., New York.

PRACTICAL ELECTRICS is for sale at all news stands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.

Published by EXPERIMENTER PUBLISHING CO., INC. (Practical Electrics Co., Inc., owner) 53 Park Place, N. Y. City
Publishers of "Science and Invention" and "Radio News"
H. GERNSBACK, President S. GERNSBACK, Treasurer R. W. DeMOTT, Secretary
General Advertising Department, 53 Park Place, New York City
Western Advertising Representatives, Finucan & McClure, 720 Cass Street, Chicago, Ill.
Kansas City Advertising Representative, George F. Dillon, Republic Building, Kansas City, Mo.
Pacific Coast Advertising Representatives, A. J. Norris Hill Co., Hearst Building, San Francisco, Cal.

What Would You Give To Become A Really Good Dancer?

How much would it be worth to you to make yourself so popular through your ability to dance all of the very latest steps, that everyone would be anxious to have you attend their social affairs?

GOOD dancers always have the best time. The best dancers and the prettiest girls always want a good partner. From the business as well as the social standpoint, it is really time and money profitably spent to add dancing to your other accomplishments. Especially so, since it now costs so little—and a fine dancing ability can be mastered in only a few hours.

Arthur Murray
Dancing Instructor to the Vanderbilts

Arthur Murray has perfected a method by which you can learn in the privacy of your own home, to dance any of the latest dances in a few minutes—and all of them in a short time. Instructions are so simple that even a child can quickly learn. In one evening, you can master the steps of any single dance. Partner or music are not necessary. After learning you can dance with the best dancer in your town and not make a single misstep.

Learn Without Partner or Music

Arthur Murray's remarkable method is so clearly explained and lucidly written that you don't need anyone to explain the instructions. The diagrams show every movement—just how to make each step of every dance, and the written instructions are concise and easily remembered. After you have quickly learned the steps by yourself in your own room, you can dance perfectly with anyone. It will also be quite easy for you to dance in correct time on any floor to any orchestra or phonograph music.

Arthur Murray is recognized as America's foremost authority on social dancing. Such people as the Vanderbilts, Ex-Governor Locke Craig of North Carolina and scores of other socially prominent people chose Mr. Murray as their dancing instructor. Dancing teachers the world over take lessons from him—and it is a fact that more than 60,000 people have learned to become popular dancers through his Learn-at-home methods.

Do You Know

The Correct Dancing Position
How to Gain Confidence
How to Follow Successfully
How to Avoid Embarrassing Mistakes
The Art of Making Your Feet Look Attractive
The Correct Walk in the Fox Trot
The Basic Principles in Waltzing
How to Waltz Backward
The Secret of Leading
The Chasse in the Fox Trot
The Forward Waltz Step
How to Leave One Partner to Dance with Another
How to Learn and Also Teach Your Child to Dance
What the Advanced Dancer Should Know
How to Develop Your Sense of Rhythm
Etiquette of the Ballroom

Free Proof You Can Learn the Latest Steps in an Evening

Private instruction in Mr. Murray's studio would cost you $10 per lesson. But through his new method of teaching dancing at home, you get the same high class instruction at a ridiculously low price. And if you aren't delighted, the instruction doesn't cost you one cent.

To prove that he can teach you, Mr. Murray will send you his full sixteen-lesson course for five days' free trial. Through these sixteen lessons you will learn, The Correct Dancing Position—How to Gain Confidence—How to Follow Successfully—The Art of Making Your Feet Look Attractive—The Correct Walk in the Fox Trot—The Basic Principles in Waltzing—How to Waltz Backward—The Secret of Leading—The Chasse in the Fox Trot—The Forward Waltz Step—How to Leave One Partner to Dance with Another—How to Learn and Also Teach Your Child to Dance—What the Advanced Dancer Should Know—How to Develop Your Sense of Rhythm—Etiquette of the Ballroom.

Send No Money—Not One Cent

Satisfy yourself that the new course can quickly teach you all of the new dances and latest steps. See for yourself how easily you can master all of the newest dances and be able to enjoy yourself at the very next affair to which you are invited. Just fill in and mail the coupon—or a postcard or letter will do—and the special course will be promptly sent to you. When your own postman hands it to you, simply deposit with him only $1.00 plus the few cents postage, and the course is yours without any further payments of any kind. Keep the course for five full days. Practice all the steps—learn everything the lessons teach, because that is the only way you can prove to your full satisfaction that Arthur Murray's method is the quickest, easiest, and most delightful way to learn how to dance correctly and expertly. Then, within five days, if you desire to do so, you may return the course and your deposit will be promptly refunded without any question. But should you decide to keep the course, as you surely will, it becomes your property without further payments of any kind.

Your Satisfaction Guaranteed

Several times Arthur Murray has been asked how one can learn by mail to dance. The answer and the proof that you can learn is found in these special lessons. After reading them over and practicing the steps as shown in the diagrams, no one can help but feel fully convinced that Arthur Murray's course does teach everything promised. And so positive is Mr. Murray that he can teach you that he absolutely guarantees your complete satisfaction or your money will be fully refunded.

You have always wanted to learn to dance—you have always promised yourself that some day you would learn. Here is your best opportunity. And remember, you now receive the

16 Lessons Only $1.00

ARTHUR MURRAY
Studio 530, 100 Fifth Ave. New York

Arthur Murray, Studio 530,
100 Fifth Avenue, New York.

To prove that you can teach me to dance in one evening at home you may send the sixteen-lesson course in plain cover and when the postman hands it to me I will deposit with him $1.00, plus a few cents postage in full payment. If, within five days, I decide to return the course I may do so and you will refund my money promptly and without question.

Name.....

Address.....

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

If apt to be out when the postman calls, you may send the dollar now and we will pay postage. (Price outside U. S. $1.10 cash with order.)

Here's What a Few Say

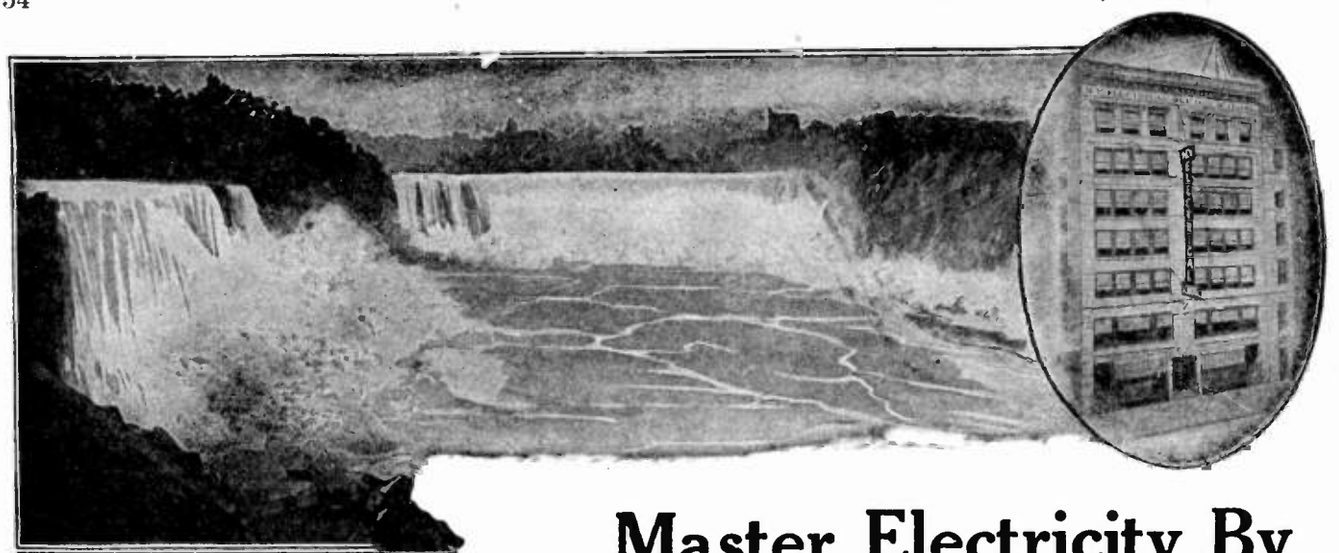
Let me say that your chart system explains many things to me which other teachers could not make clear.
WM. S. MEYERFELD,
Ann Arbor, Mich.

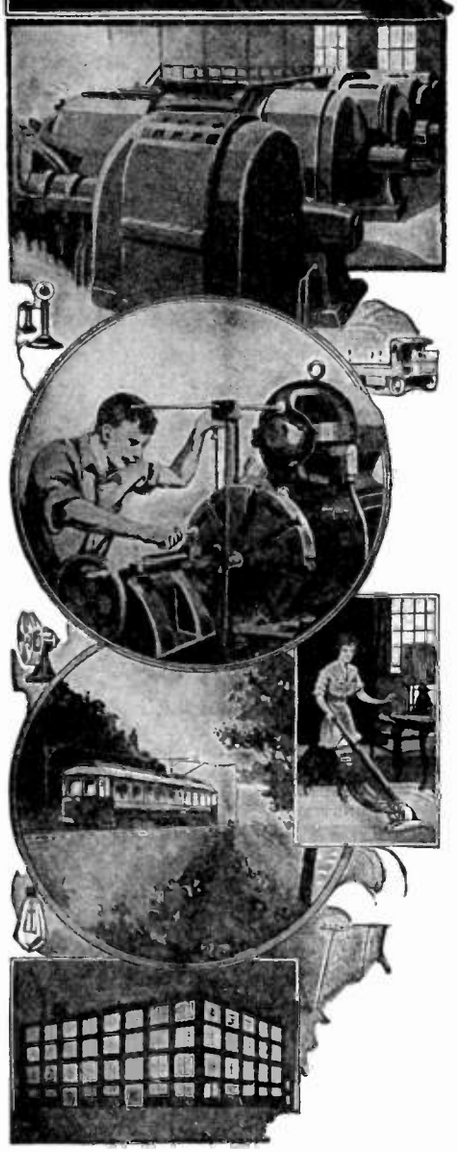
I practiced yesterday and learned the Fox Trot through the night. Tonight I danced a number of times with a good dancer to the music of a phonograph and had no trouble in leading or balance.
J. M. MEALY,
Flatwood, W. Va.

I am getting along very nicely with the instructions. I have so many pupils I have to have a larger place.
ALBERT J. DELANEY,
Bay City, Mich.

Before I got your lessons I couldn't dance a step, but now I go to dances and have a good time, like the rest of them. I'll always be thankful that I have taken your course.
BEGGI THORGERISON,
Ethridge, Mont.

Many other enthusiastic letters have been received. If interested send for special leaflet reprinting them.





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 methods 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 8,000 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.

The N. Y. E. S. gives a ***special*** Automobile Ignition Course as an advanced training for Auto Mechanics, Garage Men and Car Owners. The course covers completely all Systems of Ignition, Starters, Lighting and other electrical equipment on automobiles, motor boats, airplanes, etc.

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

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

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

..... NAME
..... STREET
.....CITY .....STATE

New York Electrical School

31 West 17th Street, New York

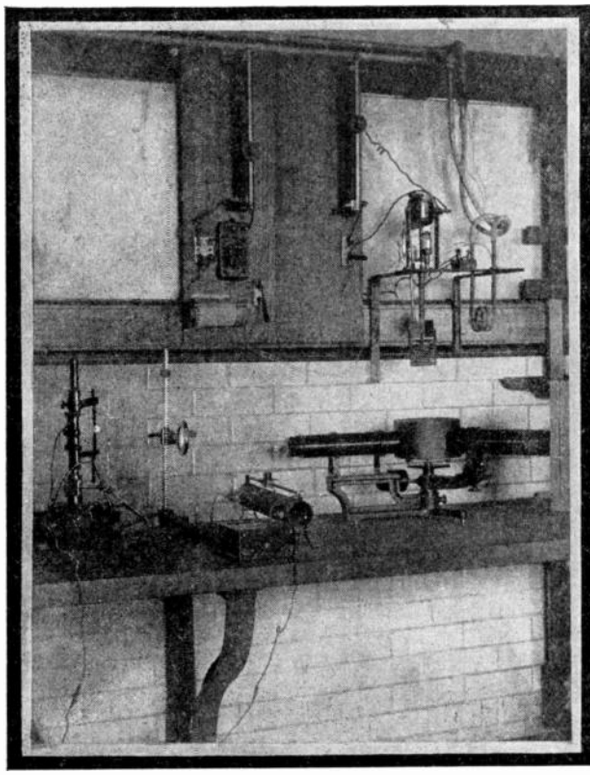
Volume 2
No. 2

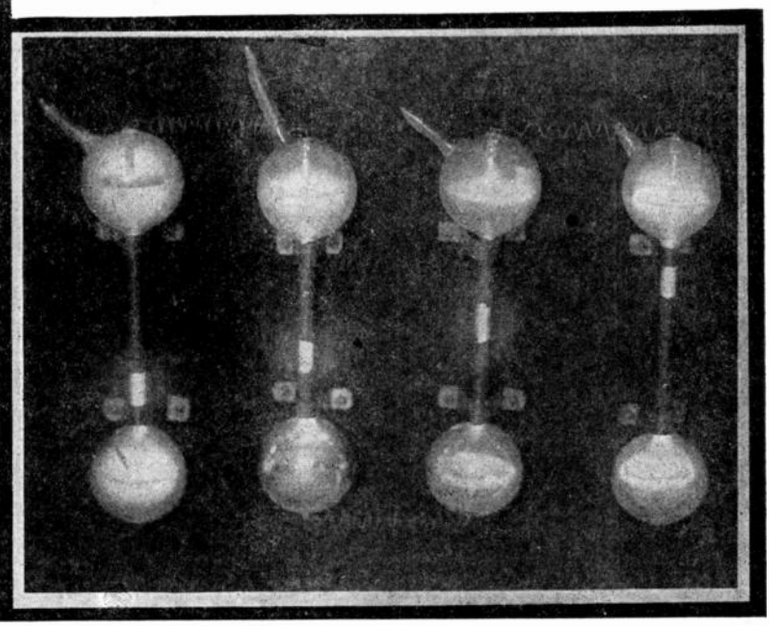
Practical Electrics

December
1922

H. Gernsback, Editor and Publisher T. O'Conor Sloane, Ph.D., Associate Editor

Testing Helium Gas





Left—Apparatus used by the U. S. Bureau of Standards for testing helium gas by electric discharge through it, the gas contained in bulbs giving the spectrum of the gas, to determine its purity.

Below—Examples of the bulbs through which an electric discharge passing develops the helium spectrum. The four bulbs are connected in series, giving a very beautiful illumination.

THE lightest of the elements, and the lightest substance known to man, is hydrogen gas. If a vessel is filled with this gas, it is buoyed up by the weight of air displaced minus the weight of the hydrogen.

Hydrogen is far lighter than the cheaper coal gas, and for that reason has been used by governments in the inflation of balloons in spite of its cost, although the old-time balloonist generally relied on coal gas, which is several times heavier than hydrogen.

The next lighter gas is helium, also one of the elements. Its first discovery was indicated by its spectrum observed in the corona of the sun, whence arises its name, from the Greek word "helios," sun. Helium is about twice as heavy as hydrogen, and therefore does not possess the same lifting power in a balloon, but the difference is so slight that it is perfectly satisfactory from the standpoint of so-called buoyancy.

Helium is one of the elements whose electrons are so disposed in the atom that it has no free bonds and combines with nothing under any conditions. Hence, it cannot burn, while hydrogen is one of the most inflammable substances known. The non-inflammability of helium makes it the ideal substance from the standpoint of safety for the inflation of balloons.

Helium is found in quite tangible quantities in natural gas. Some natural gas is very unsatisfactory on account of its low calorific power. This kind of gas is called in some places "wind gas," and it is precisely this quality of the product which is an admirable source of helium.

Major General Patrick, Chief of the Army Air Service, estimates that about 500,000,000 cubic feet of helium are taken out of the earth annually through the pipes of gas wells. This is enough to inflate 500 large dirigibles. The cost of extracting helium from natural gas, which may contain from a fraction of 1 per cent up to about 2 per cent of the desired product, is put at $80 per thousand cubic feet. Its separation and collection is without any practical effect on the natural gas that is discernible in everyday use, and really improves it slightly, just as coal would be improved by extraction of the mineral constituents, which produce the ash. In a certain sense helium is the ash of natural gas, or rather, part of the ash, as natural gas generally contains nitrogen, which also does not burn and is a useless diluent.

If gas containing helium is passed through a gas-liquefying apparatus, such as used for making liquid air, all of its constituents will liquefy more readily than helium, the latter being one of the most difficult gases to liquefy, although it has been done in very small quantity. The only constituent of natural gas to cause trouble would be hydrogen, for this liquefies only with the greatest difficulty. So by liquefying natural gas, the helium would be left in a gaseous state and can be withdrawn and collected, provided there is no hydrogen present. Usually there is none.

Had the dirigible "Roma" been inflated with helium gas instead of with hydrogen, the lives of 34 men might have been saved. The Bureau of Standards, among its other activities, is now engaged in examining helium gas, testing it for purity, and in the illustrations are shown the apparatus used, and the tubes of helium ignited electrically. To examine it spectroscopically, it is collected in tubes at a proper degree of rarefaction, sealed therein, an electric discharge passed through the same, Geissler-tube fashion, and the spectrum of the light produced is examined. In this way traces of impurities are infallibly detected.

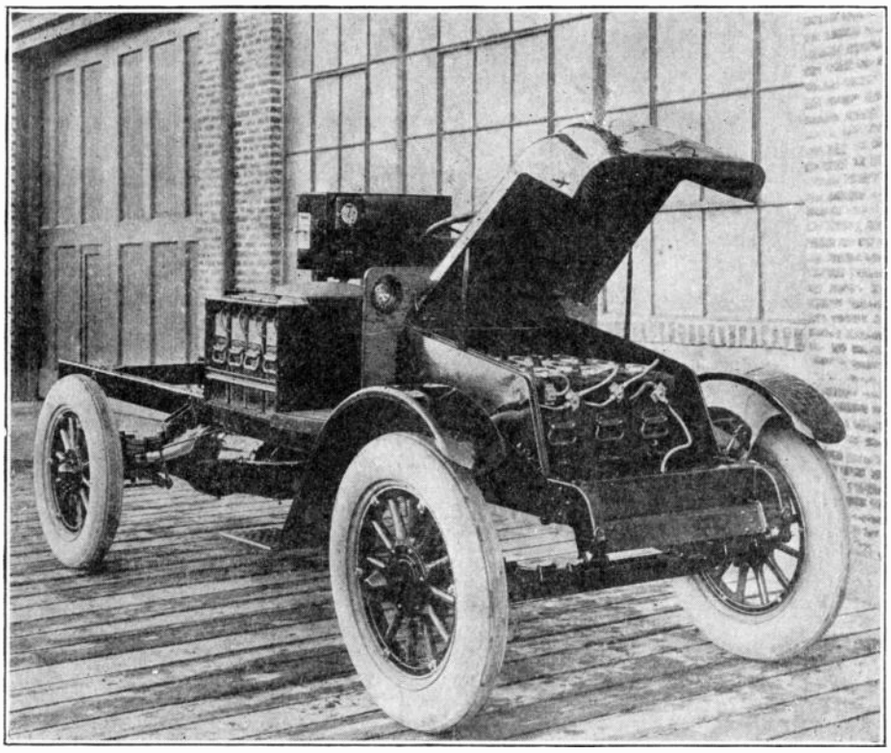
General Patrick believes that helium may be a large factor in the development of dirigible engineering.

Within a very short period of time another dirigible balloon has been lost, fortunately without causing any fatalities. The loss was due to the hydrogen catching fire. This last accident is thought by some to sound the knell of the hydrogen inflated balloon. The expense of helium is very great and it is possible that it may be cheapened by mixing hydrogen with it, in such small quantities that the mixture will be non-inflammable.

The Steinmetz Electric Truck

THE name Steinmetz has long been associated with the most abstruse developments of electricity. He won fame by his work on the induction motor, and his books on the higher phases of electrical science are classics in the field of technical literature.

Steinmetz's well-known work on the complex variable, bringing vector calculations within the scope of algebra, has been especially interesting and valuable. He is no exclusively abstruse electrician, but is thoroughly practical, and his work appeals as much to the engineer as to the physicist; and he has entered upon a new field, having settled the induction motor question and proven himself the twentieth century Franklin by his investigations of the lightning stroke.



The Steinmetz electric truck. An illustration of the latest thing in electric trucks, developed by the great electrician of the General Electric Company, in which any type of battery desired can be employed.

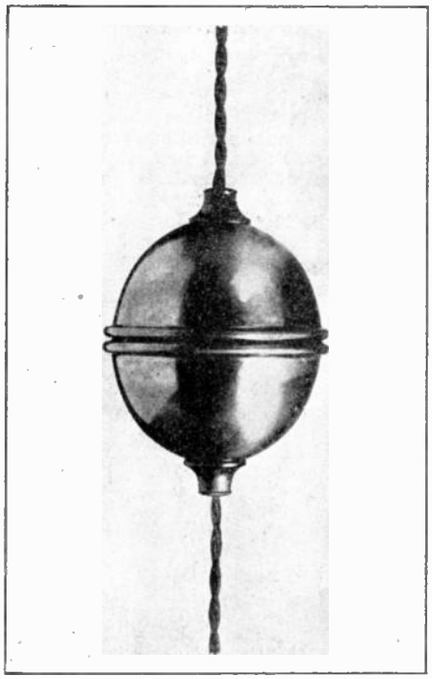
He has now produced a storage battery truck. Here there was little new to be looked for, so the peculiarities and characteristic features are to be found in the distribution of parts, perfection of bearings, means of lubrication, and the like. All important bearings are ball bearings, which are so popular in Europe, and which are advantageous because steel balls are obtainable everywhere, while the roller bearings so extensively used in this country to a great extent restrict the user to the manufacturer of the specific bearings for their parts.

The less important bearings are bushed with bronze and most of them are of the oilless type. The battery is divided into two installments; one portion is under the hood in front, the other is under the driver's seat. This makes for a good distribution of weight. The segmental drum type controller takes care of the current delivered to the motor.

In the description of the truck the data for several storage batteries are given, including the lead plate and Edison battery. Back of the driver's seat and below the level of the chassis the electric motor with its gears is placed in the vicinity of the rear axle, so that there is practically no propeller shaft. The motor sits fore and aft, in line with the longitudinal axis of the car, and drives through beveled pinion and crown wheel.

Rather interesting data are given as to weights, mileage and the like. The regular speed loaded is put at 15 to 15½ miles per hour, and many residents of our city wish that all trucks were as well disposed as this in the matter of speed. The motor takes 2,800 watts. The chassis weighs about 2,000 pounds.

Flexible Cord Absorber



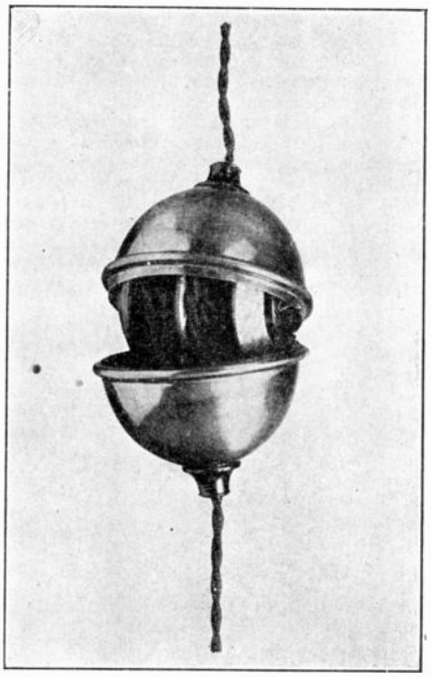
A hollow metal ball; within it is a reel on which flexible cord conductors are wound so as to shorten or lengthen the same.

FROM our English cousins comes the cord absorber shown in the accompanying illustrations, one of which exhibits the appliance open to show the interior.

A spool is mounted within it which is kept under angular tension by a clock spring, which the circular is careful to specify is a "good English clock spring." When the weight is taken off it will be seen that the cord can be varied in length according to the amount of flexible cord wound upon the spool. Another feature is that when the spool winds up, it absorbs the cord coming down from the ceiling, as well as the cord depending from the absorber to the lamp or other fixture. In this way, when the cord is shortened, the absorber rises, and descends when the cord is lengthened. The spool could be provided with the tumbling pawl arrangement of the Hartshorn shade roller, so as to hold it in any desired position.

The absorber makes a very neat substitute for counterweights and other contrivances such as the double bored block of wood, which has been employed for this in the past and is still in very general use.

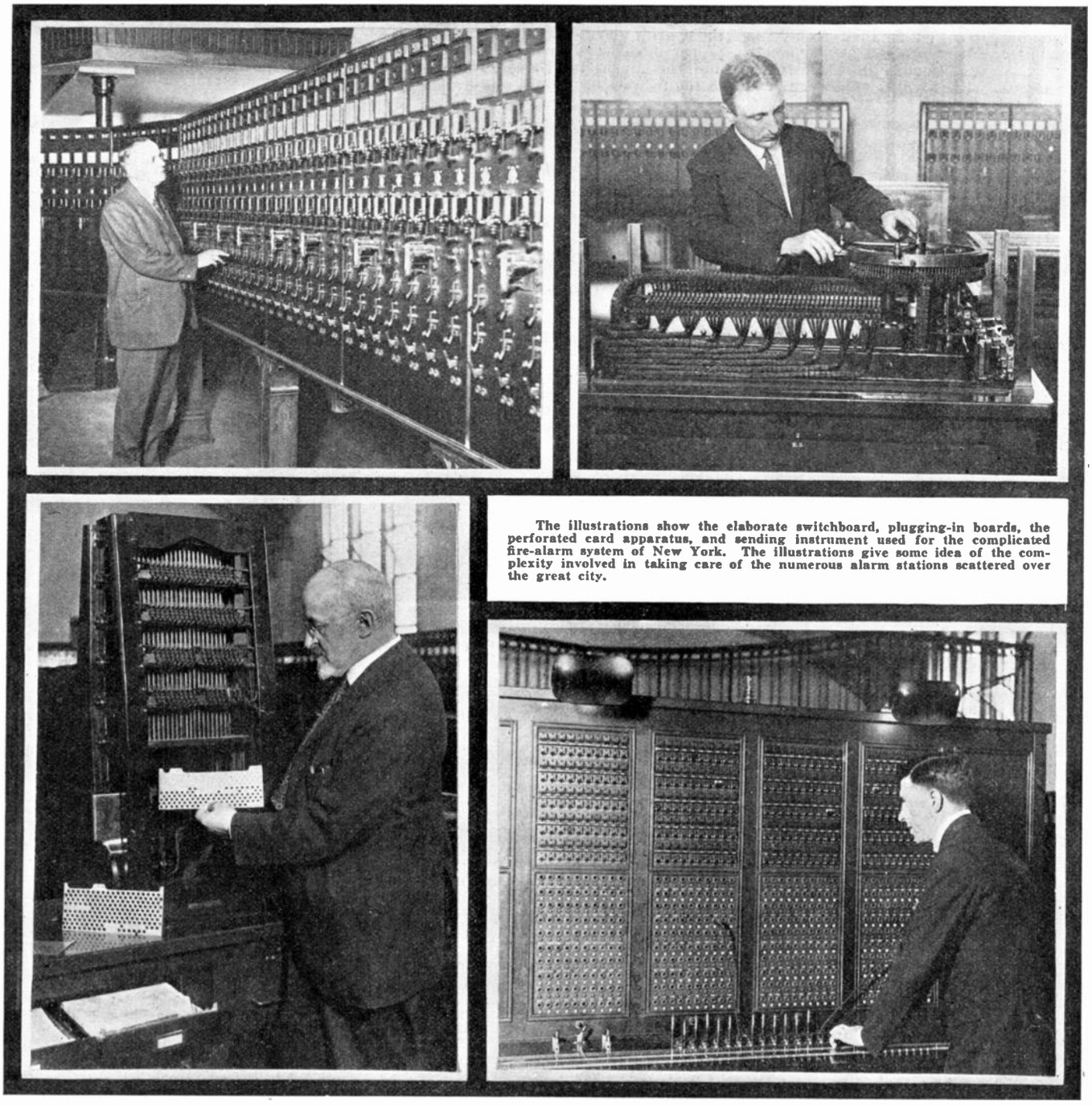
There are two standard sizes, one will carry a weight between six and sixteen ounces, the other a weight varying from a half pound to one and one-quarter pounds. It impresses us as a very interesting appendage to electric lighting facilities.



The same ball opened, showing the flexible cord wound around the reel within its interior. More or less cord is wound as required.

New York's Fire Alarm Telegraph System

By A. N. Mirzaoff



The illustrations show the elaborate switchboard, plugging-in boards, the perforated card apparatus, and sending instrument used for the complicated fire-alarm system of New York. The illustrations give some idea of the complexity involved in taking care of the numerous alarm stations scattered over the great city.

MANHATTAN today boasts of a telegraph fire alarm system which was started in 1914 and lately completed at a cost of $1,500,000, safeguarding the lives of millions of persons and billions of dollars worth of property. One can hardly conceive of the marvelous speed with which this new and perfected system transmits the alarm of fire.

One moment you see a man turning the handle of the fire box, and a few seconds later the fire apparatus may be seen rushing through the streets in answer to the call.

The fire alarm box is simple since there is no key to look for as in the old type of construction. A simple turn of the handle on the outside of the box is all that is required and the bell rings. The alarm is transmitted to the central telegraph plant and then to the engine houses.

The entire new equipment is mounted in a group of fire-proof buildings located at Central Park and 79th Street, New York.

The plant was built according to plans drawn by Vice-President J. J. Carty of the American Telephone and Telegraph Company, and Kemster B. Miller, telegraph engineer. Work was commenced under former chiefs of the Bureau of Fire Alarm Telegraph Rennard, Day and Bates, and completed under V. Fendrich, the present chief.

In the brief interval elapsing between the time of the twist of the alarm handle and the sending of the fire apparatus on its way, much happens. The central is the nucleus of every fire alarm on Manhattan Island. The method of operation is as follows:

1. The turn of the fire alarm handle sets the code wheel into rotation, which next

2. Operates two relays in the Central Park Building, one of which in turn operates a target to indicate the circuit; a buzzer beneath the target gives an audible signal; a punch-register punches small holes in a narrow paper tape recording the number of the fire alarm box.

3. The other relay operates a dispatcher's receiving board, thus while the lamp at the circuit position of the board flashes a signal, a drop switch starts a graphic recorder. Then after insertion of the plug into the proper jack, the fire box number is recorded on a paper tape.

Here is where electricity plays an all important part, all this action, that of target, buzzer, punch, register, lamp and drop on the dispatcher's receiving board taking place virtually simultaneously.

The dispatcher's board with a maze of plugs, jacks and cords is much like an ordinary telephone switchboard except there is no listening key. At the right of the dispatcher's receiving board is the dispatcher's transmission board, by means of which headquarters is notified when the engines have returned to their respective fire houses. There are 135 engine house circuits, 252 box circuits, 10 or less boxes to a circuit with a total of 1600 alarm boxes, the same covering within short distances of each other all the city.

In case of reporting a fire by telephone, the central operator connects the party telephoning with the Fire Department dispatcher, who inquires as to the location of the fire, and by means of a map locates the nearest alarm box; he then inserts the proper metal card in the selective switch and the alarm is immediately sent out to the nearest fire house.

Finally a man at the selected switch places the metal card corresponding to the number received in the switch, throws the handle and the number is automatically transmitted to the engine houses.

Twelve seconds have elapsed since the handle on the fire box was turned. In the event of a second or greater alarm a second metal card is inserted in the switch in addition to the first card and an additional alarm is transmitted.

Traffic Semaphore

A NEW traffic semaphore is being tested with success in the streets of Schenectady, N. Y., much favorable comment resulting from its use. The device, designed in the General Electric Company Works in that city, is intended to make the work of the traffic policemen easier, and at the same time to be easier for automobilists to distinguish.

The standard is about nine feet in

The so-called iron policeman—an improved traffic controlling semaphore, electrically lighted, the color of the lights giving indications in addition to the inscriptions.

height. In addition to the usual STOP and Go signals, the semaphore is equipped with a special lighting arrangement. On the Go side is a green light, somewhat on the order of a railroad block signal light, the green glass covering the powerful incandescent light behind it. On the STOP side is a red light of similar construction.

Mounted on the top of the standard is a large white globe which is not lighted while the standard is set, but upon the swinging of the standard to start traffic in the opposite direction, the light flashes, warning motorists for a considerable distance that the direction of traffic is changing, and giving ample time to slow down before reaching the intersection. Light is also directed downward by reflectors so that the movements of the traffic officer are distinctly observable.

The whole upper part of the standard is mounted on ball bearings, insuring easy turning. The officer on duty turns the standard by a lever at elbow-height from the ground. When not in use the semaphore is locked in position half way between the ends of its swing, thereby keeping the white light on top lit.

Contributed by GUY BARTLETT.

Monster Lamp

THE largest incandescent lamp ever manufactured is shown in the illustration. A rather crude and almost unmanageable metal, tungsten, by the use of electric heat and certain additions, notably of thorium compounds, has been made somewhat amenable to treatment and can be drawn into wire of considerable tenacity and durability under heat.

Melting it is practically out of the question. The devising of ways of metallurgical treatment gave a new meaning to incandescent lamps when tungsten was successfully used as the material of the filament. The old carbon filament lamp was so inefficient and defective in many ways that in itself it was anything but a creditable reflection on human ingenuity, although the successful use of such a delicate appliance spoke well for the skill of electricians.

An expenditure of four watts to the candle power in the old carbon lamps was fairly good practice. In the modern tungsten lamp, from one-quarter to one-eighth this power is used. Where we formerly were content with a sixteen candle power carbon lamp, we now use from a twenty-five to a fifty candle power tungsten lamp.

The electric companies are not greatly injured in their sales by the more efficient appliance, because people are educated to want more light than they were formerly satisfied with.

The mercury vapor arc lamps have played an important part in studio work. Their light is highly actinic and great banks of them are distributed about the stage so as to bring out all details on the film. The lamp proper is a tube some three feet long, and these are mounted side by side, like a grating on rectangular frames. When started into action each tube glows for its full length and what may be called great rectangles of light are produced and enable the short exposures of the moving picture camera to be effective.

The great lamp which we illustrate is designed for use in moving picture studios.

For smaller projections the incandescent lamp has long been successfully used. A concentrated filament characterizes the special burners made for lantern use, and

The largest electric lamp ever made, illuminating a stage or studio almost as brilliantly as would the sun.

some are of quite high candle power. The one we illustrate in size and power surpasses anything hitherto made. It is rated at 30,000 watts, a thousand times the rating of an ordinary household lamp. The power represented is about forty horsepower. Its primary object is for use in motion picture studios, and it is taken as producing the nearest approach to sunlight that has ever been attained by man. There is sufficient tungsten in one lamp of this size to make the filaments for 55,000 small lamps.

Whether a lamp of anything like these dimensions will ever be used for projection in a lantern is uncertain; but there is little doubt that the clumsy arc lamp will eventually be replaced by some modification of the tungsten lamp.

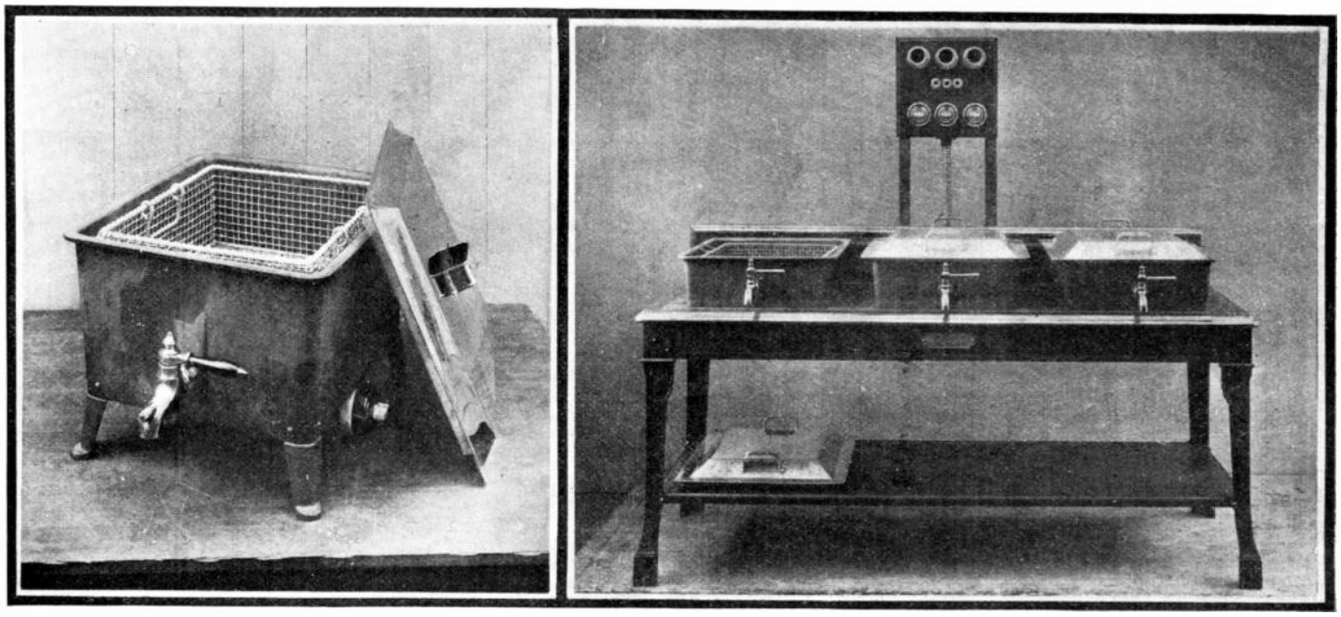
The great lamp we illustrate shows the way in which the tungsten filaments are disposed of in incandescent projection lamps, although, of course, this great bulb would never fit in the lamp house of a projection machine.

EXPERIMENTERS and amateurs, we want your ideas. Tell us about that new electrical stunt you have meant to write up right along, but never got to. Perhaps you have a new idea, perhaps you have seen some new electrically arranged "do-funny"—we want these ideas, all of them. For all such contributed articles that are accepted, we will pay one cent a word upon publication. The shorter the article, and the better the illustration—whether it is a sketch or photograph—the better we like it. Why not get busy at once?

EDITOR.

New Things Electric

Electric Frying Appliance



A deep fat frying apparatus. On the left is a single unit, on the right three units are in position on the heating stand, with electrical switchboard back of them to regulate the heat. This is adapted particularly for French fried potatoes—sometimes called chips—and the like.

THE writer has had some experience in the culinary art, which experience, while not extensive, has taught him that there are two ways of frying.

In one method, which is carried on in a shallow frying pan or griddle, the surface of the pan is coated with a thin layer of grease or butter, and the food is heated on it. Then there is another system of frying in which a deep vessel is used, containing a large quantity of melted grease which is brought to a high temperature and the articles to be fried are immersed in it.

Frying potato chips and French-fried potatoes is done by the deep vessel method; the potatoes are cut up and preferably soaked overnight in water. The vessel of grease is brought to a high temperature, the potatoes are placed in it, and they are slowly browned, and when they reach a golden oak effect they are taken out with a skimmer or, what is still better, a closely fitting, wire-work vessel may be used, which, lifted out, will take them all out in one movement. The fine art of the process lies in selecting the right instant for withdrawal. Fish are fried in the same way.

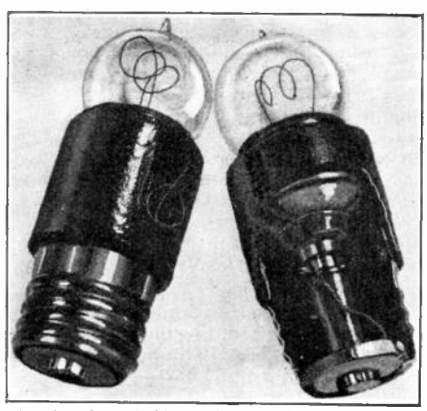
The illustrations shows an electric frying apparatus whose application will be clear to the reader from the above remarks. It includes a deep vessel with cover, with a wire basket fitting into its interior, and arranged to be heated by an electric coil. In use the grease is introduced, the current is turned with a power rate of 4.8 kilowatts for a pan 20 by 18 inches in area, and 4 inches deep.

Of course, the power used will vary with the size of the pan. By its concentration of heat where wanted, and with the absence of a large coal fire or of a set of gas burners for heating the grease, the temperature of the room will be kept down to a considerable extent and the general conditions will be greatly improved. There is a drawing-off tap for withdrawing the melted grease, and all the ordinary electric appliances for operation are included. This addition to culinary utensils is made in Scotland, and is called a fish fryer. In this country we would call it a potato fryer.

Indicating and Renewable Fuse

DURING the early part of the electrical industry houses were wired for lights only. The lights were generally installed in a fixed position so that in the early days fuses were seldom blown. As the industry developed, new uses in the home were found for electricity, such as table and floor lamps, curling irons, fans, dish washers, heaters, washing machines, and a host of other electrical appliances. They are all, in a majority of cases, operated by means of a cord and plug, with the consequence that the load on the various circuits in a house is constantly changing. With such increased use of electricity, the fuses are naturally blown more frequently, so that while a necessary safeguard the fuse is fast becoming a nuisance and a hindrance.

To overcome the prejudice against using fuses properly there has been designed an indicating and easily renewable fuse plug. The indicating device is a small pilot lamp, slightly larger than a marble, shunting the fuse element. The fuse proper is held between two positive grips making positive contact. The whole is contained in a shell which also forms the socket for the pilot lamp. Upon the rupture of the fuse the lamp receives the potential and a lighting current goes through the lamp which indicates the place of trouble. No tools or experience are required to locate and renew this type of fuse. A supply of new fuse material is attached on a bobbin on the fuse so that there need be no temptation to use wrong materials as substitutes for the proper fuse, and the location of the blown out fuse is known with certainty.



A nice household appliance. A fuse with a miniature pilot lamp, which goes out when the fuse parts.

Contributed by C. F. P. CARRIER.

Every-Day Uses of Electro-Magnets

By H. Winfield Secor

Associate Member, American Institute of Electrical Engineers

THE electro-magnet, perhaps more than any other electrical device, has found application in the greatest number of every-day industrial and other requirements. Electro-magnets form the basis of all our dynamos and motors, of all or practically all voltmeters, ammeters and other electrical measuring instruments, and represent the actuating factor in the major part of our electrical machinery and apparatus in use everywhere.

A novel application of the electro-magnet not known except to those who have visited or worked in potteries is the so-called clay magnet (see Fig. 1). A number of these powerful electro-magnets, each capable of lifting one-half ton or more, are used in various potteries for extracting the iron from clay mixtures, as they pass down through chutes or other passageways. These electro-magnets have to be excited, of course, from direct current for this purpose; in some cases they are operated from the lighting circuit, if it is D. C., or else from storage batteries or a small D. C. dynamo of the proper size driven by an A. C. motor, gasoline or steam engine. In operation these electro-magnets are raised periodically, and the fine particles of iron attracted and held to their pole-pieces removed, when the magnets are again placed back in the trough or sluiceway. In some cases several of these magnets are placed along the length of the trough, so that the iron missed by one will be caught by the second or third magnet, etc. There are several other similar applications of the electro-magnet in industries, the action of which will be understood from the foregoing.

Magnets have been used for many years in separating magnetic iron ore (magnetite) from various ore mixtures. One method of applying a series of permanent steel or electro-magnets for this purpose is shown in Fig. 2. A series of magnet poles close together, or else continuous magnetized disks are arranged on the axle of one of the pair of belt drums, as indicated in the illustration, and as the ore travels along on the endless belt the non-magnetic material flies off into a catch basin or on another traveling belt, as the case may be, while the iron particles attracted by the magnet are retained against the belt until they reach a position on the under side of the belt, where the magnet begins to lose its hold on them and they fall into a catch barrel or conveyor. Iron particles are often separated from brass in foundry work in this way, some of the magnetic separating machines being quite elaborate affairs.

Many of our readers no doubt have seen giant electro-magnets several feet in diameter in use for loading or unloading pig iron, iron scrap, boiler plate or other iron into or out of freight cars and barges around foundries and machine works. An electro-magnet suspended from the boom of a locomotive crane is shown in Fig. 3. In these cases it is usual to provide a small steam engine of about three to five horsepower which drives a D. C. dynamo to supply the necessary direct current for exciting the giant electro-magnet suspended from the boom. Such a lifting magnet when skillfully operated will do the work of several men in a given time, and the iron bars can be picked up or dropped with the throw of a switch in the magnet circuit, which is under the control of the engineer on the crane, who also swings the boom, etc. Steel track rails are loaded and unloaded in many yards by means of such powerful electro-magnets, and it is said that some of the operators become so adept in manipulating the electro-magnet switch that they can open and close it at just the proper time intervals to permit but one rail to drop at a time.

Many a person's eye has been saved from fatal injury and possible total loss of sight, thanks to the powerful electro-magnets now found in all physicians' offices situated around large factories and industrial plants. These eye magnets, as they are called, are extremely useful whenever a piece of iron or steel has lodged in the eye, as it cannot be removed without a great deal of pain or even danger to the sight in the ordinary way. By placing a patient's head in the correct position and carefully noting the location of the iron particle in the eye, it can be made to come out the same way it entered, in most cases. These magnets, with their pole-pieces pointed to give a very concentrated magnetic flux or pull at the apex of the conical pole, are eminently useful in many other cases, such as removing iron or steel which may have entered into the flesh in any part of the body, an accident occurring occasionally around industrial plants. (See Fig. 4.)

Some years ago a considerable part of a cargo of hardware, including kegs of nails, was retrieved from a watery grave in the Mississippi River by the judicious use of a powerful electro-magnet lowered into the water on the end of a cable, as Fig. 5 shows. Even without the use of divers, the electro-magnet used in this way has proved most serviceable in several instances, for wherever the material may be, so long as it is of iron or steel, and not held fast under a deck or other structure, the electro-magnet, if it is a powerful one, will bring it to the surface.

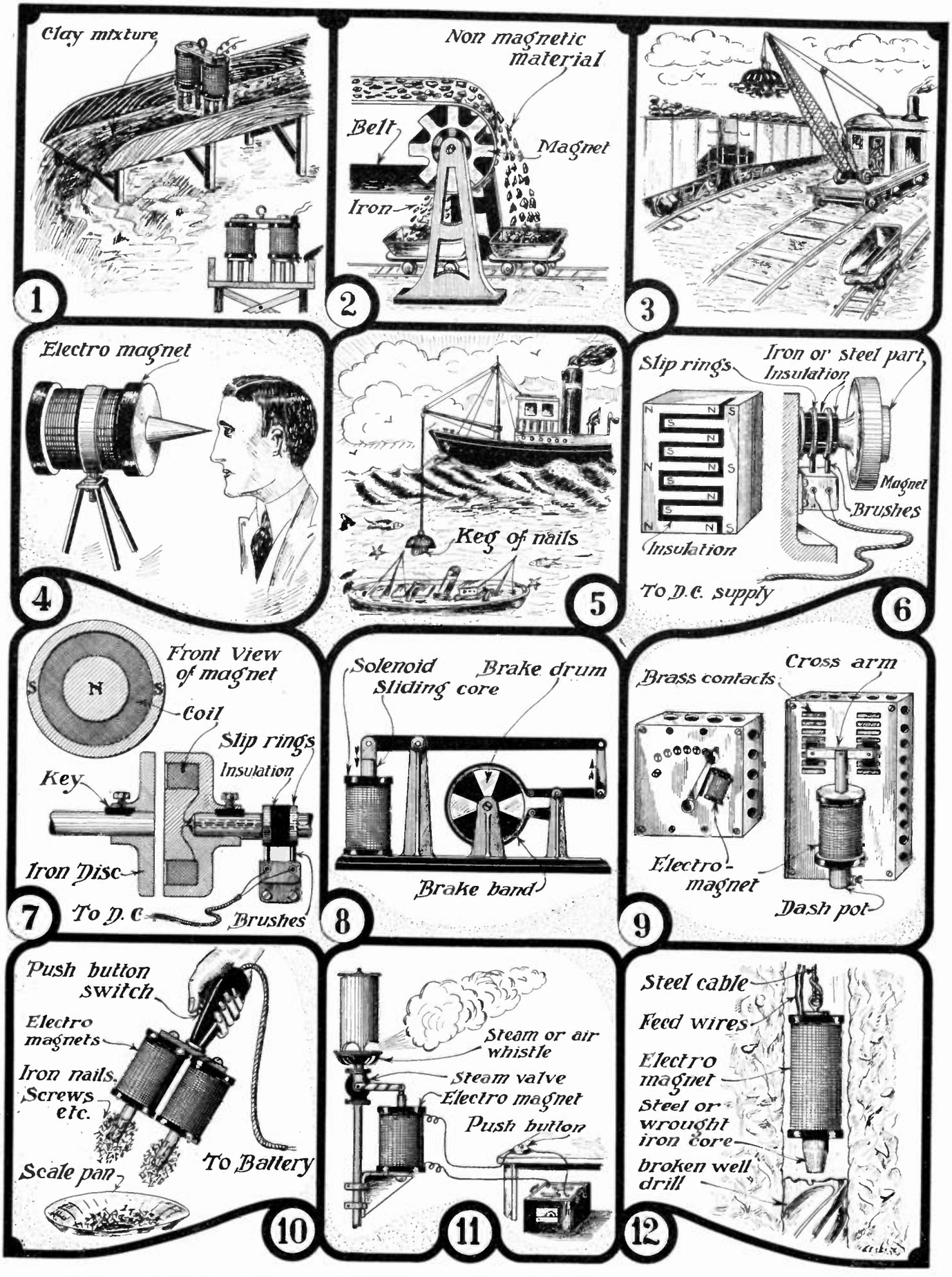
A unique case of this nature which recently came to the author's attention was where a young man who somehow or other lost his small gasoline engine overboard from his rowboat—one of those vest-pocket affairs that is clamped on the rear of a canoe or rowboat, and then you tell your friends what a fine gasoline launch you have down on the river. They are mighty fine little devices, and this buddy of ours was actually disconcerted at his loss; try as he might with sweeping lines and grappling hooks, he could not pick up the engine or even locate it. He finally conceived the idea of using an electro-magnet which he had lying home in the laboratory, and so he specially prepared it for its subaqueous duties by thoroughly soaking it in paraffin wax. The electro-magnet was only a small one, but our hero was fully confident that he could raise the engine with grappling hooks, once he located the exact spot where it had lodged. In a short time the electro-magnet stuck fast, and the line pulled taut. He brought the boat around until the line appeared to go straight downward, and shortly the engine was salvaged in good order with a long pole and a heavy wire net improvised for the purpose.

In all of the better grade machine shops today one is sure to find the magnetic chuck (see Fig. 6). The large chucks are provided with a plurality of opposite pole-faces, or rather auxiliary branches of the common pole-faces, so as to provide a well-divided attractive surface or surfaces, so as to hold such delicate parts as piston rings, etc., while they are being ground or otherwise machined in the lathe or milling machines, drill presses, etc. These magnetic chucks are useful in accurate machine work, especially where freak parts, such as thin iron or steel disks, are to be machined, etc. Of course, they have to be excited by direct current, and where this is not available they may be operated from a storage battery, or else from a small D. C. dynamo driven by a small A. C. motor or engine of some sort. Where the magnetic chuck rotates, as in a lathe, a special slip ring and brush arrangement has to be employed to supply its exciting current, as shown in Fig. 6 also. The multiple faced magnetic chuck shown at the left in the same figure, although it looks quite complicated, is really very simple internally and has but one magnetizing coil. The various branches of the north and south pole-faces are cut from the same iron member, and the space between the north and south polar extensions is filled with some insulating material.

Magnetic clutches, as shown at Fig. 7, have been used quite extensively in various machines and also on line shafting. The half of the clutch containing the electro-magnet winding shown in the sectional view at the left in Fig. 7 has to be supplied with a fiber or other insulating drum containing a pair of slip rings and stationary brushes secured to the wall or to the shaft-hanger, so that direct current is supplied steadily to the magnetizing coil of the clutch. When a switch of the magnet circuit is closed the clutch attracts the iron disk on the opposite shaft and locks it, so to speak, thus driving the second shaft. As soon as the current is cut off from the electro-magnet it loses its power to attract the iron disk and the second shaft stops rotating.

Magnetic brakes of various kinds have been used for many years on electric elevators and in various other capacities. Fig. 8 shows a magnetic solenoid brake of simple form, a great many different varieties of which have been devised for controlling high-speed electric elevators, etc. The solenoid or suction type of electro-magnet is used in this case, the sliding iron core passing easily into a brass tube inside the magnet coil. This core slips in easily with a little clearance so as not to bind. When the current is switched to the solenoid in this magnetic brake the iron core is sucked inward, or rather downward, causing the brake band lever (A) to be pulled upward, thus tightening the brake band around the drum on the main driving shaft.

Electro-magnets are used freely in all sorts of motor starting boxes and controllers, two different types of which are illustrated at Fig. 9. One of these is an automatic elevator starter in which a powerful solenoid or suction type electro-magnet pulls an iron core upward, this core carrying a cross arm which slides over a series of brass contacts, causing the resistance coils within the controller box to be switched slowly out of circuit with the motor, and enables it to accelerate in speed. In order that this solenoid shall not jerk the iron core and its attached switch bar upward too quickly it is invariably provided with a dash-pot arrangement. In one form this dash-pot is fitted at the bottom of the magnet, and a continuation of the sliding core carries a piston which slides in a closed brass tube filled with oil, the piston moving upward through the oil slowly, owing to a small



1. Purifying clay magnetically. 2. Magnetic concentration of iron ore. 3. Electro-magetic crane. 4. Magnet for extracting iron splinters from the eye. 5. Salvaging a cargo of hardware. 6. A magnetic chuck. 7. A magnetic clutch. 8. A solenoid brake. 9. Electro-magnetic starting boxes. 10. The electro-magnet in the hardware store. 11. Blowing a whistle with an electro-magnet. 12. Extracting a broken drill from a well bore.

aperture, allowing the oil to pass through the piston or in some other similar manner. In the motor starting box with which most of us are familiar, and shown at the left in Fig. 9, an electro-magnet holds the starter arm in place once the motor has been accelerated and brought up to speed. Some of these starting boxes are very elaborate and are provided with electro-magnets connected in series with the main current supply to the armature of the motor, so as to act as overload cut-off relays, an abnormal current passing through them, serving to release the starter arm and stopping the motor.

Several years ago we were quite amused to see an extremely novel and practical application of small electro-magnets in a large eastern hardware store. Upon ordering several pounds of iron nails we were surprised to see the clerk pick up a small double pole electro-magnet fitted with a handle and push-button switch, as shown in Fig. 10, which he jabbed into the stock containing the nails, and lo behold! he drew it forth with two big fistfuls of nails clinging to each pole. He released the button and they dropped into the scale pan. There are many other applications of this nature which are yet waiting to be developed and wherein the electro-magnet of the size found on electric bells, etc., will save time, money and injury to human hands. Of course, the magnets will not pick up brass or other screws, but only iron or steel bolts, screws, nails or other small parts.

When you hear the shop whistle blow you never know whether it was started by opening a steam valve actuated by a pull rope or chain, or whether the chief engineer in his private office pushed a button, causing an electric current to instantly energize an electro-magnetic solenoid, as shown in Fig. 11, which opened the steam valve to the whistle. There are many useful purposes just like this one, where the electro-magnet or solenoid is awaiting its turn to help in the world's work.

There is not space enough here to dwell on some of the interesting and ingenious uses to which electro-magnets have been put, especially in the past five or ten years, but in closing we might mention an idea which might prove useful in one form or another at some time in your own career. In drilling a well some years ago the drill was broken off, and after a good deal of time was wasted trying to recover it, one of the engineers conceived the idea of constructing a long, thin electro-magnet, which was passed down the hole at the end of a cable, as shown in Fig. 12. In a short time the piece of broken drill was recovered from the well, and operations started once more.

Operating Railroads by Static Electricity

AN interesting paper was presented to the French Academy of Sciences recently by M. Maurice LeBlanc on the subject of a trolleyless electric railroad. The title we have given the article may be a little far-fetched, but really expresses the idea.

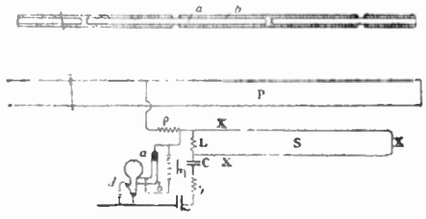


Diagram of static conductor and of the circuits on the car top in this proposed new system of electric transit.

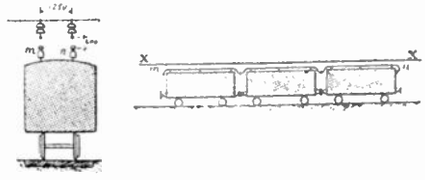
The cars are to be operated without any connection with a trolley line. In place of such trolley line, there are a set of tubes of two sizes, one within the other, separated by a dielectric, and so connected as to constitute a series of condensers. Each tube is to be 1/25th of an inch thick, the outer tube to be about an inch in diameter, and a pair of them extend over the line of track like double trolley wires.

Somewhat exhaustive figures are given in the paper, but these we will not reproduce, as we only wish to give the general outline of the very ingenious and striking project. In a general way, the system of condensers represented by what we may term the "trolley line"— only that there is no trolley—are charged with a current of 20,000 cycles per second frequency. On the roof of each of the cars there are tubes running the length of the car, one under each of two of the condenser lines we have described. These tubes are carried on insulators and those on one car are connected to the next; at the rear of the train the two are connected, and at the front of the train the circuit embracing the two tubes is closed by the transforming apparatus.

The current after transformation operates a squirrel-cage motor which drives the car.

Automatic tuning is required and the illustration explains rather clearly how this is effected. The inductances (L_1 and L_2), one being moved by rack and pinion, are caused to vary their total inductance, the element (D) with the motor (G) keeping everything in tune. At (E) the coils (λ_1 and λ_2), constantly oscillating under control of a motor (H), control the movements of the motor (G). (K) represents a galvanometer needle which moves over an extremely small range between the two stops (μ and ν); if it touches the left-hand stop it closes the circuit of the motor (G) by a relay not shown. If it goes to the right-hand stop it opens the circuit.

It will be seen that this arrangement dispenses with the overhead trolley and leaves the car entirely disconnected from any source of current. Currents at extremely high pressure can be used in the transmission line, and the voltage collected by the capacity tubes on the train is only about 75 volts for a 45-foot coach, or about 5½ volts to the yard.



Relation of the car driven by static electricity to the two static conductors above its roof. XX represent the line of such conductors.

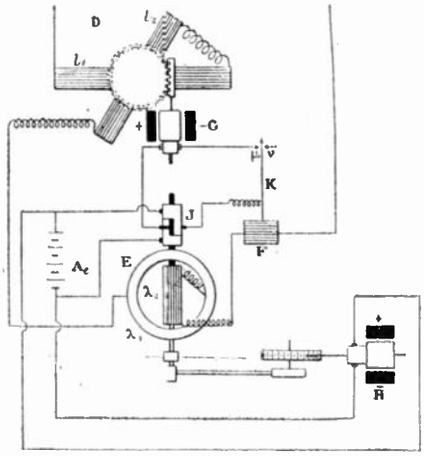
A large-output vacuum tube will be required to transform the high frequency current, and it is here that some idea of the difficulty may be encountered.

If alternating current at low frequency were used on the line, it would interfere with telegraph and telephone lines in the vicinity. The frequency of 20,000 cycles per second is so great that it would have no effect on receiving instruments. To prevent the induction of high pressure in single wire telegraph or telephone lines in the vicinity, they could at intervals be connected to one terminal of a condenser, whose other terminal would be grounded. This would remove all trouble from the standpoint of induced current in the line.

This system is by no means fully developed. It is an exceedingly interesting and suggestive application of static excitation for current work.

The first trolley was a little car which ran along a wire. The first electric cars were operated from the rails or from such a trolley. Then, early in the art, the trolley pole, pressing upward against the wire was invented, which was a fundamental improvement. The wire was no longer subject to the downward pull of a heavy trolley, but was pushed upward, so as to do away with all extraneous pulling. Recently the trackless trolley is coming to the fore. This requires two trolley wires as no rails are available for the return or ground circuit.

But here we have the trolleyless car and the possibility of a trolley-and-trackless car is before us.

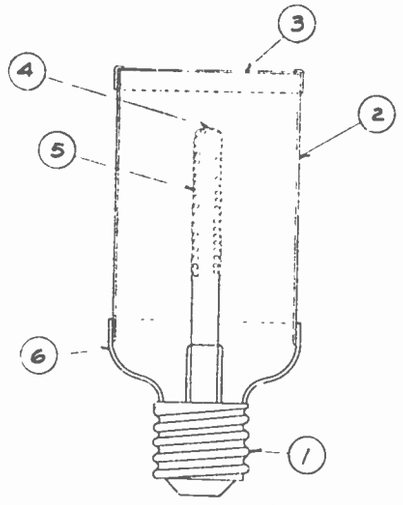


Enlarged diagram showing the circuits on the car so that it shall be driven by its overhead static conductor.

Elimination of Accidental Explosion in Gas Mixtures Made Possible by New Invention

By Dr. H. C. P. Weber

Research Laboratory, Westinghouse Electric & Manufacturing Company



Sectional view of an incandescent lamp which effectually burns inflammable mine gases without producing any explosions. A wonderful contribution to the safety of miners.

THE accumulation of explosive gas mixtures in enclosed spaces is of frequent occurrence, and accidental ignition of these explosive mixtures in public places has led to disastrous results.

Thus, the explosion of sewer gases in city sewer systems is not at all infrequent. So, also, occasional explosions are reported from public service tunnels and underground systems. The same problem presents itself as a result of gas mixtures which accumulate from various causes in closed vaults containing control apparatus, electrical or otherwise, in transformers and in similar apparatus.

Explosive gases accumulating in public service tunnels and similar places may arise from a variety of causes. In general, however, they are essentially hydrocarbons (principally CH_4 and related compounds), with occasional admixtures of hydrogen and carbon monoxide.

A similar problem presents itself in the gases accumulating in mines. Here the quantities of gas are so enormous and the spaces to be controlled are so vast that little can be done beyond securing the best possible ventilation. In more limited spaces, however, some preventive measures have been taken, such as the use of fire-snuffing vapors, chloroform and carbon tetra-chloride, but these measures have been rewarded with only a limited amount of success. The use of carbon dioxide to dilute the explosive mixture below the explosion point has been suggested, but this requires an entirely impracticable amount.

The method to be described here eliminates the danger of explosion by continuously burning the explosive mixture more rapidly than it can accumulate. In order to do this the gas must be oxidized at a temperature considerably below that at which the explosive wave is propagated; that is, below the explosion point. It has been possible to do this by the use of an oxidative catalyst finely distributed over a porous surface.

In the diagram, No. 1 is a lamp base of the ordinary type which may be screwed into any ordinary lamp socket for the purpose of making connection with 110-volt circuit. The leads are brought in from this base in the standard fashion through a glass insulating member. No. 6 is a glass member supporting 2 and 3, which two consist of fine mesh wire screen which is intended to prevent any flame which may form in the interior from striking through to the outside, according to the well-known Davy principle. The bulk of the results described in the succeeding were obtained with the bare and unprotected filament, and the wire gauze is in the nature of *additional* security. In practice there are a number of variations on the filament shown, which are more suitable for special purposes, either consisting of a solid porous cylinder internally heated or of wires sheathed in porous tubes and arranged to form a hollow cylinder.

The essential feature in the whole device is the application of a catalyst to a considerable porous surface, and the control of the resistance of the whole system so that it normally takes on a safe and effective operating temperature. The temperature we have found most satisfactory to use has been between 600 and 800 degrees Centigrade (1,100 degrees and 1,472 degrees Fahrenheit), using a platinum catalyst.

The temperatures (measured by the optical pyrometer) necessary to explode a mixture of ten parts of air to one of natural gas varied from 925 degrees Centigrade to 1,080 degrees Centigrade (1,697 degrees Fahrenheit to 1,976 degrees Fahrenheit).

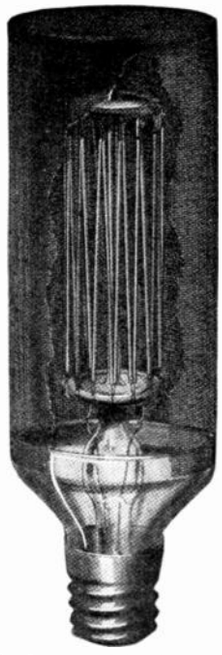
Many tests with natural gas in various mixtures uniformly showed that under the conditions of filament bare and unprotected, a temperature of nearly 1,000 degrees Centigrade (1,832 degrees Fahrenheit) was necessary to produce explosion.

Other determinations had to do with the operating efficiency of the device as a gas consumer, and a further series of experiment was carried on to determine the effect of a number of well-known oxidation catalysts. They were carried out by running up the temperature for each catalyst and determining the rate of gas consumption at various temperatures. Some catalysts were *relatively* more effective than others at low temperatures.

The best of these results shows that with the volumes as given, 97 per cent of the combustible constituent, methane, of a mixture in the proportions for complete combustion and highly explosive, can be burned out in one-half hour. The temperature at which this is possible is about 300 degrees Centigrade (572 degrees Fahrenheit) below the ignition point.

One astonishing result is that the device functions in a 10 or 15 p.c. hydrogen-air mixture. This is probably the most severe test that could be made. The rate of consumption is enormously increased in the last-named mixture as is natural. For mixtures of air and hydrogen (submarines and the like) we recommend a type of lamp specially designed for this purpose.

In conclusion it may also be stated that when actively functioning in an explosive mixture, the temperature of the filament is somewhat higher, due to the heat of reaction. This is readily discernible and the temperature drops again when the combustible gas is exhausted, giving a qualitative indication of the presence of explosive vapors. By the use of a thermocouple junction this indication may be made to be self-supporting and capable of accurate measurement.



View of the lamp used in these investigations, which investigations point out a means of making a mine evolving fire damp and the battery on a submarine practically safe.

Electric Power on Farm

THE Rural Lines Committee of the National Electric Light Association, reporting at a late session of the annual convention, predicted the electrification of the farm along lines similar to those developed in the factory in the last 15 or 20 years. The farm now presents much the same problem as the factory one or two decades ago, says the report. Electrical development on the farm is expected to be a most potent factor in raising the standard of rural life. Development of electrical machinery is expected to be of special value in view of the shortage of farm labor, and the use of labor-saving devices in rural homes should do much to simplify domestic work, the report continues.

Electric companies must interest themselves in developing equipment suitable for farm use, the report declares, just as in the past they applied themselves to producing factory equipment that would fit the facilities of electric power. The committee is now engaged in a study of the needs of the farmer and of the electrically driven equipment available.

Investment of three and a half billion dollars by electric light and power companies of the country will be required by 1925 to meet the demands for service, according to the report of the Relations with Savings Bank Committee, submitted today. The industrial area along the North Atlantic coast from Boston to Washington will require an investment of a billion and a half dollars to meet the development required, the report stated. Investment of the required money would increase the economy and efficiency of railways and factories on account of the superiority of electric supply of energy from large central sources, it was declared.

Shocked—But How?

$100 Prize Contest

OUR front cover shows how a number of mischievous boys have tried to ring a neighbor's doorbell, as, indeed, has been their habit, and is the pleasing indulgence of many young boys.

Sometimes this prank simply exasperates us, and sometimes we try to run after the boys, if our legs are good enough. More often the angry householder can only satisfy himself by shaking an angry fist at the departing, jeering urchins.

The up-to-date victim, however, after this has occurred a number of times, feels a consuming desire to teach the offenders a lesson, and, naturally, here is where electricity comes to the fore. Why not give them a good shock, by some means known to the electrical fraternity, so that when the bell is pushed, or the handle pulled, whichever style the bell may be, the unruly offender will experience a sensation that he will not soon forget.

We have a handle which is metallic. We have the ground which is usually moist or wet, and the rest seems easy. A high tension current strong enough to give a severe shock, but not strong enough to injure; just sufficient to cause discomfort, is what is needed. There are various ways of accomplishing this. Naturally the spark coil would suggest itself at once, but then to the clever electrician there are other means open. What are these means?

Study our cover illustration carefully. *Do not overlook any detail.* Then try to decide how the trick was turned. It looks very simple, but really is not. There is ONE correct solution to it, and the right solution is the one that will win a prize.

PRIZES

$100 in Gold

1st Prize	$50.00	in Gold
2nd "	20.00	" "
3rd "	15.00	" "
4th "	10.00	" "
5th "	5.00	" "

Now in order to make this contest of a little more than average interest, *we have hidden the correct solution somewhere in the magazine.* To be sure, it will not be easy to find the solution. As we said, the solution is hidden, and we mean it. You will have to do some careful scanning of the pages to find the hint. Then when you are lucky enough to find it, it will be necessary to write the answer in 100 words or less. The best answer, in order to get the first prize, will have to explain how the trick is done, leaving out nothing of importance in connection with it. The second best letter will get the second prize, the third best the third prize, the fourth best the fourth prize, etc.

A condition of all prizes awarded is that you mention in the answer on which page the hidden solution of the contest is printed.

In publishing the various ideas all the rights revert to the publishers. The latter also reserve to themselves the right to publish all manuscripts sent into this contest, although these may not be prize winners. In that case, full space rates will be allowed.

All photographs, diagrams and other matter submitted by contestants which are not used will be returned at the publisher's expense.

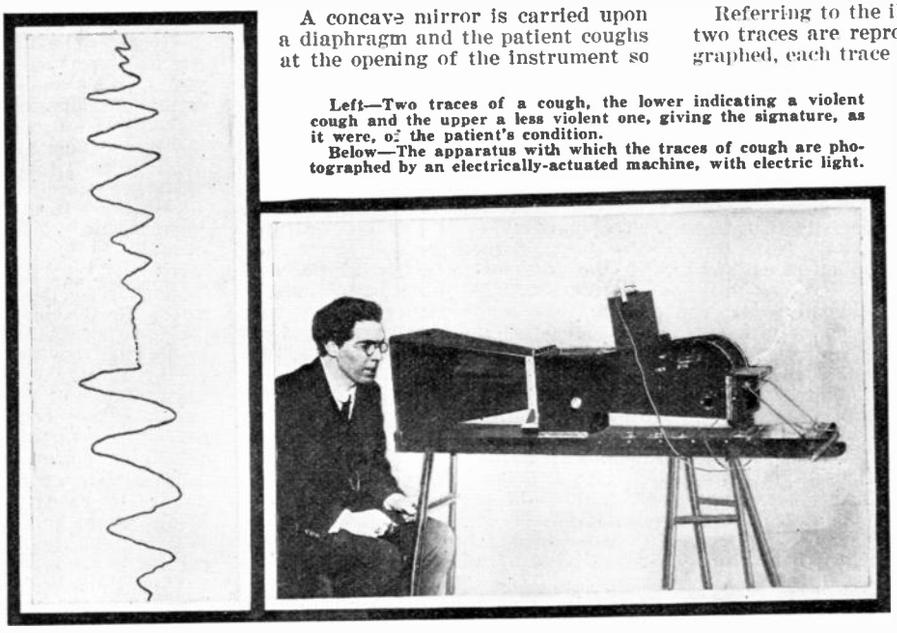
Should two contestants submit the same prize-winning solution, then both will be awarded the same prize.

Manuscripts must not be longer than 100 words. All prizes will be paid upon publication. This contest closes in New York January 25th, and the first prize-winning article will appear in the March issue.

Address all manuscripts, photographs, parcels, etc., to *Editor, Shocked—But How? Contest,* in care of this publication.

The Audiometer

AN old experiment is to cause a sound of the human voice to throw a mirror into vibration, which mirror, being slightly concave, focuses a spot of light upon a moving sensitized film. In this way, by developing the film, a species of photograph of the motions of the mirror is secured. If the film were stationary, only a straight line, depending for its length on the amplitude of the motion of the mirror, would result. But if a long film were used and were moved by an electric motor across the field, instead of a straight line, a sinuous one would be attained, so that sound might be said to be photographed.



Left—Two traces of a cough, the lower indicating a violent cough and the upper a less violent one, giving the signature, as it were, of the patient's condition.
Below—The apparatus with which the traces of cough are photographed by an electrically-actuated machine, with electric light.

The illustration shows a genuine apparatus based on this principle, an invention due to Mr. A. W. Low of London. It is used to get the traces of coughs of invalids, so as to use the records for diagnosis and study of the condition of a patient.

A concave mirror is carried upon a diaphragm and the patient coughs at the opening of the instrument so as to throw the diaphragm carrying the mirror into vibration. During the exposure the film, which is moved at a constant rate across the field of the camera, receives the projection of light from the mirror, and when developed gives the desired graph or traces of the cough.

Referring to the illustration on the left, two traces are reproduced there as photographed, each trace representing the oscillations of a mirror reflecting a beam of light from a powerful electric lamp upon a sensitized film, photographing the motions greatly increased in amplitude by their distance from the mirror. The lower one obviously shows a more violent cough than the other one, and every cough can be made in this way to give its autograph. It is obvious that the methods are open to other variations and that other sounds can be thus made to give their record by it. An apparatus like this seems to come in line with other graphic appliances used in modern medicine and which discriminate so much in favor of the scientific diagnoses of symptoms and the methods of securing a permanent record of the patient's progress and condition, especially in hospital work, where such appliances are available. This is the photographic record of a cough.

Motor Electrics

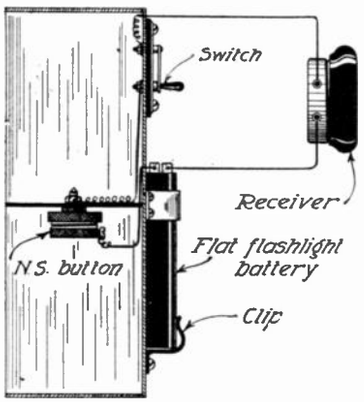
Automobilist's Microphone

EVERY motorist knows the difficulty of locating a knock, either in the main bearing, crank shaft bearings, or in the wrist-pin, and will no doubt be interested in the construction of a microphone which I have used with very favorable results for this purpose.

An ordinary cigar box is cut in two, lengthwise along the middle, and the side board is placed in the open side, giving a box one-half the size of the original. An N-S transmitter button or a Skinderviken button is then placed in the center of the end board. All is then secured as shown in the drawing.

An Everready flat type battery supplies all the current requisite, and the switch, which may be of a simple spring type so as to stay open when not depressed by the user, must be put into the circuit. Next, a small pony receiver is connected up in the circuit as shown in the diagram. It is well to solder the joints so as to get the very best results.

To use the appliance, the switch is closed, the receiver is held to the ear, and the sound box, as we may call it, is used to explore the engine and deter-



A microphone with a flashlight battery to detect and identify noises in an automobile motor.

mine the region of the knock. Presumably, the point where the loudest sound is heard will indicate the locality of the knock. The faintest sound will be picked up by this device.

Contributed by CHARLES DE BERRY.

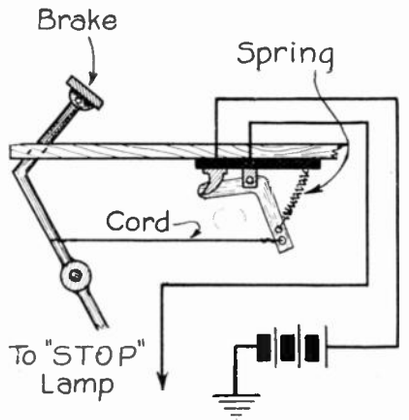
Automobile Safety Signal

THE following neat and compact safety signal can be constructed at little cost and labor.

Take a heavy tin or metal box, such as one that contains yeast, about 5½ inches by 3½ inches, divide into three compartments by soldering in two partitions. With a bit of tin strip solder a single contact socket in each compartment and wire as shown in the diagram.

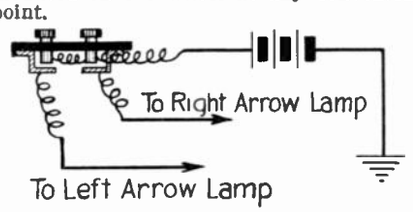
The lid of the box should be stenciled and cut out, with the arrows pointing right and left on two sections, and on the third section the word "Stop." This lid should be hinged and fastened securely to the box in a way to give access to the bulbs, yet not to fall off. A red glass, either natural or painted, should fit inside the lid, held in place with clips.

The entire inside of the box should be enameled white, and the outside may be painted any color desired.



A safety system for automobiles; the connections arranged to signal "STOP!" to those following when the brake pedal is pressed.

This is then to be wired and connected by simple switches to the battery or source of electricity, the stop signal switch is connected to the brake pedal, and the right and left arrow switch mounted on the wheel at any convenient point.

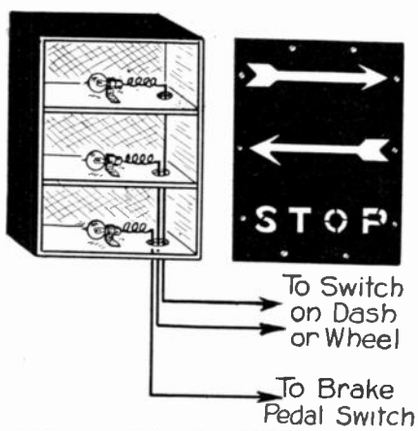


The same system giving warning of a turn to the right or left to the following traveler.

Another suggestion is to make this appliance in duplicate, one being bracketed to the front of the car, one to the rear, all wires using the same switches.

Any size of lamp desired may be employed.

Contributed by FRANK H. AMBERS.



"RIGHT TURN," "LEFT TURN" and "STOP" signals as operated by the system just described.

Sparks from Filtering Gasoline

IT has long been believed and asserted by automobile authorities that when gasoline is filtered through chamois, sparks due to static electricity have been produced. Many have denied this, and some have considered it quite discredited. From some recent issues of the *London Electrical Review* we reprint the following letters, which tell their own story and will interest automobilists:

REMOVAL OF A STATIC CHARGE

During the process of rinsing silk and other garments in warm, dry benzine, static electricity is generated in such quantities as to ignite the vapor by a spark discharged under certain conditions.

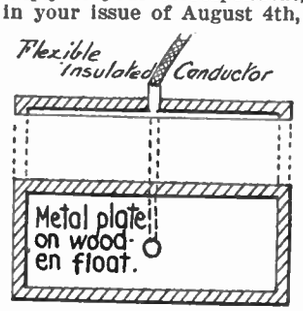
All the metal tanks and machinery are electrically earthed, but owing to the benzine being a non-conductor, it appears to retain sufficient electricity to produce a spark on discharge, and I should be much obliged if any reader could give information as to how to conduct the electricity from the surface of the benzine as fast as it is generated. F. W. F.

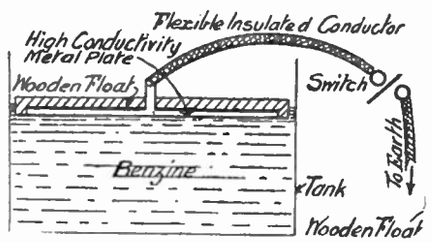
July 19th, 1922.

In the next issue the following appeared:

REMOVAL OF STATIC CHARGE

In reply to your correspondent, "F. W. F.," in your issue of August 4th, I think





A suggestion for preventing sparks being produced from gasoline, when strained through an insulating fabric.

the entire removal of the static charge from the surface of the benzine would be extremely difficult.

I would, however, suggest as an experiment, that the apparatus shown in the accompanying diagram be given a trial, and I venture to think this should meet with some measure of success.

The apparatus consists of a light wooden float, made to cover the surface of the benzine. Attached to the bottom of the float is a plate of high conductivity metal (preferably aluminum), riveted to which is a metal rod which passes through the center of the float to an insulated flexible conductor, connected through a switch to earth.

This switch should be kept open during the immersion or removal of the float to prevent any discharge taking place between the surface of the benzine and the metal plate, and should be closed during the rinsing process.

It is also advisable to have the metal plate recessed into the wooden float, to prevent a discharge to the tank.

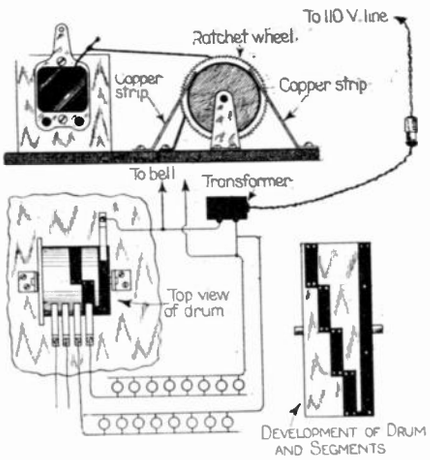
Awards in the Electric Bell Contest

First Prize

Sign and Lamp Flasher

By Otto J. Prucha

THE arrangement shown in the illustration is a Sign and Lamp Flasher. The essential of it is the wooden cylinder with four intermittent contact strips, and one complete contact strip entirely encircling it, all connected together as shown. The development of the drum-surface with its contacts is given in the illustration.



The rapid vibrations of the hammer of a bell are made to produce a slow rotation of a cylinder, fitted with flashing connections and brushes.

There are four springs that are arranged to bear against the four intermittent contact strips, and there is a fifth spring which bears against the continuous strip. The spring bearing against the continuous strip is connected to one of the terminals of the electric circuit, and four other leads are connected one to each of the springs bearing on the intermittent strips. This establishes, as can be seen, four circuits, and on these are connected four sets of lamps and the distant terminals of these circuits eventually unite and connect with one lead from the continuous strip on the cylinder. A battery, of course, is included in the circuit on the single lead. Thus, as the cylinder rotates, each of the four groups of lamps is successively brought into the lighting circuit. A bell with the gong removed is mounted in line with the end of the cylinder, which end carries a ratchet wheel. From the clapper of the bell a strip of steel acts as a propelling ratchet, pushing the flasher cylinder around one tooth at a time as the bell clapper vibrates. Below, a second stationary ratchet is arranged to prevent the cylinder being turned the wrong way by friction. In this way the very rapid action of the bell clapper is made to turn the cylinder quite slowly so as to give the desired flasher action.

Second Prize

Automatic Telegraph Key

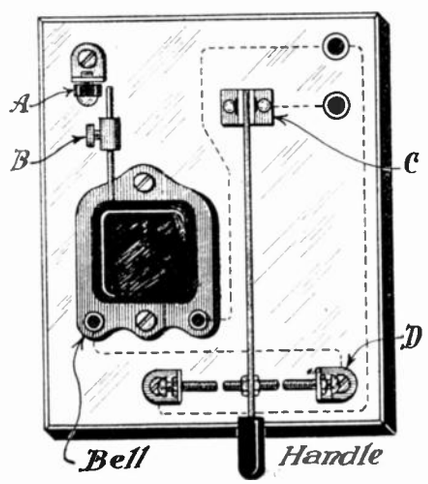
By Amedeo Giolitto

AN electric bell can be used for constructing an automatic telegraph key such as a Vibroplex, for home practice in telegraph operating. These keys are expensive to buy, but this one can be cheaply built from material which can be found in any experimenter's workshop.

Reference to the diagram will give one a good idea of how it is made. The bell has its gong and hammer taken off; a sliding weight (B) is placed on the hammer arm, while near the end of the hammer arm a stop (A) is fixed in the position as shown in the diagram. The purpose of this stop is to stop the arm from vibrating when no current is flowing through the coils.

Next a lever is clamped between a switch clip (C) while at the other end of the lever a knob is fastened. This lever operates between the two contacts (D). The different parts of the key are connected to the bell and binding posts as shown by the dotted lines in the diagram.

When connecting the key to the circuit, it is connected just like an ordinary telegraph key, that is, in series with the sounder and battery. Pressing the lever to the left contact (D) makes dashes, while pressing it to the right contact makes dots. For example, if the letter B



A telegraph key producing dots and dashes automatically, according to whether it is moved to the right or to the left. The frequency of the dots is adjustable by the weight (B).

were to be made, we would press the lever to the left contact once, and then hold it to the right contact until three dots are automatically made.

The speed at which the dots are made can be changed by adjusting the sliding weight (B), for if this weight is placed nearer the end of the arm it will reduce the speed at which the armature vibrates. Therefore the speed at which the dots are made would be slower.

It should be noted that this key will not operate in connection with a 20 ohm sounder, for the reason that the bell is connected in series with the sounder and battery when the lever is pressed to the right contact, and if the sounder had a high resistance, enough current could not get by it to operate the bell.

The key will give excellent results if used with three good cells and a 4 ohm sounder, as the resistance of the 4 ohm sounder is almost the same as that of the bell.

PRIZE WINNERS

First Prize, $50.00
Otto J. Prucha
Omaha, Nebraska

Second Prize, $20.00
Amedeo Giolitto
Rockford, Ill.

Third Prize, $15.00
Leroy Cox
Placenta, Cal.

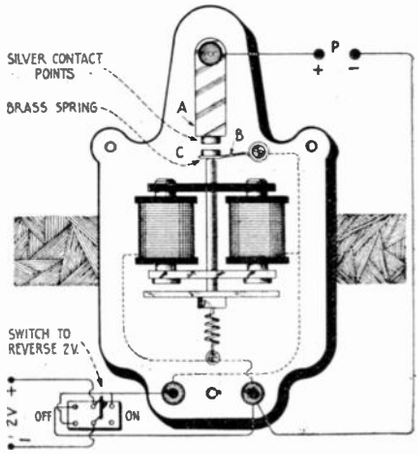
Fourth Prize, $10.00
Howard Hughes
Worcester, Mass.

Fifth Prize, $5.00
Max Cohen
New York, N. Y.

Third Prize

Power Circuit Relay

By Leroy Cox



The mechanism of a direct acting bell made to close a circuit and keep it closed without exhausting the primary battery used to bring about the action in question.

THIS relay is constructed from a direct stroke door-bell. The bell is taken off and in its place is mounted a strip of copper (A) which has a silver contact on one end. This strip is insulated from the base.

A piece of spring brass (B) is mounted by means of a machine screw on the base as shown, and this also has a silver contact on one end. The two silver points are adjusted very finely so that when the electro-magnet pulls the armature the contacts are closed. The make-and-break contacts are then bent so that they will make a closed circuit. The switch is now connected in series with the coils, as shown in the illustration, and the device is ready for action, being connected with the power circuit as shown.

Next, a 2-volt circuit is connected to the binding posts as usual, so that when the switch is closed the current will flow through the coils in the same direction as the other current will, when the contact points are closed. If the switch is then pressed just for an instant, the clapper will close the contact points and the power at (S) will then flow through the switch, thence through the coils, which will in turn hold the contact points together, causing a continuous flow of power.

If the 2-volt circuit connections are then reversed and the button is pressed for an instant, the current will react upon the coils, causing the contact points to separate, thus cutting out the circuit.

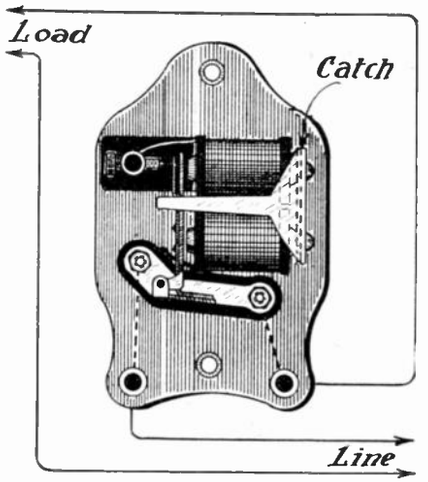
This system has the advantage that it uses very little current from the 2-volt dry cell. It proved entirely successful in tryouts, and will operate on any line where the amperage drawn is not sufficient to burn out the coils.

A double throw, double pole, switch is used to reverse the polarity of the connections. This switch is only closed for an instant, whether opening or closing the local circuit.

Fourth Prize

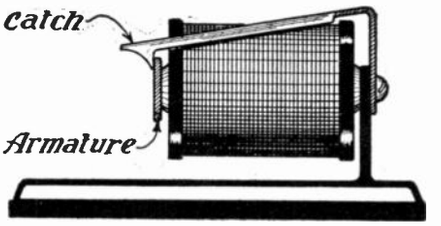
Circuit Breaker

By Howard Hughes



A bell magnet with its armature fitted with a spring catch which holds the armature against the poles of the magnet mechanically when it is once attracted, keeping the circuit open until released.

A BUZZER can be very readily converted into a circuit breaker. The purpose of this breaker is to open a circuit carrying an overload, or one that has been short-circuited, thereby saving the expense of fuses.



Side view of the bell magnet with its armature showing how the catch retains the armature, breaking the circuit.

As may be seen from the illustration, the only material used in addition to the buzzer is a piece of brass strip bent as shown, to act as a catch for the vibrating armature. When a short-circuit or overload occurs, the electro-magnets will draw this armature over, allowing the catch to drop down, holding the armature in place and keeping the circuit open.

All that is necessary to reset this breaker is to raise the catch sufficiently to allow the armature to swing back, closing the circuit.

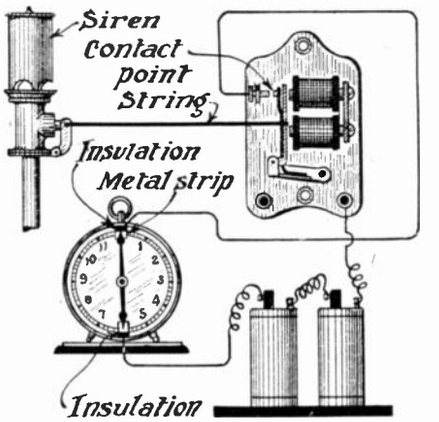
Fifth Prize

Bell for Sounding Siren

By Max Cohen

A SIREN is made to sound at any time by a clock connection. When the circuit is closed by means of hands on the clock closing the circuit, the bell rings. However, as one wire is connected to the contact point, it is a single stroke bell.

As the armature is pulled towards the magnet, it pulls a string, which opens the air or steam valve and sounds the siren.

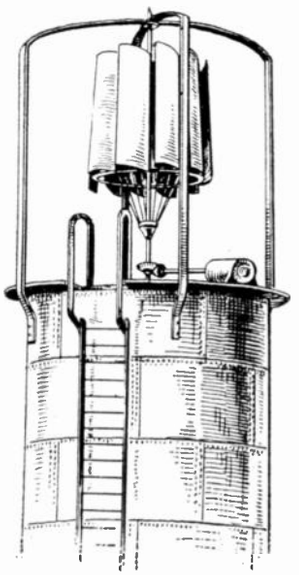


A clock, by means of a bell magnet and clapper is made to open a steam or air siren, producing a sound for as long a period as desired, according to the contact on the face of the clock.

The sound continues until the circuit is opened by the motion of the clock's hand.

Wires on the clock are connected to metal strips which are insulated from the frame of the clock, so as not to cause a short-circuit. For a large siren, a very powerful bell is required.

Farm Wind Motor



The farm wind motor mounted on top of a steel water tower.

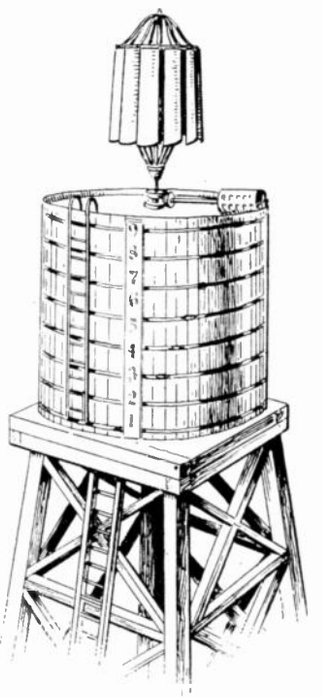
WE have had occasion previously to illustrate and describe windmill plants for supplying farms and isolated dwellings with electric power. The storage battery has become so perfected and simple to handle, and farm motors have become so standardized as regards voltage, construction and general regulation, that no farm house need be without electric current to give the advantages of the city to the rural regions.

The illustration shows a certain departure from the ordinary vertical plane windmill. Here a compact cylindrical air motor is mounted directly on top of the gable end of a building, where it rotates about a vertical axis. We are informed that it will stand up against a 50-mile per hour gale of wind.

The wind motor on the gable end of a building, a very practical application of it.

A 1-kilowatt generator occupies a position below the mill, but it is obvious that the generator could be placed in the basement of the house or elsewhere, as the shaft running from the mill simply rotates and has no reciprocating motion.

Another place suggested for the installation of this wind motor is on top of the water tower. The diagrams show, very much in outline, the general relations of parts; the generator is firmly established on a floor directly under the motor and is driven by bevel gears therefrom. Of course, the diagrams only show suggested arrangements, while the illustration of the house shows another disposition of parts.



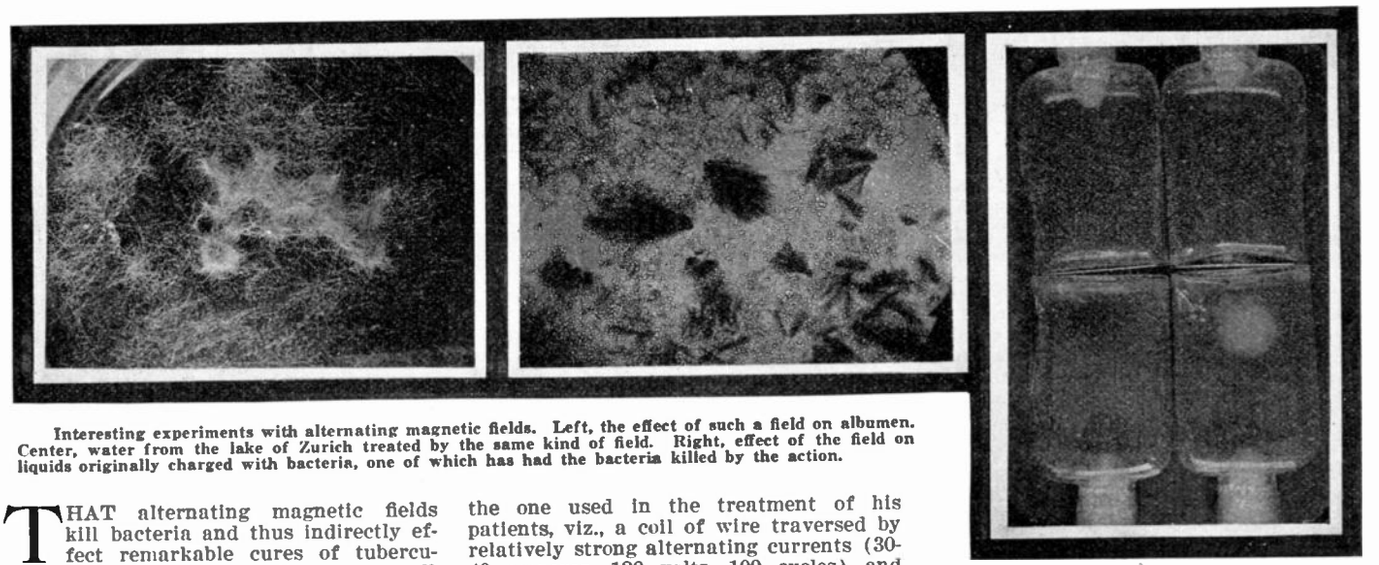
The wind motor mounted on an elevated wooden water tank of the usual type used on farms.

The regular storage battery, switchboard and general appurtenances are to be installed, so that spells of windless weather will be provided for. The extensive introduction of these windmill and wind-motor electric plants is educating the farmer in electrical engineering and is ameliorating the sometimes hard and wearing conditions of farm life.

Strange Effects of Magnetic Fields

By Dr. Alfred Gradenwitz

Berlin Correspondent, PRACTICAL ELECTRICS



Interesting experiments with alternating magnetic fields. Left, the effect of such a field on albumen. Center, water from the lake of Zurich treated by the same kind of field. Right, effect of the field on liquids originally charged with bacteria, one of which has had the bacteria killed by the action.

THAT alternating magnetic fields kill bacteria and thus indirectly effect remarkable cures of tuberculosis and other infectious diseases as well as produce a marked immunity to infection was definitely determined by Mr. E. K. Müller, of Zurich, one of the pioneers in electrotherapy. Due to the fact that many of his patients who in previous winters were invariably subject to severe attacks of influenza and the like reported their perfect freedom from such ailments after his treatment, Dr. Müller was naturally induced to investigate these unexpected effects.

The cooperation of a chemist specializing in the physiology of fermentation having been secured, an outfit similar to the one used in the treatment of his patients, viz., a coil of wire traversed by relatively strong alternating currents (30-40 amperes, 120 volts, 100 cycles) and comprising in its interior a specially designed iron core, was installed in a laboratory where both the temperature and illumination could be controlled at will. While certain bacteria were found to be checked in their development by the action of alternating magnetic fields, the growth of others, e. g., luminous bacteria, was, according to the arrangement of the experiment outfit, either checked or activated. However. the feeding medium containing the bacteria would invariably become immunized.

Above are shown four bottles full of bacteria cultures, one of which has been exposed to the action of an alternating magnetic field. The checking effect is strikingly seen.

Other strange effects of alternating magnetic fields are also illustrated, showing some remarkable precipitates from albumen, due to magneto-chemical (molecular) effects not yet elucidated, while some molecular formations precipitated in water from the Lake of Zurich, submitted to the same sort of magnetic fields are illustrated.

Leak Detector

THE firm of Siemens & Halske has introduced a leak-detecting apparatus for watching the condition of electric power lines. It is utterly simple and reminds us of the electrogeoscopic apparatus described in our issue of July last.

If there is a ground in an overhead cable, the current escapes down the pole, enters the earth, and radiates from the pole as a center, approximately at least. If a telephone has its terminal wires connected to the earth, so that one is at a greater distance from the pole than the other, there will be a difference of potential between them if there is a leak. If it is an alternating current, the telephone will produce a sound, under the same conditions.

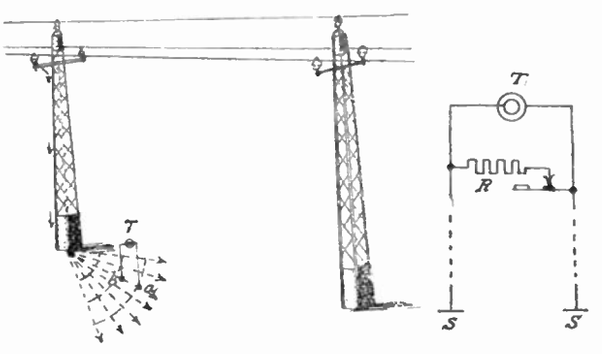


Fig. 2.

Simple system of detecting leaks from high voltage, alternating-current lines. A telephone is used as detector, and the shoes are armed with metal plates to take the current.

The distances from the foot of the pole are determined by the length of radius fixed by each of the points of attachment of the terminals. If they are in contact with the ground at some distance from each other, yet at equal distance from the pole, in other words, on the line of a circle struck from the pole as a center, there will be no sound. But if they are so located on the ground that their positions lie on circles of different radii, referred to the pole as the center, sound will be produced if there is a leak.

The operator has metal plates on the soles of his feet which form the terminals of the telephone wires, for it is found that he can get potential difference enough between the two feet to make the apparatus operative. The apparatus is so sensitive that a leak can be detected 60 feet or more distant from the pole.

To protect the telephone in case the leak is very large, and offers the possibility of injuring it, a non-inductive resistance may be brought into parallel with the telephone by pressing a key. In the diagram (T) represents the telephone, and (R) the resistance which is connected in parallel therewith when the key is closed. The wires are held to the body of the operative by a belt and the apparatus is adjustable for men of different heights. It is so simple that anyone can adjust it, and the loudness of the sound gives an idea of the extent of the leak. Experience will give a quantitative aspect to the work.

Experimental Arc Furnaces

By Allan R. Kenworthy

ASIDE from the interest and instruction which may be obtained from high temperature research, the usefulness of the electric arc furnace makes it a desirable piece of apparatus in the experimenter's laboratory.

Strangely enough, however, few experimenters possess such apparatus, and the majority of them seem to regard the arc

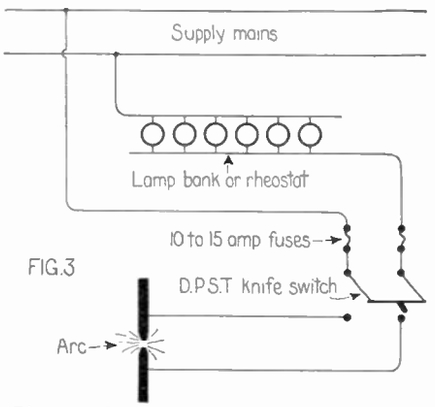


FIG. 3

Diagram of connections for an arc furnace using a bank of lamps for resistance, and with protective fuses.

furnace as a complicated and difficult piece of apparatus to construct and operate. The fact is that the arc furnace is about as simple a piece of apparatus, both in construction and operation, as the experimenter could desire, and its usefulness in laboratory work and as a means of instruction is only limited by the resourcefulness of the experimenter himself.

The furnaces described in this article are designed for operation on 110 volts, and with them practically any experiment requiring a high temperature carried on.

The furnace illustrated in the diagrams below is the larger of those we describe and is intended as a permanent laboratory installation.

The materials needed for the construction of this furnace are as follows:

Four carbons such as are used in arc lights, and preferably uncored, about 12 inches long and one-half inch in diameter. These dimensions are only approximate, but the use of smaller carbons is not recommended. Two fire bricks, two blocks of slate about 1 x 2 x 6 inches, two strips of heavy copper or brass about 1 x 6 inches, a board for the base of the furnace

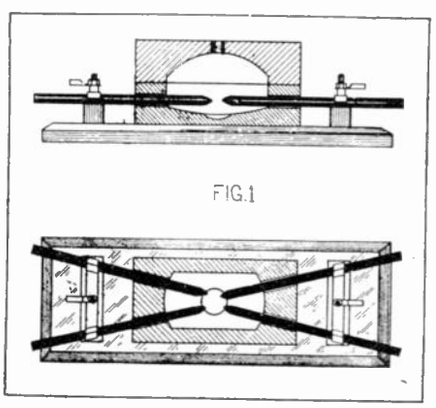


FIG. 1

Arc furnace with four carbons of the reverberatory type, giving a concentrated heat at the arc.

about 1 x 8 x 16 inches, and two bolts and lugs for making connections and clamping the carbons in place.

From the illustration it can be seen that the fire bricks form the body of the furnace, and it also shows the manner in which they are "scooped" out. The inner surface of the upper brick, which forms the cover of the furnace, is made concave in order that the heat may be effectually reflected down on the substances being heated. Through the top of this brick a hole is bored so that, while the furnace is in operation, the arc and the processes within the furnace may be observed without removing the cover. This hole should be covered with a piece of asbestos board to prevent any escape of heat when not used for inspection.

The lower brick should be hollowed out as shown in the illustration, care being taken to leave a half-inch wall on the sides and bottom. In the center of the lower brick, just beneath the point where the arc is formed, a small, shallow, circular depression should be made. This will prove of aid in retaining substances placed in the furnace, and especially proves its worth when ores are being reduced, as the button of metal will collect in this depression rather than spread over the floor of the furnace.

Two holes are drilled in each end of the lower brick of such size that the carbons to be used will move freely in them.

The base upon which the body of the furnace is mounted should be preferably of some hard wood and the upper side should be covered with a thin sheet of asbestos board. The two blocks of slate are fastened near the ends of the base by boring holes through them edgewise and passing bolts up through the base and through the slates. These bolts also clamp the strips of copper or brass which hold the carbons in place, and at the same time serve as binding posts for making the necessary connections to the furnace. After the carbons are in place the nuts on these bolts should be tightened sufficiently to assure good contact between the clamps and carbons, otherwise considerable heat will be developed at this point.

Handles can easily be made by wrapping the ends of the carbons with tape and forcing a short piece of fiber tubing over them. If the experimenter has no fiber tubing on hand, short pieces of ordinary garden hose of the right size will make satisfactory substitutes.

It is recommended that a good flexible asbestos covered cable be used for making connections to the furnace, and if the furnace is to be used often or if connections are changed frequently, the ends of the conductors should be fitted with substantial lugs.

If desired, the furnace may be fitted with but one carbon for each electrode, but it should be observed that the capacity of the furnace will be reduced by more than half if this design is adopted. Another suggested alteration in the above design, of special advantage where quantities of metal are to be kept in a state of fusion or where substances are to be heated in shallow crucibles, is to have the carbons enter the furnace at an angle rather than horizontally as suggested.

The furnace next illustrated is a compact arrangement and suitable for chemical reactions at high temperatures.

Two electric light carbons, not to exceed one-half inch in diameter (A and A'), two clamps for making the necessary connections to the electrodes (B and B'), one clamp for supporting the upper electrode (C), a piece of asbestos board (D), one clay flower pot about four inches in diameter (E), one small crucible and cover, preferably of porcelain, and about half the size of the flower pot (F), a ring support for holding the flower pot (G), some heat insulating material such as powdered asbestos or fire clay (H), and a laboratory support (I) are the required materials.

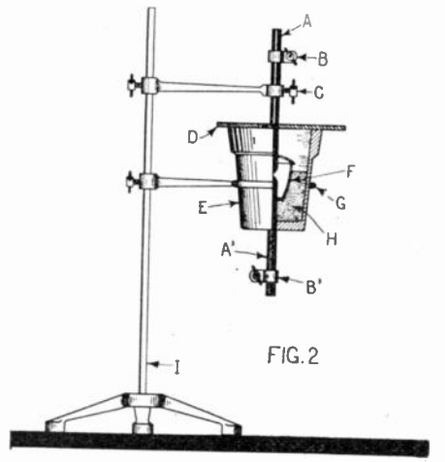


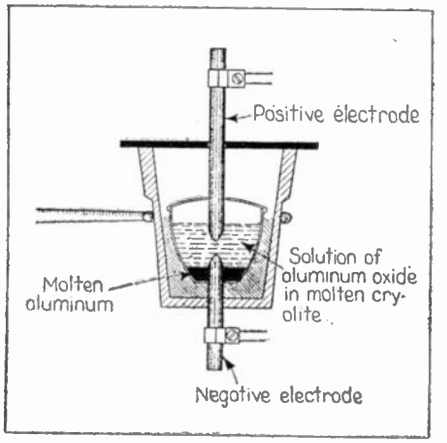
FIG. 2

Vertical carbon furnace, made from a flower pot for crucible treatment.

Little need be said regarding the construction of the furnace, as most of the points are covered in the illustration above. A flower pot forms the body of the furnace, and the hole in the bottom admits the lower electrode. Holes are made in the cover and bottom of the crucible for admitting the electrodes, and the whole arrangement is supported in the center of the flower pot and packed tightly about with powdered asbestos or fire clay. This material holds the crucible in place and prevents loss of heat. The flower pot should be kept covered with the piece of asbestos board while the furnace is in operation.

The clamp (C) holding the upper electrode in place should be insulated from it by wrapping a piece of asbestos around the carbon. The electrodes may be fitted with handles.

Connections are made to the electrodes by means of the clamps (B and B'). When the furnace is to be operated on direct current, care should be taken to make the upper electrode the positive one so that the contents of the crucible will



Making metallic aluminum in the flower pot furnace described above.

get the full benefit of the heat reflected from the "crater," which forms on the

end of the positive electrode after the current has been passing a short time.

These furnaces on 110-volt lighting mains should not require more than 5 to 10 amperes of current. The resistance, which is essential, may be a lamp-bank or a rheostat. The resistance should be 10 to 20 ohms.

A knife switch and a fuse block are advisable as a part of the furnace equipment. The fuse block should carry 10 to 20 ampere fuses.

After the proper connections are made, the electrodes should be touched together and then separated about an eighth of an inch. If everything is properly adjusted an arc will be formed and if the carbons are left in this position the arc will burn with a very bright light and a sharp "hissing" sound.

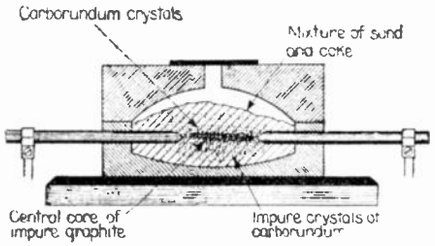
Dark glasses must be worn or the arc viewed through a piece of thick cobalt glass to protect the eyes.

Usually an arc two inches in length can be maintained in these furnaces operating at the voltage mentioned. When the arc is lengthened considerably it will "roar" (if the current used is A. C.) and this should be of aid in keeping the furnace in proper adjustment. Between the extremes where the arc "hisses" and "roars" there will be found a point where the arc is comparatively quiescent and when in this position it will give out a maximum amount of heat for the current used.

Probably the first experiment that suggests itself to the owner of the electric furnace is the preparation of calcium carbide. If the quantity to be prepared is large, the use of the flower pot furnace shown is recommended. A mixture of one part lime and three parts coke, both substances pulverized and intimately mixed, is introduced into the furnace in small quantities. As fast as the materials fuse more should be added until the capacity of the furnace is reached. The chemical reaction will require from 15 to 30 minutes.

Carborundum, a silicide of carbon, much used in the manufacture of abrasives, is prepared by heating a mixture of three parts of coke to one part of sand in the electric furnace. Some experimenters claim that the addition of a little salt to the mixture will aid the reaction.

The smaller furnace should be used, with the following procedure:



Making carborundum and graphite, in the reverberatory type furnace, carrying out the Atchison process, based principally on incandescence.

The electrodes are adjusted so they just touch and the crucible is then charged with the mixture of sand and coke. The mixture should very nearly fill the crucible. The covers of the crucible and furnace are put in place and the current turned on. The electrodes should then be gradually separated and the furnace left in operation until the reaction is complete. The carbons should be kept apart the greatest distance that will allow an arc to be maintained in the furnace, and particular care should be taken not to let the arc fail until the reaction is complete, otherwise the entire experiment must be started again with fresh materials.

The mixture itself is a conductor of less resistance when heated than when cold, and the current operates largely by incandescence. The reaction takes some time to complete and when complete the carborundum will be found in the form of purplish-black crystals surrounding a central core of graphite. The crystals may be cleaned by washing in sulphuric acid.

For the experimental production of aluminum the use of the smaller furnace and D. C. current is absolutely essential. Connections should be made so that the upper carbon forms the positive electrode. Some powdered cryolite is placed in the crucible and the arc started. After some of the cryolite has melted the negative electrode should be adjusted so that the end is but a little way above the bottom of the crucible. Powdered aluminum oxide is then added to the melted cryolite and electrolysis at once starts, melted aluminum collecting on the lower electrode, and because of its density sinking to the bottom of the crucible. The oxygen which forms on the positive electrode unites in part with the carbon.

The larger furnace is likewise quite suitable for melting quartz. By melting these crystals and quickly dipping a glass rod in the mixture, long, very fine threads of quartz can be drawn out, which, because of their torsional qualities, are well adapted for use as suspension fibers in scientific instruments.

For melting metals the larger furnace is recommended, the metals being placed in shallow crucibles under the arc. This is of particular use in the calibration of pyrometer couples, the couples to be tested being immersed in the molten metal and the reading of the galvanometer or millivoltmeter used in conjunction with the couples noted. Since the melting point of the metal used may be readily ascertained from tables, the corresponding readings of the recording instrument may be marked in degrees of temperature.

Indicating Voltmeters and Ammeters

By W. R. Wellman

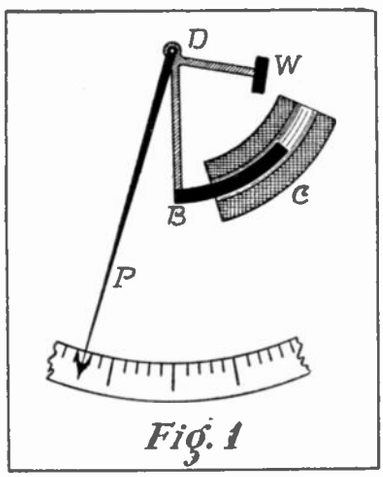


Fig. 1

A plunger type instrument particularly adapted for heavy current, a curved solenoid attracting a curved core.

INDICATING instruments may be divided into six general classifications as follows: 1, Solenoid; 2, Inclined Coil; 3, Permanent Magnet or Weston; 4, Electro-Thermal or Hot Wire; 5, Dynamometer; 6, Electro-Static.

A simple, cheap instrument for rough measurement is the solenoid or plunger type shown in Fig. 1. A soft iron core (B), is pivoted at (D) and arranged to enter the solenoid (C). When current is passed through the solenoid, the core is more or less attracted against the restraining force of the weight (W), or in some instruments, of a spring. A pivoted pointer (P), attached to the core indicates the current value on a scale. This meter may be used on alternating or direct current, and by using a solenoid of many turns of fine wire, may be used as a voltmeter.

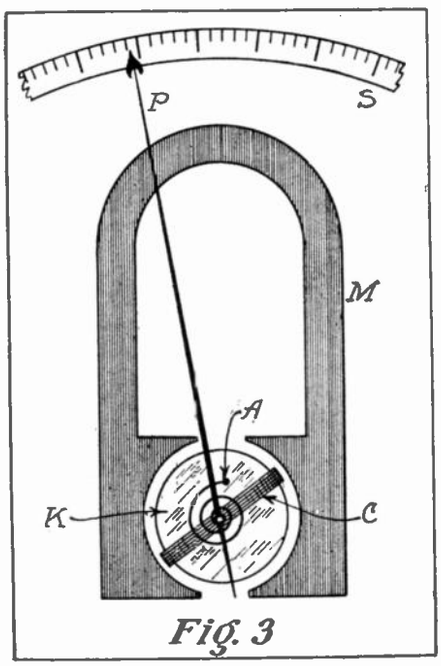


Fig. 3

The construction of the Weston instruments used as voltmeters and ammeters, really a modification of the d'Arsonval galvanometer.

Fig. 2 shows the essential parts of the Thomson inclined coil ammeter. This instrument is the most accurate of all moving iron types. It consists of a light iron vane (V), mounted on a shaft (A) which is supported on jewel bearings (L, L¹) within the coil (C). The spring (S) restrains the shaft and holds the pointer at zero. When current passes through the coil the iron tends to turn so that its longest sides become parallel with the lines of force, which results in the shaft being rotated, and the needle (P) moves over the dial (B). This instrument may be used with alternating or direct current.

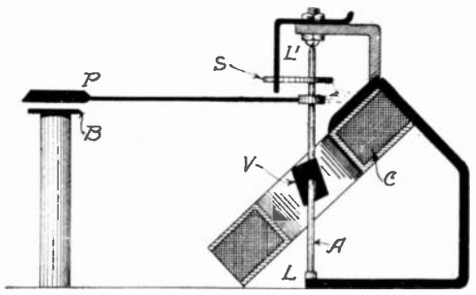


Fig. 2

The Thomson inclined coil ammeter, taken to be the most accurate of all types, depending on the movement of an iron core.

Most of the ammeters in use in this country are of the Weston or permanent magnet type, which is really a form of d'Arsonval galvanometer. In Fig. 3 (K) is an

aluminum bobbin, upon which the coil (C) is wound. The bobbin carries a needle (P), and is supported, free to rotate, between the poles of a permanent magnet (M). Two springs (A) one above and one below the coil, serve to hold it in normal position. When a current passes through

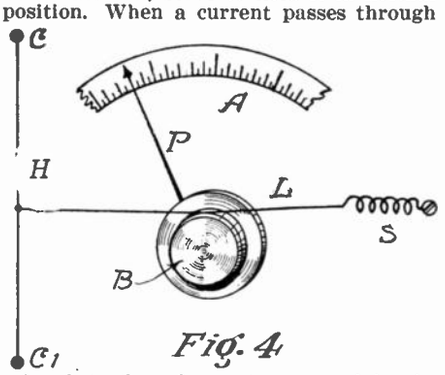


Fig. 4

An electro-thermal ammeter, operated by the change of length of a wire heated by the current; especially useful for alternating-current work.

the coil, magnetic lines of force are set up in it, which are an angle to those of the permanent magnet. These lines of force tend to shorten themselves and in so doing cause the coil to rotate. This rotation is resisted by springs, hence the coil moves until equilibrium is established between the two opposing forces. This instrument is "dead beat," *i.e.*, the needle comes to rest without oscillating. This action is brought about by the damping effect of eddy currents set up during any motion of the coil, in the aluminum bobbin on which the coil is wound. The use of the permanent magnet type meter is limited to direct current, but it may be used either as voltmeter or ammeter.

A sketch of the electro-thermal or hot wire ammeter is shown in Fig. 4. When a circuit is connected to posts (C, C¹) and a current passes, the wire (H), being of high resistance, heats up, causing the wire (L) attached to the center of (H) to become slack. (L) passes once around a pulley and its other end is joined to a spiral spring (S). The spring tends to take up slack in (L), and so a torque is applied to (B), which causes it to rotate, carrying a needle (P) over a portion of the scale. The hot wire type meter has one disadvantage, that of requiring frequent resetting to zero, and it also may be affected by changes in room temperature. This meter may be used as a voltmeter, and may be used on either alternating or direct current. It has come into use in measurement of alternating currents of high frequency in radio circuits.

The Siemens' Dynamometer, an extremely sensitive and accurate instrument, is shown in Fig. 5. It is one that requires considerable skill to operate, and is rarely used, except in laboratories. The coil (C¹) is movable, being suspended by means of a thread and spiral spring (F), and carries an index pointer (Y). The spring (F) is attached to a milled headed screw (T) which carries a pointer, and travels over a dial (S). Within the coil (C¹), a fixed coil, (C) is placed, the two coils being connected in series through mercury cups (M, M¹). When current is applied to the

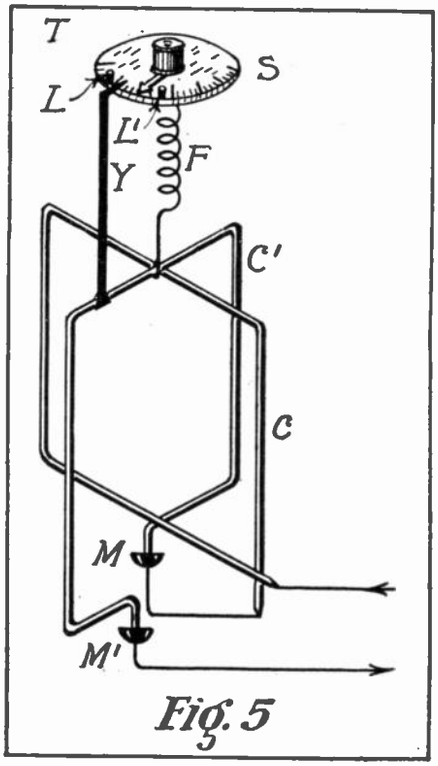


Fig. 5

The Siemens dynamometer, an instrument of great sensitiveness, applicable for both alternating and direct current.

coils (C¹) is deflected until the pointer (Y) comes against one of the stop pins

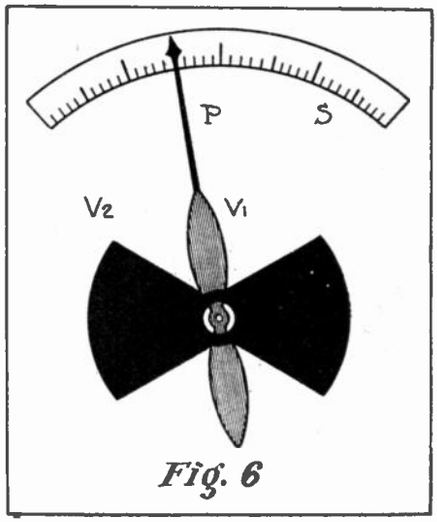


Fig. 6

An electrostatic voltmeter, giving the voltage without taking any current, by direct reading on a scale.

(L, L¹). The screw (T) is then turned in direction to oppose the deflection, until the coil is brought back to normal. The angle through which the pointer of the torsion screw was turned is directly proportional to the square root of the angle of torsion. To determine the current strength, in amperes, the square root of the angle of torsion is multiplied by a constant furnished by makers of the instrument. The dynamometer may be used on alternating or direct current; its indications of alternating current values are correct even though it has been calibrated on direct current.

One disadvantage of all types of meters described above is that they take power from the line to operate. The only meter that does not, the electrostatic voltmeter, is shown in Fig. 6. The operation of this instrument is based on the principle of attraction between oppositely charged bodies. When the vanes (V, V¹) are connected to opposite sides of a line, they become oppositely charged and attract each other. (V¹), being pivoted, rotates, carrying a pointer (P) across the scale (S). This instrument may be used on alternating or direct current, but as a voltmeter only.

Motor Wiring Chart

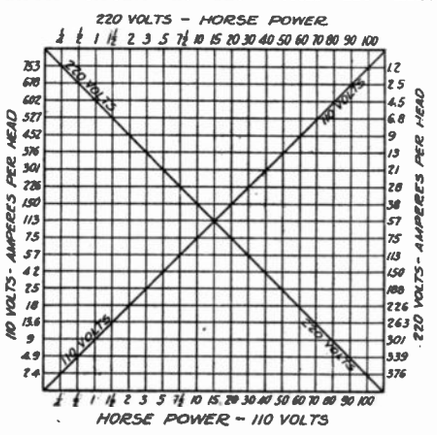
By Frederick J. Rumford

A CHART which will indicate at a glance the required amperage per lead on motor wirings and hook-ups of 110 and 220 volts D. C. is illustrated here.

The method of reading the chart is as follows: As will be seen, the bottom of the chart is marked with figures indicating horsepower ranging from ¼ to 100 at 110 volts D. C. The left-hand side is marked in amperes per leads, ranging from 2.4 to 753 amperes at 110 volts D. C. The top is marked in horsepower ranging from ¼ to 100 at 220 volts D. C. The right side is marked out in amperes per lead, ranging from 1.2 to 376 amperes at 220 volts D. C.

There are also two lines running diagonally across the chart. The first one is the 110-volt line, beginning at the lower left-hand corner and running to the upper right-hand corner. The second line is the 220-volt line, beginning at the upper left-hand corner and runs to the lower right-hand corner. Both of these lines are properly defined.

As an example of the correct reading of the chart, suppose the electrician is desirous of knowing the amperage of each lead at full load. Take a 10-horsepower direct circuit at 110 volts. He first



A useful and practical electric horsepower diagram with allowance for overload, starter action and the like, giving approved safety coefficients.

glances at the bottom until he comes to the line marked 10. He then follows that line up until he crosses the 110-volt line. He will then follow the horizontal line from that point over to the left, which will signify that 10-horsepower, 110-volt direct circuit motor at full load has a carrying capacity of 75 amperes.

Another example may follow: If an electrician is desirous of knowing the amperage at full load of each lead of a 30-horsepower motor, 220 volts direct current, he first glances at the top and follows down the line marked 30 until he comes to where it intersects the 220-volt line. The horizontal line at the right is marked 113, showing that the 30-horsepower 220-volt direct current at full load has a carrying capacity of 113 amperes to each load.

After this chart has been studied a while it will be an easy matter to obtain the necessary information very quickly.

The diagram gives an allowance for overload, starter action and the like, and the figures have approved safety coefficients for practical work.

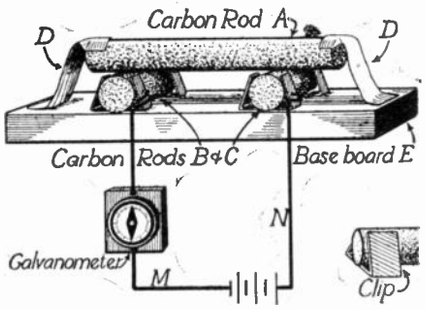
Awards in the $50 Electrical Wrinkle Contest

For Junior Electricians and Electrical Experimenters

First Prize

Electric Scales

By Joe Coleman



This ingenious experiment is most suggestive and is susceptible of development and refinement. A very sensitive balance with no moving parts could be built on these lines. The attempt is worth the making.

THE following scales for actual weighing operates on the principle of the microphone. Two surfaces of conducting material are placed together, one above the other, and pressing it. The resistance at the point of contact varies with this pressure. It is on such principle that the microphone and all modern telephone transmitters work. In them pieces of carbon are used as the material to be pressed together; the pulsations due to the voice acting on the diaphragm of the transmitter, presses and releases to a degree from pressure the bits of carbon within the chamber of the microphone. A current is maintained through the microphone, and these variations in pressure cause variations in the current by a change of resistance of the circuit and produce what is called the talking current.

The present scales designed for actual physical weighing, is based on the principle described above. One carbon bar or rod rests upon two others, and an electric current is passed through the three rods, thus having to pass through two contacts of carbon on carbon. If a weight is placed upon the upper carbon, the pressure is increased, the resistance is diminished and the current increases. A sensitive galvanometer is in circuit with the battery and carbons, so as to indicate the strength of current passing. The heavier the object, the greater will the current be.

Referring to the illustration, two carbon rods are shown, held upon a board by brass clips. To each brass clip a wire of the circuit is connected. This circuit includes a battery and galvanometer as shown. Upon the two carbons a third one rests. If there is any danger of the carbon being displaced, it may be held by a piece of thin paper attached as shown in the illustration. The whole is carried on a baseboard. The construction is susceptible of considerable variation, as instead of the upper carbon rod a very thin slip of carbon should be used in its place, strengthened by being glued to a strip of wood. It would even seem possible to use a piece of aluminum coated with pulverized graphite or even with stove polish at the points of contact with the carbon rod. The experiment certainly is open to a number of interesting variations, and is given the place of honor in this competition largely for this reason.

Our contributor writes that this instrument has been tried and found to work with success.

PRIZE WINNERS

First Prize, $25.00

Mr. Joe Coleman
Boulder, Col.

Second Prize, $15.00

Mr. Carl Masson
Jamaica Plains, Mass.

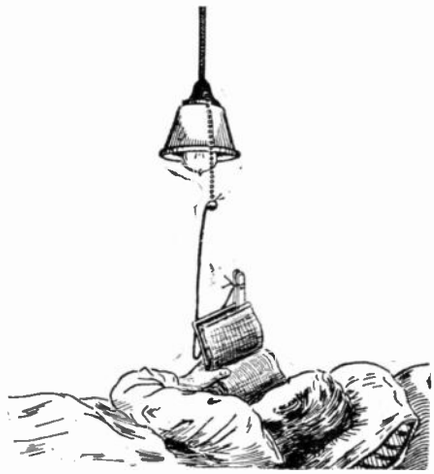
Third Prize, $10.00

Miss Clare R. Tracy
Toronto, Can.

Second Prize

Self-Extinguishing Switch

By Carl Masson



The reader comfortably ensconced will inevitably fall asleep unless the book is of unusual interest; then, if the string is adjusted properly, the book falling from his hand will extinguish the light.

PEOPLE of studious propensities who like to read themselves to sleep often fall asleep at the switch (the electric switch), and on the morning after find to their surprise that the electric light was on all night.

A simple remedy for this unnecessary waste and expense is to tie a piece of string to the pull chain of the electric light, and to attach the other end of the string to the book by means of a spring clothespin, as shown in the accompanying illustration.

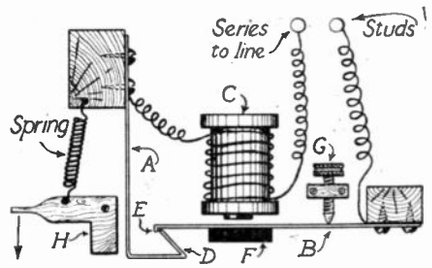
When the reader falls asleep the book falls out of his hand, and if the string is properly adjusted the weight of the book will operate the switch, causing the light to go out; the book will slip out of the grip of the clothespin so as to relieve the fixture of the weight of the more or less ponderous volume.

There is a possibility that the book would not have a long enough fall to shut off the light, but that would be provided for by using a short enough string. Our reader seems to have arranged for a long fall for his literature, perhaps from his hand to the floor. It reminds us of the old story of the sleepy student who held a ball in his hand, whose fall would wake him if he fell asleep.

Third Prize

Experimenter's Circuit Breaker

By Clare R. Tracy



An exceptionally good circuit breaker. The armature is fastened to the bottom of the brass spring so as to be released when the current is cut off. A simple resetting key completes the apparatus.

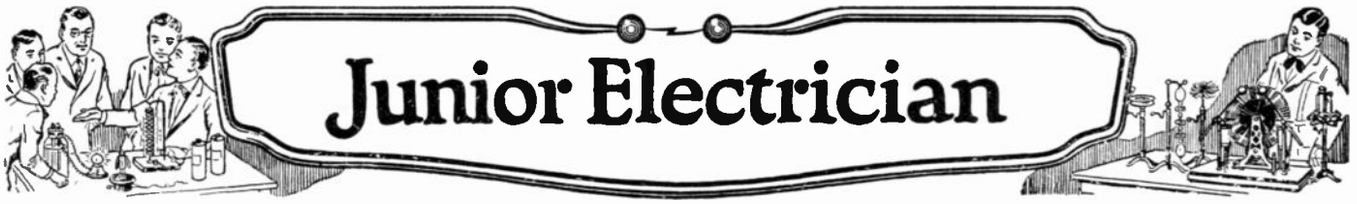
THE advantages of the circuit breaker described here are that it has only two moving parts and that there are no pivots. Pivots often imply the necessity of a certain amount of attention and oiling. The moving parts in this depend entirely on spring action, and a setting device is added by which the circuit can be closed by a simple pull, when it has been opened by too heavy a current.

Another advantage is that there is only one contact involved, and it is this contact which is made and broken in the use of the apparatus.

Referring to the illustration, (A and B) are two flat brass springs. The lower end of (A) is bent as shown at the end (D), and on the left end of the spring (B) there is a small, downwardly projecting part at (E), which is so constructed that it will catch over the retracted end of (D) and hold it when (D) is pushed over to the right. It is important to have this bend exactly at right angles, or square to the spring (B), the idea being that its whole width shall be in contact with the entire width of the end (D) of the spring (A). This is in order to give a better electric contact.

C represents a magnet and below its pole an armature (F) of iron is bolted to the bottom of the brass strip (B). The reason it is bolted to the bottom is, so that it will never come in full contact with the core of the magnet, as then it might be liable to stick from residual magnetism when the current was cut off. H is the setting device, a right-angled piece of brass or other convenient material pivoted at the angle, so that when its left end is pulled down it will force the end of the spring (A) over to the right. The effect of this is to raise the end of the spring (B) which at once snaps down and catches the end of the bent piece (D), thus closing the circuit.

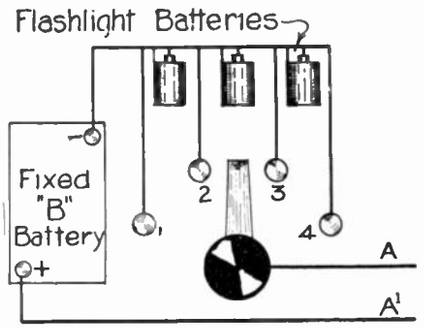
If the circuit is followed, it will be seen that the wiring carries the current through the coils of the magnet (C), through (A) and through the contact at (E), then through (B) and out again to the line. If the current gets too strong, the armature (F) is attracted, the spring (B) is pulled upwards, the end (D) of the spring (A) is released, and the spring (A) flies back and the contact is broken. To close the circuit again, the left end of the lever (H) is pulled down and the appliance is again operative as the circuit is closed.



Junior Electrician

Changing Battery Voltage

SOME TIME ago I possessed a battery which was a puzzle as far as getting a variable voltage from it, its individual terminals being inaccessible.



Using flashlight batteries connected in opposition to the voltage of a storage battery, so as to regulate the charging voltage, and consequently the intensity of charging current.

Connecting a rheostat in series with it did not reduce the voltage much, as the voltage drop across the rheostat is equal to the product of its resistance and the current through it. But as the current used was small, the resistance of the rheostat would have to be great in order to reduce the voltage sufficiently.

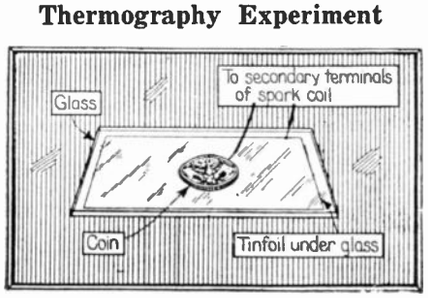
I finally conceived the idea of connecting some flashlight cells in opposition to the battery. Three flashlight cells after being connected in series were connected in opposition as shown; that is, the negative wire of the group of cells was connected to the negative wire of the battery. Then the voltage of the batteries will substract instead of adding when they are connected in this way. Tops taken from the batteries were connected to a switch as shown in the accompanying diagram.

Now, if one cell has a voltage of 1½ volts, when the switch lever is on point (1), the voltage between the leads (a) and (a_1) will be 22½ volts, but when the lever is on point (2) the voltage between the leads will be 22½—1½ volts, and when it is on point (3) the voltage will be 22½—3 volts, while on point (4) it will be 22½—4½ or 18 volts.

If the positive wire of the group of flashlight cells were connected to the negative terminal of the original battery their voltages would be added instead of subtracted, and it would be a good idea to connect them in this way when the battery gets old, as this would tend to increase the voltage.

Contributed by AMEDO GIOLITTO.

Thermography Experiment



A very interesting and simple experiment in the production of a breath image, which can be made permanent by treating it with iodine vapor.

FIRST procure a piece of glass about two inches square and coat one side with tinfoil. Place a coin on the other side and connect coin and tinfoil to secondary terminals of a small spark coil.

Let the coil work two seconds or so, then take off the coin and breathe on the glass. An exact reproduction of the face of the coin will be seen.

To make this effect permanent expose the glass to the vapors of iodine. This is done by heating sulphuric acid, manganese dioxide, and potassium iodide (1 gm. of each) in a test tube, or heating iodine crystals alone.

Contributed by ESTEN MOEN.

$50 in Prizes!

A special prize contest for Junior Electricians and Electrical Experimenters will be held each month. There will be three monthly prizes as follows:

First Prize	**$25.00 in gold**
Second Prize	**$15.00 in gold**
Third Prize	**$10.00 in gold**
Total	**$50.00 in gold**

This department desires particularly to publish new and original ideas on how to make things electrical, new electrical wrinkles and ideas that are of benefit to the user of electricity, be he a householder, business man, or in a factory.

There are dozens of valuable little stunts and ideas that we young men run across every month, and we mean to publish these for the benefit of all electrical experimenters.

If in any way possible, a clear photograph should be sent with the idea; but if that is not possible, a good sketch will do.

This prize contest is open to every one. All prizes will be paid upon publication. If two contestants submit the same idea, both will receive the same prize.

Address all manuscripts, photos, models, etc., to *Editor, Electrical Wrinkle Contest,* in care of this publication.

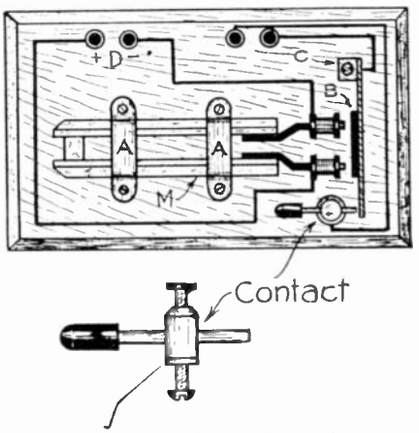
Sensitive Relay

THE illustration shows how to make a sensitive relay from the magnet taken from a telephone receiver.

The magnet (M) is fastened to wooden bases by means of the brass or copper straps (A). It is important that these straps should be of copper or brass, for if they were of iron the magnetic lines of force would leak through them, thus reducing the sensitiveness of the relay.

The armature is carried on a brass spring to which a piece of iron (B), the armature proper, is soldered. The whole is held in place by screwing it to a wooden block (C).

When the relay has been set up, as shown in the diagram, the magnet, as it is a permanent one, will attract the armature and if the attraction is sufficient will cause the end of the spring to touch the contact. To prevent this the magnet should be moved back from the armature until the armature spring does not touch the contact, but not too far back, as a small current through the coils should



A polarized type relay, utilizing the magnet taken from an old telephone receiver; it is extremely sensitive and is made up from simple discarded parts.

cause the armature to go against the contact.

It will be seen that this relay is of the polarized type, and while more sensitive than the ordinary relay, it will only respond to currents flowing in one direction, this being due to the fact that a current flowing through the coils in the wrong direction tends to neutralize the magnetism of the permanent magnet so that it will not attract the armature. How it should be connected in the circuit can be determined by experimenting; by connecting the binding posts (D) to a battery, if the armature does not respond, the connections to the battery should be reversed and now the armature will move against the contact. The binding post connected to the carbon of the battery is now marked positive (+) while the other is marked negative (—), and if the armature touched the contact in the first place, the same order of marking holds true, as the carbon is the positive pole of the battery.

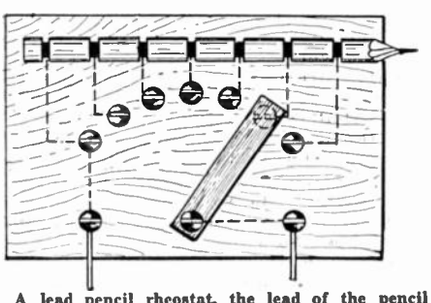
When the relay is connected to a circuit, the positive wire should be connected to the positive binding post and the negative wire to the negative binding post.

Contributed by AMEDEO GIOLITTO.

Lead Pencil Rheostat

A LEAD pencil rheostat such as described herewith will undoubtedly prove useful for many purposes, as for dry batteries or even storage batteries:

Seven notches are cut at equal spaces



A lead pencil rheostat, the lead of the pencil acting as the resistance and being tapped at different points along the pencil to give a number of resistances.

on an ordinary lead pencil, down to and around the lead. A seven-point switch is now constructed on a board according to the size of the pencil. The points are made by using round headed screws which will go through the board. A piece of brass or copper is used for the switch arm, pivoted as shown.

The connections are now made on the back of the board, as indicated by dotted lines.

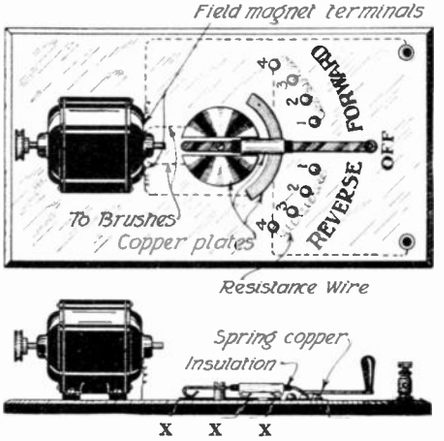
Such a rheostat, if carefully constructed, will reduce from 40 to 60 volts, or down to some 5 to 10 volts for short lengths of time.

Contributed by RAYMOND ROBINSON.

Electric Motor Control Switch

AS a means of controlling the speed as well as the direction of my motor by means of a single handle, I devised the following switch which may be of interest to some of your readers. The switch is safe, simple and effective in operation, and it can easily be constructed by the average amateur.

The motor is mounted on a wooden base, as shown in the illustration. The main lever of the switch is made of a strip of spring copper (or brass) with a short handle attached to one end. The other end is turned over underneath so as to form a spring contact to connect with the plates below it, all as shown in the diagram, and a hole is drilled in the



A very interesting construction of a control switch for use with a motor which not only controls the speed, but changes the direction of rotation, all by a single handle.

strip near this end to take the pivot screw about which the lever turns.

Around the middle of the lever are carefully wrapped three or four layers of insulating tape about two inches wide, and over this layer of insulation a strip of sheet copper about 1½ inches wide is wrapped and wired on so that it is quite secure. The ends of this are also turned under to form two spring contacts. A test should be made to see that the two pieces of copper are perfectly insulated from each other.

As is shown above, pieces of thin copper sheet are tacked or shellacked to the base. These form the plates already alluded to on which the three spring contacts rest when the switch is turned on.

The lever makes contacts at the three points marked X, X, X. The resistance is then arranged to suit individual tastes and requirements. It must consist of two similar rheostats, one on each side of the center line of the base. In my own case I used brass-head tacks for contacts, and fine iron wire sunk into the underside of the base for resistance.

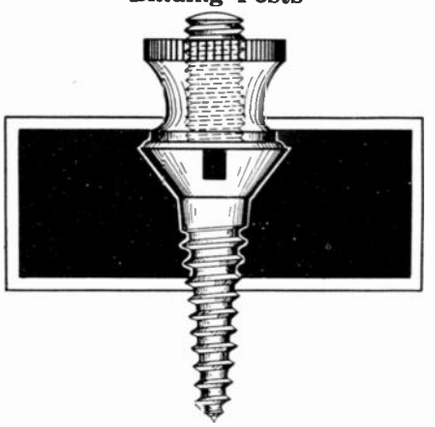
Connections were made as clearly indicated in the plan diagram, *one* battery terminal being connected to *both* of the terminals, 4 and 4, of the resistances.

The switch is now complete and needs only adjustment at the points of contact.

The diagrams show the switch connected to suit a series-wound motor; but by a slight variation the switch may be adapted to a shunt-wound machine as well.

Contributed by C. OSMOND KELLY.

Binding Posts



A binding post from a dry battery soldered to a wood screw, so that it can be screwed in at any point, where its services may be required.

AS binding posts are rather expensive, I devised the following method for making my own:

Remove the binding posts from old dry cells and solder them on the top of a flat-headed screw so they can be mounted on wood. The binding post that is fastened to the zinc of the dry cell should be filed off flat on the bottom so that it will fit the head of the screw.

Contributed by CORWIN HEIN.

Advertising Device

OUR readers are familiar with the old-fashioned smoke jack illustrated in many of the books treating of old-time mechanics. A reproduction of this idea may be made by cutting a spiral out of paper and suspending it from the center by a thread. If this is held over a source of heat it will rotate.

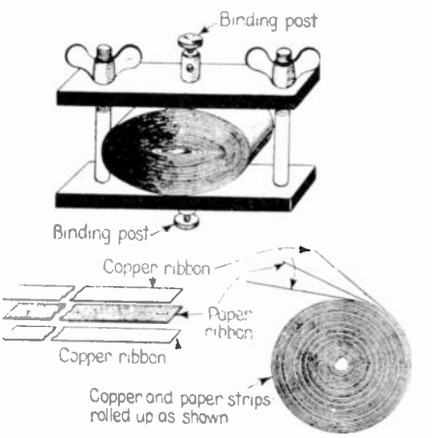
A nice little advertising device is illustrated here, in which the ascending currents of air from a lighted lamp act upon a sort of windmill placed horizontally, causing it to rotate. The horizontal windmill, which represents the driving element of the smoke jack, forms the top of an open-ended cylinder, within which the lamp is contained. The whole is delicately poised, concentric with the lamp bulb, and the rising air acting on the inclined vane keeps it turning as long as the lamp is lighted. The speed of rotation will vary, of course, with the heat of the lamp. A small lamp will make it rotate slower than a large one. It is a question of wattage. Like a number of other devices which we have shown in the section devoted to "Elec-tricks," this is admirably suited for window display, and if the cylinder is made translucent, the appearance of the display will be enhanced.

A rotating cylinder operated by an incandescent lamp; the current of hot air rising from the bulb causes the turning and produces a very effective display.

Selenium Cell

THE following method of making a selenium cell is claimed to have a specific advantage due to the fact that it is easily renewed as regards the selenium.

To make it, three strips, one of paper and two of copper, one or two inches wide and four feet long, are required. The paper is sandwiched in between the strips of copper and the three are then rolled into a tight spiral roll, as indicated in the illustration. The roll is then placed between two flat pieces of wood with bolts



A selenium cell constructed on different lines from any such cell hitherto described in our columns. A very interesting addition to photo-electric experimentation.

and wing-nuts or thumb-nuts for pressing them together; the roll is placed between the boards and they are squeezed up hard. A binding post above and below as indicated connect, one to one sheet of copper and the other to the other, so that the paper acts as insulation between the two strips and binding posts. The end of the roll is filed smooth and is warmed sufficiently to melt selenium, which is then rubbed over it, so as to give it a thin coating.

It will be seen that the electrical conductivity between the two sheets of copper depends upon the selenium which covers the edges of the pasteboard. This conductivity, as we know, varies with light; in the darkness it is practically zero, and in light it is quite sufficient to affect a galvanometer.

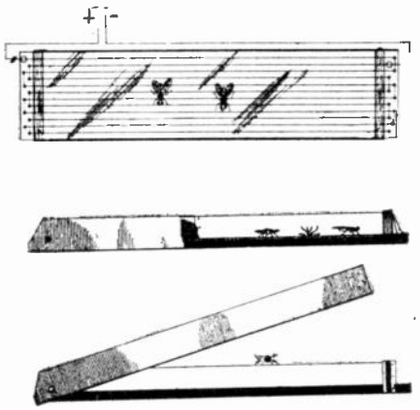
Several systems of construction of selenium cells have been devised, but this one presents considerable novelty of design, and it will be quite interesting to try its efficacy and sensitiveness to light. It is an open question whether too much is not anticipated from the selenium cell, but the future may let tell an interesting story, and the strange element may yet play a part in the transmission of images by wire.

Contributed by ADOLPH F. LONK.

Fly Electrocution

A NUMBER of years have elapsed since it was decided inhumane to hang criminals, as there was always a suggestion of suffering before death would come.

Accordingly it was determined to shock them to death by electricity, using the alternating current as more effectual. At the time that this was done there was



A fly destroyer. An apparatus for shocking diptera to death by the use of the alternating current—a wholesale fly exterminator.

quite a war between the direct current and alternating current inventors and investors, and the latter took it very hard that the alternating current was selected as the death-dealing instrumentality. The dispute had almost a comic aspect.

That the simple and obvious killing by anaesthesia administered by gas or otherwise was not deemed preferable to the complicated electrocution which has been in use ever since is somewhat curious.

No one thinks of hanging a fly; it is too light for such treatment; and any such operation would be unsatisfactory, because only one could be killed at a time. But in the invention which we illustrate we have an electrocuting apparatus for flies which will dispose of them on the wholesale scale. A shallow tray is strung across with wires like an aeolian harp and connected so that the two leads of the lighting circuit are represented by adjoining parallel wires. They are so close together that a fly in alighting is definitely certain to touch two of the wires at once, so as to get the 110 volts, or whatever voltage the lighting circuit may include, through his body. There is a mirror in the bottom of the tray to make it more attractive to the insects, and the inventor has put some decoy flies upon the surface of the mirror to attract the victims. The circuit is always open, so that no current is wasted. How far the conductance is affected by dead flies is not stated; it is trivial in amount.

One of the sides is pivoted, for the purpose of allowing the trap to be easily cleaned.

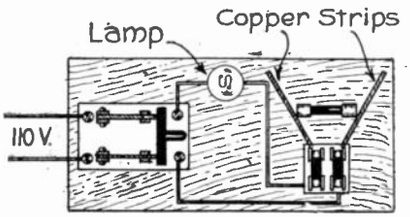
Fuse Tester

A FUSE tester which will accommodate any sized fuse, is constructed as follows:

A one-inch board, 8 by 16 inches, is procured and covered with thin asbestos sheeting (secured with shellac). To this board are fastened and wired a double pole switch (indicating snap preferred), a lamp receptacle in series, and an old fuse block. To the upper contacts of the fuse block are fastened two strips of copper; these strips are about six inches long and one-quarter inch in width. A twist is given the strips just above the block so that the edges face to the front; bend to suit fuses.

To test a fuse, simply make a contact across the two strips of copper (small fuses near base, larger ones toward top). The lamp will light if the fuse is perfect.

Contributed by H. M. STIENECKER.



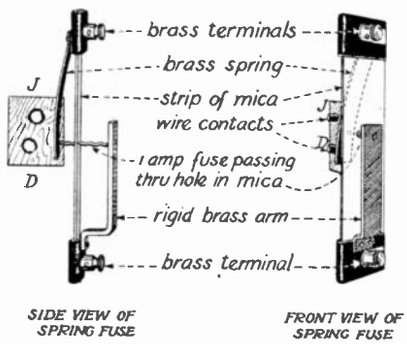
A simple apparatus for testing fuses. They merely need to be dropped between the two flaring copper strips to indicate by the lamp whether they are in order or not.

Burglar Alarm

THE main idea of the burglar alarm illustrated centers around a special spring fuse, and anyone with some mechanical ability can construct the complete alarm at home, and at small cost.

The principle of this appliance can be understood without much study. The distinctive feature is a fusible wire which melts and breaks a circuit when the door is opened. The ends of the fuse wire are attached to two pieces of sheet brass, which are screwed to brass terminal blocks, one on each side of a sheet of mica or fiber extending from terminal to terminal, all as shown in the diagram.

One of the arms is of rigid brass, the other is of spring brass, and the fuse wire extends from the end of one to the end of the other, passing through a hole in

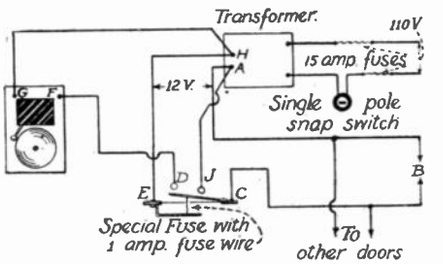


An alarm to be applied to a door or other opening, which works by the fusion of a thin wire so as to start the alarm.

the mica sheet. It is not easy to explain, but the illustrations make it perfectly clear. If the fuse wire is cut, the left-hand brass arm, which is of spring temper, will fly back and connect (D) and (J), which are terminals of a local alarm bell circuit.

The fuse wire may be of 1 ampere capacity. When the door is opened, a special circuit is closed by the ordinary automatic contact, the current melts the fuse wire, releasing the spring arm, which springs back, closing the bell circuit and starting the bell to ringing. The two circuits may be operated by a 110-volt light circuit, reduced to 6, 8 or 12 volts by a door-bell transformer.

In localities where an electric lighting circuit is not available, a battery of dry cells will do the work satisfactorily.



The wiring diagram of the burglar alarm whose principle of action is shown in the preceding illustration.

Three cells in parallel have been found to be sufficient.

One of the illustrations gives a diagram of the connections. B represents the regular door-bell automatic switch, which closes when the door is opened. There may be one or more circuits to different doors, one of which is indicated in the illustration. When any one of these contacts closes, the current passes through the circuit (A), (B), (C), (E), (H), from the transformer, and back thereto, melting the fuse wire as described. This closes the bell circuit (A), (J), (D), (F), (G), (H), as before, from the transformer and back to it. The bell will now ring whether the door is open or shut, the point being that the alarm cannot be made to stop ringing by shutting the door.

A single pole-indicating snap switch is to be installed between the transformer and circuit, so that the switch can be turned on or off according to whether the door is to be protected or not.

Contributed by THEODORE MADISHEK.

What I Would Like to See Published in "Practical Electrics"

It has always been the Editor's desire to publish what the readers want, not "what strikes the Editor's fancy." As a rule we believe that we publish such material as is of greatest interest to our readers. Occasionally, however, it is necessary to check up to see whether our guess is right, for, after all, in publishing a magazine such as this there is some guess-work connected with the selection of articles for publication. For this reason we shall put it up to our readers from time to time, to make certain that we publish just what they desire.

In the blank space below, please list your preferences for certain articles, or classes of articles, which you would like to see printed in this magazine. The Editors will try their utmost to comply with the wishes of the majority. The results of this work will be published from time to time:

.....

.....

.....

.....

.....

NAME .....

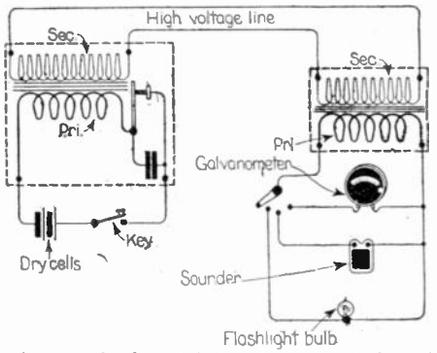
STREET ADDRESS .....

CITY OR TOWN.....STATE.....

High-Voltage Experiments

WITH two Ford spark coils, two dry cells and a galvanometer, sounder or flashlight bulb, some very interesting experiments may be performed.

The object is to send power over a high-resistance line. From experience and books we know that, for a long distance transmission of power, small wires of high resistance can be used if the voltage is great enough.



A very simple yet interesting presentation of the transmission of power at high voltage, illustrative of the practice of electric engineering on the large scale.

By making use of this high voltage power can be thus transmitted. At the sending end one of the Ford spark coils, two battery cells and a key are needed. When the key is depressed the make-and-break of the coil begins to work, exciting the windings and developing a high potential on the line. The other or distant ends of the line are connected with the secondary of the other Ford coil.

The high voltage of the secondary excites the secondary of the receiving coil, and the interrupter on it is turned down hard so that it will not vibrate.

From the primary of the receiving coil connections go to any kind of indicator. The illustrations show three, all controlled by a 3-point switch.

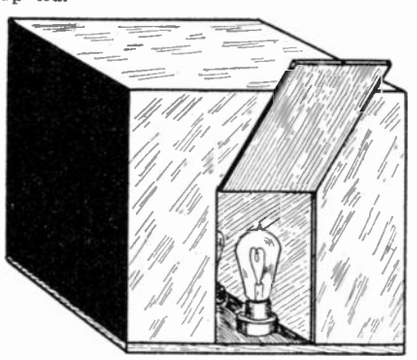
Now a few ideas about the "power line." No. 40 B. & S. gauge wire has been used with success. Power over a cotton thread? Salt water conducts the electric current. Therefore, soak a cotton (or woolen!?!) thread in salt water and substitute for the copper wire!

The line should be kept free from spark gaps.

Contributed by ESTEN MOEN.

Workshop Water Heater

A HEATER, intended primarily to bring the temperature just sufficiently high for washing the hands while in the shop, may be constructed from a tin tank formed in an inverted U shape, with a top lid.



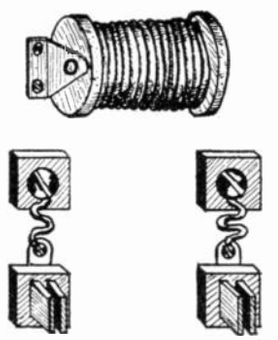
A simple water heater, available for use in a shop for warming up lunches, all made from simple materials.

Within the inner space are placed three or four sockets and old carbon lamps screwed in for heating purposes. If the sides are closed by a small door of some kind or other, the heat from the lamps will raise the temperature to a satisfactory degree for such ablutions as are performed within the shop from time to time.

Contributed by JOHN F. BRONT.

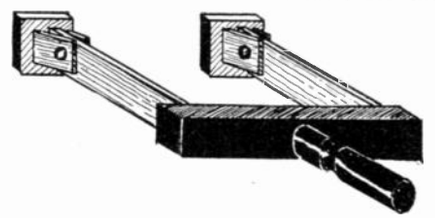
Renewable Fuses

WHEN visiting a western powerhouse, I noticed a rather novel manner of making fuses immediately available on the power switchboard when the old links burned out on the low tension circuits. In the case referred to these circuits were not fitted with the better protection of circuit breakers.



An effective system of having at hand fuse material for renewing fuses as they burn out.

Immediately above the individual switches was placed a small rack holding a reel of the fuse wire suitable for the

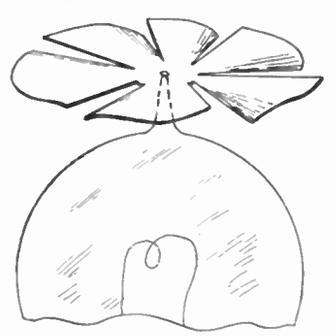


A switch for use with the above arrangement.

individual circuit entailed. Upon the blowing out of a link, a new one was immediately available, without recourse to hunting new fuses on the shelves of the store room across from the building.

Contributed by JOHN F. BRONT.

Mysterious Windmill



A version of the old-fashioned smokejack; a windmill set in rotation by currents of air ascending from a lighted incandescent lamp.

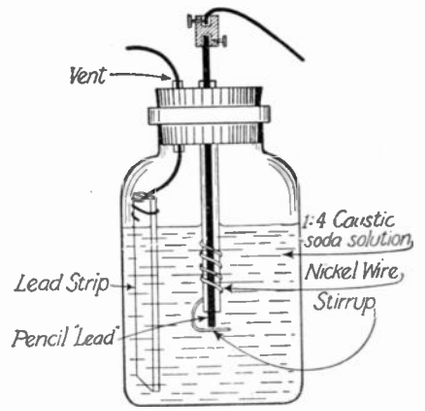
A FEELING of bewilderment is sustained by anyone when upon entering a room he sees little wheels rotating merrily over the electric light globes. At first sight it seems a case of perpetual motion, but a moment's consideration will show that the effect is produced by the rising of the hot air heated by the sides of the globe.

The revolving part should be constructed of stout yet light pasteboard, strong enough not to be warped by the heat. To obtain the best effect it is essential that it shall be exactly balanced on the point of the lamp. The most satisfactory lamp is one with a gas-filled bulb, as such evolves the most heat.

Contributed by W. A. REID.

Electrolytic Interrupter

By RAYMOND B. WAILES



An exceedingly interesting example of an electrolytic interrupter, utilizing a pencil lead as one of the electrodes.

THE accompanying illustration shows clearly the details of a simple electrolytic interrupter operating on 110 volts or less.

The elements are a lead strip and a graphite pencil "lead." The latter fits inside of a glass tube as snugly as possible, yet large enough to allow the downward movement of the pencil-lead at will. The end of the glass tube is used for mounting the nickel wire stirrup as shown. This stirrup is bent so that the pencil lead rests upon it at all times, and so that about one-eighth of an inch of the lead is exposed to the action of the electrolyte. As fast as the pencil lead wears away it automatically descends through the glass tube and exposes fresh surface to the electrolyte. The metal binding connector at the top of the rod serves to make external connection and to feed the rod as it is depleted.

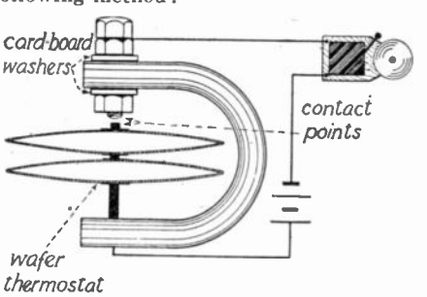
The electrolyte consists of one part of sodium or potassium hydroxide in four parts of water. The nickel wire is not dissolved or attacked by this or any other caustic solution.

It is best to operate one lamp or a small resistance in series with the whole instrument.

Immersing the whole in a larger jar containing water serves to collect the heat which often builds up in any interrupter of this type.

Home-Made Fire Detector

AN efficient fire detector can be constructed at small expense by the following method:



A fire detector, operated by the expansion of air or other vapor in an incubator thermostat.

From an old incubator procure a "wafer" thermostat together with its U-shaped mountings, then get an old discarded doorbell and three or four dry

cells, a ⅜-inch bolt with three nuts, and sufficient wire.

First screw the thermostat in place, then the bolt that is put in place just above the "wafer" is insulated by two cardboard washers. All should be adjusted so as to make a contact at 110 degrees F., which can be tested by a thermometer.

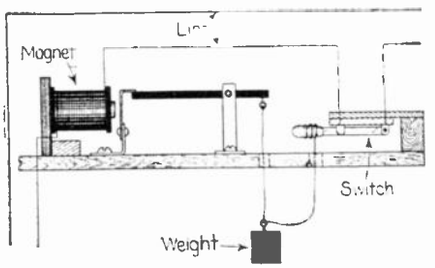
Contributed by CLARENCE MOORE.

Switch Opener

A DEVICE used to open a switch which is located at some distance from the point of control, operates as follows:

In operation a weighted lever is released from a horizontal position by an electro-magnet, and one end swings down, the weight which is suspended to it and pulling the switch open.

The lever consists of a strip of quarter-inch wood, 1 inch wide by 20 inches long. Four inches from one end an eighth-inch hole is drilled. A support for the lever is made from a thin piece of strap iron or brass bent as shown. When made it should be about 2 inches wide by 4 inches high. Holes are drilled through the sides one inch from the top. The support is



A very simple and ingenious switch opener, operated by generator or by touching a button at a distance from the location of the switch.

mounted on a wooden base, 4 by 6 inches in size. The lever is then fastened upon the support by means of a long machine screw.

A piece of wood two inches wide by four inches long is screwed to the end of another base the same size as the former one. Before mounting this piece, drill a one-eighth-inch hole through the center and three inches from the bottom. This hole is for the screw which holds the magnet in place.

A magnet such as is used in A. C. telephone ringers or drops is procured and mounted by means of a machine screw to the support prepared for it. Two binding posts may be mounted near the magnet for the magnet wires.

Two safety razor blades of the thin flexible variety, such as Gillette, are fastened together with a screw through the holes in the ends, thus making a double length of thin flexible steel. A narrow piece of iron or brass, with a hole drilled near each end, is bent to form a bracket, and is used to support the razor blades which compose the armature. A piece of iron about one-half inch long, with a hole drilled at one end, and with the other end bent over so as to extend one-sixteenth of an inch, is mounted on the upper end of the armature. The assembled armature is fastened to the base directly in front of the magnet, and in such a way that the iron on the top of the armature is not more than three thirty-seconds of an inch from the end of the magnet core.

The writer mounted these two units on a two by four-inch piece of wood which was fastened to the wall near the switch. The forward end of the lever should be close enough to the armature so that when set there will not be more than three thirty-seconds of an inch between the armature and the magnet core.

The switch is mounted on the under side of a piece of wood four by six inches, which is fastened to the same two by four as the other units. The switch handle should be directly under the end of the lever.

After the three units have been mounted, the switch is closed, and the forward end of the lever is placed under the catch, so that the lever is in a horizontal position. A strong piece of cord is looped over the short end of the lever, and about two feet below a weight is hung on the cord. Another cord is fastened to the switch handle and also to the weight, allowing about one inch of slack in the last named cord.

Wires are now run from the magnet to the place from which the switch is to be controlled, and a telephone magneto is connected. The device is now ready to operate.

It may be found necessary to place a piece of metal on the end of the lever for the catch to rest on. It will require less current in the magnet to pull the armature over, as this will reduce friction.

The leverage may be changed at will by merely moving the cord nearer or farther away from the fulcrum. By adding more weight a large or stiff switch may be opened readily.

The reason for using an A. C. telephone magneto instead of batteries, is that on account of its voltage the magneto will operate over a long line of high resistance. Moreover, instead of exerting a steady pull, as batteries do when the circuit is closed, the magneto administers a series of strong jerks on the armature, thus making more easy the operation of the device.

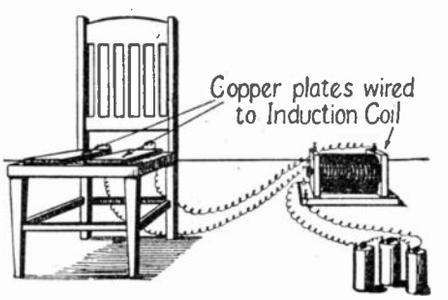
Batteries may be used if the distance is not too great. The A. C. magnet must be replaced by one taken from a door bell or buzzer, or one may be wound with No. 22 magnet wire.

Contributed by P. D. WILSON.

Shocking Chair

THE idea of this trick is to give anyone who sits on the chair a shock. The materials necessary are: An old chair, or a box, some fine insulated wire, an old spark coil off a Ford, a small strip of tin, which should be about one-quarter inch wide by three-quarters inch in length, and two or three batteries.

The tin should be bent slightly so as to act as a spring. A nail long enough to extend through the chair should be driven through the seat from the top, with the head slightly raised; to the point of this nail one insulated wire should be soldered. The tin should now be nailed on the seat of the chair directly over the nail so that when it is pressed down it will come in contact with the nail. A wire should also be soldered to the point of the nail which holds the tin.

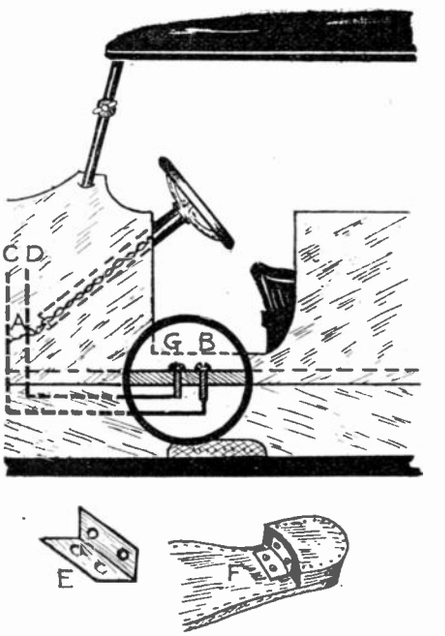


A very amusing trick chair; a person sitting down has a slight shock given him as he settles down to rest, but concludes not to settle.

Now five or six small nails should be driven through the chair from the bottom, with the points slightly above the seat; the points may now be filed even with the seat, and an insulated wire soldered to the heads of all the nails. Three binding posts which may be taken from old batteries should now be soldered to the terminals of the spark coil, and the wiring done as in the diagram.

The batteries and the coil should be hidden where they cannot easily be seen, with only the fine wires in view, or if you have used a box, they may be hidden inside of it. Now your chair is ready. As soon as anyone sits on it they will very quickly rise, feeling as if he sat on a hornets' nest.

Electric Foot Horn



A foot horn offering several advantages; it can only be sounded by the driver, and to a considerable extent it baffles interference when the car is parked.

THE usual way of operating a horn on an automobile is to have a push-button on the steering column, which button is operated by a touch of the finger or thumb. This is supposed by some to lead to too frequent use of the horn, either producing too much noise or expending the battery uselessly.

The arrangement which we illustrate takes the connections away from the top of the steering column and transfers them to the floor, where they may be sounded by the foot.

Two leads are brought out on the floor near the driver's seat. If the electric system of the car is single wire with grounds, one of these brought to the foot-board may be grounded or connected to the frame of the machine at any convenient point. The other is connected to the horn and battery.

It is obvious that if the two terminals are connected by a conducting strip of metal the horn will sound. To effect this, two nails projecting a little above the foot-board are used as the terminals. The driver has affixed to his shoe a plate of metal backed by the heel. To sound the horn he brings this plate into contact with the two terminals.

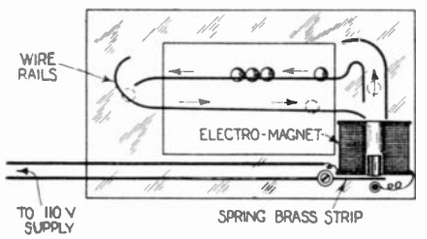
Contributed by D. CHARLES WILSON.

Elec-Tricks

IN this department are published various tricks that can be performed by means of the electrical current. Such tricks may be used for entertaining, for window displays, or for any other purpose. This department will pay monthly a first prize of $3.00 for the best electrical trick, and the Editor invites manuscripts from contributors.

To win the first prize, the trick must necessarily be new and original. All other Elec-Tricks published are paid for at regular space rates.

Novel Advertising Device



Interesting application of the solenoid to keep steel balls in perpetual motion.

ANY advertising device to be a success must embody the qualities of novelty and of possessing movement, being thus attractive.

The present device comprises two rails (made of wire), the top one carrying three steel balls such as are used for bearings. At intervals a rapidly moving ball strikes the stationary ones, and to the onlooker's amazement all the balls are not dissipated, but only the end one, which springs off at apparently the same rate as that with which the first ball arrived.

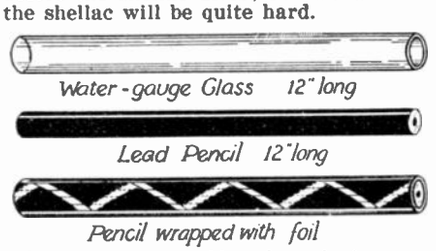
The method will be apparent from the accompanying illustration. To start the machine working the running ball is dropped into the electro-magnet, the magnet thus being immediately energized jerks up its armature core, causing the ball to shoot out with some velocity. It is then guided to the top rail, where it does what has already been described.

Contributed by W. A. REID, *London.*

Window Display

THE apparatus here described, while not essentially new, is so constructed that it constitutes a very attractive window display.

A glass tube about 12 inches long is the first requirement, which may be a gauge tube, the same as is used on steam boilers. A piece of smooth, round wood, such as a lead pencil or a piece of dowel stick which will fit the tube rather closely, comes next, and finally a strip of tin-foil which may be quite narrow and which is to be wound spirally around the wood is needed. The wood first receives a coat of shellac, which should be very thin, over which the tin-foil is to be wound before the shellac dries; in half an hour the shellac will be quite hard.



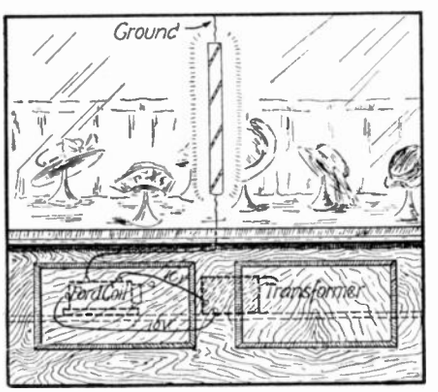
Preparation of a sparking glass tube for use as a window display and attraction.

The tin-foil is now to be cut through in a dozen or more lines along the wooden rod, and a safety razor blade is recommended for this purpose. The wood with its interrupted coating of tin-foil is placed within the glass tube; if too small it is centered by little wedges at the ends, and may be made fast with sealing wax or with the shellac. A line of thin wire, No. 36 or 40 gauge, cotton or silk covered, connects with each end of the tin-foil.

Eight or ten volts from a transformer, if convenient, stepped up by a Ford coil, complete the connection. As long as the current is maintained, the piece of wood within the tube will sparkle at all the interrupted points.

The wire is invisible, when behind the plate-glass window, and the tube appears to hang in midair. A background of dark cloth will add greatly to the effect.

Contributed by E. G. PARSONS.



How the sparking tube is mounted in the window so as to attract the attention of the public.

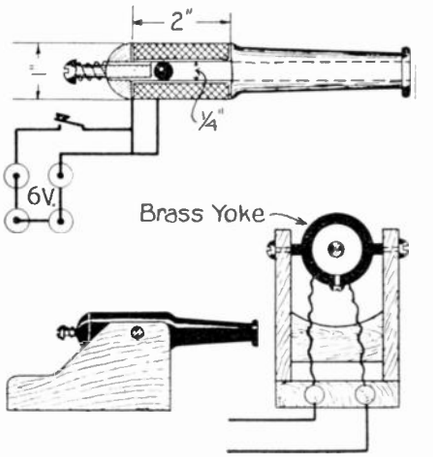
Electric "Big Bertha"

THE following is a description of a toy cannon actuated by electricity. Out of a piece of hard pine a wooden cannon, with a chamber at the breech, was turned. At this place five layers of No. 26 S. C. C. wire were wound, bringing the ends to binding posts, as illustrated. A ¼-inch hole was drilled exactly in the center, clean through. A round-headed machine screw was next secured and cut off, so that when the bolt was all the way in the cannon it just reached to the center of the solenoid.

A light spring was slipped over the bolt with one end soldered to the slot in the bolt. The other end was sharpened and forced into the breech of the cannon.

The cannon may be mounted as shown or in any other manner that may suggest itself. An application of two coats of gray enamel gave quite a realistic appearance to the one constructed. Three or four dry cells are necessary to operate it. The operation is controlled by means of a strap-key or push-button in the circuit. When the key is depressed the solenoid draws the iron bolt forward quickly, shooting out the "bullet" with considerable force. Then when the key is released the spring automatically brings the plunger back to the firing point.

Contributed by HOWARD HUGHES.



An interesting development of the electric cannon, mysteriously shooting projectiles, the process not being apparent to every observer.

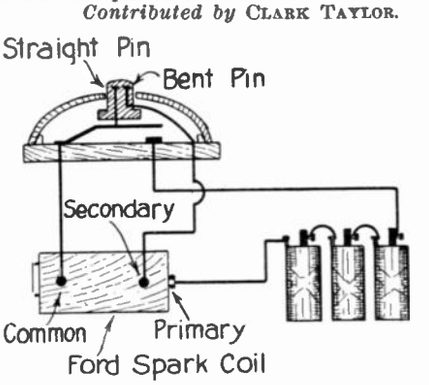
Push-Button Shocker

THE idea of this push-button is to administer a good shock to anyone who pushes it.

An ordinary push-button is used, but a special button is necessary also. Using the original as a model, a button is made of either sealing wax or sulphur. This button is moulded around two pins, which are used as contacts. They must be as far apart as the size of the button will permit, and must terminate very near the top surface of the button. One pin goes straight through the button and makes contact on the spring side of the switch. The other bends at right angles about half way through the button. It is important that this pin and the wire leading to it be kept as far as possible from all other metal parts and connecting wires in the circuit.

When wiring the push-button be sure that the primary of the coil is connected so that pushing the button closes that circuit through the battery. The common post of the coil, that is, the one which is connected to both primary and secondary, must lead to the spring side of the switch, and through that to the straight pin in the button. The secondary lead is connected to the bent pin in the button.

Contributed by CLARK TAYLOR.



A shocking push-button, giving an electric shock when pressed by anyone trying to ring the bell.

Short-Circuits

THE idea of this department is to present to the layman the dangers of the electrical current in a manner that can be understood by everyone, and that will be instructive too. There is a monthly prize of $3.00 for the best idea on "short-circuits." Look at the illustrations and then send us your own particular "Short-Circuit." It is understood that the idea must be possible or probable. If it shows something that occurs as a regular thing, such an idea will have a good chance to win the prize. It is not necessary to make an elaborate sketch, or to write the verses. We will attend to that. Now, let's see what you can do!

Our Maggie lies here,
No more will she rove.
Feet wet—then a hairpin
In coil of a stove.
—LEONARD CHAMBERLIN.

PRIZE WINNER $3.00

He lies buried here,
Though he died when not sick.
An underground current
Came up through his pick.
—HARRY J. KELLY.

Lightning Kills Five Cows Attached to One Chain

FIVE cows, all attached to the same chain, were killed on Frank Ford's farm a few miles from the village of Unionville, Orange county, by a bolt of lightning, Mr. Ford reported yesterday.

Another bolt ripped off a section of the steeple of Grace Church in Port Jervis. Slate shingles were scattered about for a distance of a hundred feet from the edifice.

Five cows here are buried,
Three ones and a pair.
A bolt hit their chain,
And their hoofs hit the air.
—RAYMOND B. WAILES.

Here in earth's pocket
Lies Michael O'Moore.
A juicy lamp socket—
A near furnace door.
—GEORGE A. WILLOUGHBY.

BUTCHER IS KILLED BY AN ELECTRIC CURRENT

Charred Body Found in Icebox by Widow.

SHORT-CIRCUIT IS BLAMED

[Special to The Indianapolis News]

TELL CITY, Ind., September 21.—William Eckert, age twenty-eight, a butcher, was shocked to death by an electric current at the Eckert meat market late yesterday afternoon, shortly after he closed the shop. He apparently came in contact with an electric cord attached to a light and a small fan in the ice box. The cord, it was found, was grounded on a frozen coil near the top of the box. Mrs. Eckert, who started looking for her husband, opened the door of the refrigerator and the body fell out on the floor. The clothing had been burned off the body, which was badly charred.

Eckert also is survived by two children.

KILLED BY LIGHTNING.

Young Farmer Living Near Paxton Is Victim.

Dear friends, here's the grave
Of a dead one, a croaker.
He would move a switch
With a crooked poker.
—E. HENDRICKS, JR.

THIS department is conducted for the benefit of everyone interested in electricity in all its phases. We are glad to answer questions for the benefit of all, but necessarily can only publish such matter as interests the majority of readers.

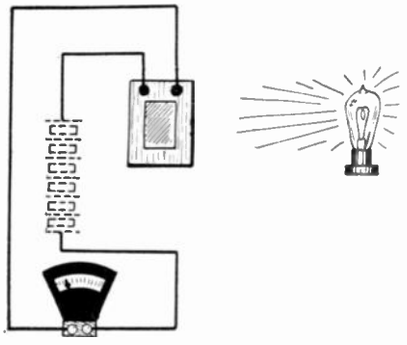
1. Not more than three questions can be answered for each correspondent.
2. Write on only one side of the paper; all matter should be typewritten, or else written in ink. No attention can be paid to penciled letters.
3. Sketches, diagrams, etc., must always be on separate sheets.
4. This department does not answer questions by mail free of charge. The editor will, however, be glad to answer special questions at the rate of 25 cents for each. On questions entailing research work, intricate calculations, patent research work, etc., a special charge will be made. Correspondents will be informed as to such charge.

Kindly oblige us by making your letter as short as possible.

Photo-electric Substance

(200)—J. F. Heavner, Elkins, W. Va., asks:

Q. 1.—Is there any substance which is entirely non-conductive of electric currents in darkness and perfectly conductive when exhibited to light?



A surface coated with selenium is placed in series with a battery and galvanometer. When light strikes it, as shown in the illustration, current passes. When the light is withdrawn, practically no current passes.

A. 1.—There are some substances which conduct electricity to a greater extent in light than in darkness. Such substances would be selenium, tellurium, various radio-active ores, rhubidium, etc. None, however, are total conductors of current under the influence of light and non-conductors when enshrouded in darkness.

Resistance Data

(201)—David R. Haynes, of Cleveland, Ohio, inquires:

Q. 1.—Please give me the data for a resistance to cut down current at 110 volts A. C. to 32 volts if you advise same.

A. 1.—Although a resistance will operate in cutting down 110 volts A. C. to 32 volts, a transformer is the cheapest and best for this purpose. Data upon the same has appeared in past issues of this publication.

Peculiar Conductor

(202)—Owen W. Welch, Detroit, Mich., asks:

Q. 1.—Is there any conductor of electricity which will clear up completely when current passes through the same, said conductor to be in solution form, and which will completely block out the passage of electric current when the conductor is not clear?

A. 1.—There is no conductor of electricity which will do as you desire in either way, that is, become clear on the passage of a current through the conductor, or vice versa. Nevertheless, experiments along this line have been carried out and are today being used in various polarity testers, and it may be that you will while experimenting strike something suited for your purpose. Thus an ammoniacal solution of phenolphthalein will turn red at the negative pole whenever current is allowed to pass through the solution, and will clear up again when the current is stopped. A potato will turn green at the negative pole, and clear up again when the current is stopped, but the amount of coloration is not dependent upon the amount of current allowed to pass through the solution.

¼ KW. Transformer

(203)—Magnus Smith, of Titusville, Pa., asks:

Q. 1.—Please give the data on a ¼ kw. step-up transformer with taps so arranged that the secondary voltage may be varied. Also, what is the voltage when all the turns are connected in the primary circuit, and what will the voltage be when but 100 turns of wire are in that circuit?

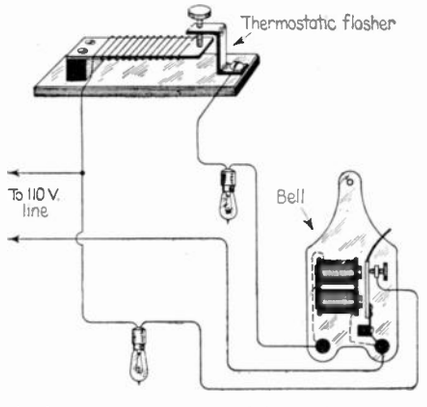
A. 1.—We would advise that upon an iron core 11 inches long, 6½ inches wide and 12 inches thick you wind 666 turns of No. 15 D. C. C. wire in six layers (about five pounds of wire), a tap being taken off every hundred turns. On the secondary place 18 pies, ¼-inch thick, wound with 2020 turns of No. 34 D. C. C. wire, B. & S. gauge. The voltage for the entire 666 turns is 6,003 volts. This varies gradually until with only 100 turns in the primary, a voltage of 41,421 turns is obtained from the secondary.

Sign Flashers

(204)—H. C. Frank, Canton, Ohio, asks:

Q. 1.—Can a commutator be arranged so that it will light one lamp and extinguish another at the same instant, and vice versa? This may be motor driven or otherwise. Can you make any suggestion for doing this work with a flasher?

A. 1.—You can make an electric sign flash as you intend it should by mounting your copper segments directly upon a bakelite or hard rubber shaft. Everything should be made rigid. We are giving here the design of a thermostatic flasher.

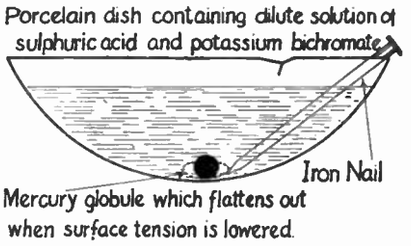


A thermostat or compound bar, which curves by the influence of heat, is wound with the wire. When current passes the circuit is closed and the lamps are lighted. The bar curves from the effect of heat, opens the contact, and puts out the light. It then cools, straightens, closes the circuit, and the lamps burn again.

Electric Shimmy Dance

(205)—George Whitby, Newsonville, Tenn., asks:

Q. 1.—In a recent magazine I have noticed a description of an electric "shimmy dance" in which some mercury was kept in motion under acid by touching a nail. Can you describe it more clearly?



The illustration of the interesting experiment with a globule of mercury, sulphuric acid and a nail. The electric action seems to affect the surface-tension of the mercury.

A. 1.—The illustration we think clearly explains the experiment. The black object represents mercury in the shape it would take in the air, but when immersed in acid it takes the shape indicated by the dotted line, owing to change in the surface tension, presumably identified with an electric charge. In flattening out this way, as the illustration shows, it comes in contact with the point of a nail. This forms a galvanic couple, and the mercury loses its charge, and for a fraction of a second reassumes the approximately globular shape. But under the influence of the acid it immediately flattens out again, so as to touch the nail, and this succession of action goes on indefinitely until the nail is dissolved by the acid.

Magneto for Lighting Purposes

(206)—L. F. Hockett, of Pratt, Kan., wants to know:

Q. 1.—Can a telephone bell-ringing magneto be used for furnishing current to light the head and tail lights of a motorcycle? If so, how is this done?

A. 1.—If a telephone bell ringing magneto is used on your motorcycle for furnishing light, it must be rewound so as to give current at a pressure of about six volts. The armature should be rewound with No. 28 D. C. C. B. & S. gauge wire. The magneto should likewise be fitted with a commutator to furnish direct current, whereupon a small storage battery could be installed upon the motorcycle, which battery could be charged by the magneto, and current therefrom could be used to light the head and tail light when the engine is stalled.

Home Lighting with Auto Generator

(207)—Vernon Young, of Milan, N. H., wants to know:

Q. 1.—Whether a 6 or 12 volt automo-

bile generator can be used to light two small rooms, the electrical generator to be driven by a small gasoline engine.

A. 1.—To furnish current for lighting two rooms of a house by means of an automobile generator to be used in connection with a small gasoline engine, we would advise you to use the 12-volt generator.

Q. 2.—How should the storage batteries be arranged (two 6-volt or one 12-volt battery)?

A. 2.—If your two 6-volt storage batteries are of the same amperage as the 12-volt battery, it will not make any particular difference which you use. However, if your generator is of a large enough capacity, we would advise you to connect the two 6-volt storage batteries in series, and then connect them in parallel with the 12-volt battery.

Electric Furnace Compound

(208)—John Rey, Vallejo, Calif., asks for a compound to be used in the making of an electric resistor furnace.

A. 1.—One of the best substances employed for the making of your resistor furnaces is a mixture of asbestos and water glass. This compound makes a very good hard mass, which is an insulator to both electricity and heat, and the entire furnace may be made with the mixture.

Battery Charger

(209)—R. Thompson, of Indianapolis, Ind., asks for detailed sketches regarding a storage battery charger using current from 110-volt D. C. source.

A. 1.—You do not need more than one sketch for installation of a charging plant for storage batteries, in view of the fact that you have direct current. Assuming that these batteries are of the regular 6-volt, 60 ampere hour type, and you desire to charge one, it is merely necessary to insert a lamp bank in series with one end of your 110-volt mains. These lamps in the lamp bank are arranged in parallel and the more lamps screwed down into the various sockets, the more current will pass. If you have five 1-ampere lamps, you are charging at a rate of five amperes, and it will require twelve hours at least to fully charge your batteries, provided there are no losses, but in view of the fact that there sometimes are, this time interval may be a trifle longer. Remember also that a storage battery is never supposed to be completely run down before it is placed upon the charge, and this tends to decrease the time required. It is, therefore, essential that the storage battery tester for determining the specific gravity of the electrolyte in the battery be used. Diagrams are to be found in past issues, and need not be repeated here.

Induction Coils for Phone Ringers

(210)—J. C. Shipley, of Cave City, Ky., asks:

Q. 1.—Why can't induction coils be used for ringing telephone bells?

A. 1.—Attempts have been made to employ induction coils for ringing bells at the distant ends of a line, but the systems are not favored, due to the irregularity of the current and its high frequency. We would advise that you use a regular telephone bell ringer of about 500 ohms resistance and employ a magneto for the ringing circuit.

Puzzling Transformer Design

(211)—F. O. Dahl, Nampa, Idaho, states:

In various issues of this magazine I have found data for the construction of two transformers, one with a capacity of 250 watts, having a core of 5" x 3¼", and a cross section 3" x 1½", the primary winding consisting of 960 turns of No. 22 B. & S. gauge D. C. C. wire. The other was of 50 watts capacity, having a core 5" x 6" and 1" x ½" cross section, the primary winding consists of 400 turns of No. 18 B. & S. gauge D. C. C. wire. The point which is not clear to me is that if 400 turns of No. 18 will carry 50 watts, 960 turns of No. 22 will carry considerably less instead of more, as stated above; or if 960 turns of No. 22 will carry 250 watts, 400 turns of No. 18 will carry more, since it is heavier and there are fewer turns, therefore less resistance.

Q. 1.—Please make this clear through your How and Why columns.

A. 1.—There is no question of carrying capacity for watts in your recent communication. It is merely the absorption capacity for watts and the carrying capacity for amperes. The greater number of turns indicates a greater number of lines of force per ampere passing, and it is the production of lines of force that absorbs watts of power. For the same amperage the coil of most turns will absorb the most watts per unit size of wire. Both transformers listed are correctly designed.

Skin Effect

(212)—F. P. Keegan, of Echo, Utah, says:

Q. 1.—There is a discussion between two boys with regard to the way electricity travels. A claims that it travels on the surface of a conductor whereas B says it travels through the entire wire. Kindly state which is correct and what proof there is of this fact.

A. 1.—Electricity of high frequency travels on the surface of the conductor. This is known as the skin effect. It is for this reason that stranded cable, or sometimes a tubular conductor is used. This is par-

ticularly so when the frequency of the currents is high; the higher the frequency the greater the skin effect, and the lower the penetration of the current.

Voltage of a Telephone Magneto

(213)—Hugh Willingsbrook, Riverside, Cal., writes:

Q. 1.—I have a high tension 5-bar telephone magneto. I do not know its voltage, but turning the handle as slowly as possible a powerful shock results when the two connections are touched. What is its approximate voltage?

A. 1.—It depends entirely upon the speed at which the magneto runs. The voltage may vary from 300 volts to 1000 volts or more.

Q. 2.—What arrangement do you suggest to run the magneto up to its full power for 3 or 4 seconds?

A. 2.—Make a 6″ to 8″ wooden pulley. Mount it on the shaft. Then wind one or two turns of stout cord on the pulley. *When one end of the cord is quickly pulled or jerked* it will rotate the pulley with its armature, thus bringing the magneto to its full power for a few seconds.

Transformer with Ford Coil Units

(214)—Wm. Braverman, Redding, Cal., asks:

Q. 1.—In winding a step-up transformer using Ford spark coil secondaries, what voltage is obtained from the same, and please advise how to wind the primary for 100 watts?

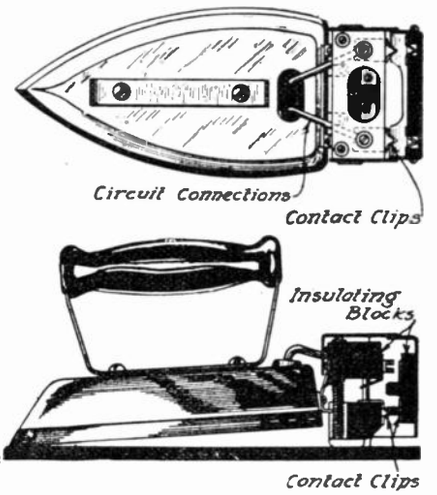
A. 1.—It is hard to say what the secondary voltage from your transformer would be. This depends on the number of secondaries and the number of turns in each. We would advise that you wind upon the primary 666 turns of No. 15 double cotton covered wire. The primary should be about 10 inches long, 6 inches wide, made in the form of a rectangle with each side 1 inch square. These dimensions can of course be varied in order to fit into the Ford coils.

Electric Iron

THE idea of the flatiron illustrated, which is the subject of a recent patent, is to provide an iron which, as usual, is heated by an electric circuit within the body of the iron, which circuit in all except two positions of the iron is open.

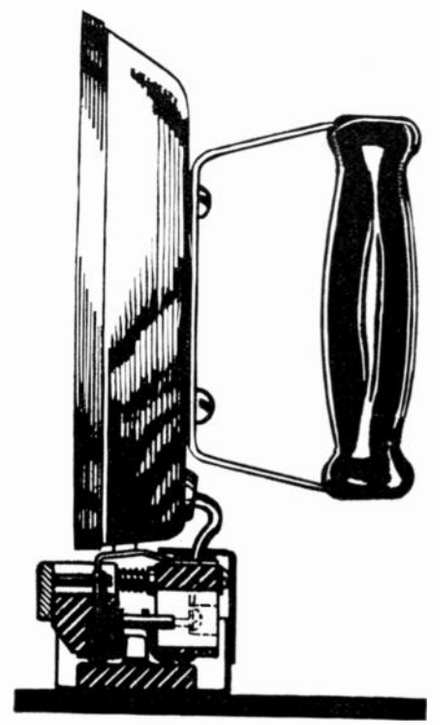
Thus, in the lower figure the iron is seen resting at the left on its toe, and at the right on a contact case. In this position the contact blocks, as they may be termed, which are made of insulating material, are pushed apart by a spring, and the heel of the iron is held up from the material on which it rests. These contact or insulating blocks are situated one above the other in the left of the base as shown; if they are pressed together the contact clips, which are seen facing each other, will touch, which will close the circuit and start the heating of the iron. These blocks are brought together by the pressure of the hand on the iron, so that as long as the iron is in use and pressed down by the operative it is receiving heat.

But there are other contact clips, and these are made to close the circuit when the right-hand insulating block is pressed forward. This pressure is brought to bear upon it by placing the iron in a vertical position so that the weight is carried by the contact case. The back of the case carrying one element of the clips is then pushed forward against action of a spring, closing the circuit and heating the iron. If, therefore, the iron is relinquished and left to stand upon its base, the insulating case at once raises its heel from the material and cuts off the heat; while if it is desired to heat it when not in use, all that is necessary is to stand it in a vertical position with the toe upward.



Two views of a flatiron which automatically shuts off current when not in use, thus saving the expense of wasted electric power.

A minor advantage claimed for this iron is that if put down upon the material when hot, not only is the current cut off, but it is raised from the material so that air may have access to the under surface, and it quickly cools, and there is no danger of burning the material beneath it.



Another position of the flatiron. When placed vertically on its heel it closes the circuit and receives current, so as to be heated when not in use.

Million-Volt Laboratory of the California Institute of Technology

THE electrical department of the California Institute of Technology expects to have a laboratory in service in the fall in which potentials of 1,000,000 volts and even higher can be produced from line to ground. Voltages of this magnitude will be obtained by means of four 250-kva. transformers (3,000–6,000/250,000 volts) developed by Prof. R. W. Sorensen and being built by the Westinghouse Electric and Manufacturing Company. When con-

nected for full voltage to ground three of the transformers will be supported on redwood insulating platforms, the fourth transformer being grounded.

The transformers may also be used independently or connected for the following conditions: (a) 1,000,000 volts with grounded neutral and 500,000 volts line to ground; (b) 500,000 volts step-up-step-down system. one side grounded; (c) 500,000 volts step-up-step-down system, neutral grounded; (d) three of the transformers may be Y-connected with grounded neutral to give 433,000 volts between lines; (e) single-phase combinations for 250,000 volts may be made.

Two-legged core-type transformers with one high-voltage terminal on the secondary are used. the other terminal being grounded. Each transformer will be equipped with means for connecting instruments at the grounded end of the high-voltage coil and with crest voltmeter connections, voltmeter coils, protective reactances, etc. The weight of each unit is approximately 45,000 lb. complete with oil.

Although the primary of each transformer is wound for 3,000/6,000 volts, the power for the laboratory will be supplied by a 50-cycle, 15,000-volt line. Connection between this line and the testing transformers will be made through automatic oil switches and two regulating transformers. By means of these transformers energy can be supplied to the testing transformers at voltages varying smoothly from 0 to 6,000 volts as desired.

A 20-kw. Poulsen arc set and other high-frequency and direct-current apparatus for high-voltage work will also be installed in the laboratory. The building which will house the equipment will have an unbroken metallic lining to prevent interference with the radio work of the community.

The laboratory will be under the general direction of Dr. Robert A. Millikan, director of physical research and chairman of the executive council of the California Institute of Technology.—*Electrical World.*

Wonders of Age Are Performed by Pressing Tiny Disks

WHAT'S behind the electric button? We of the twentieth century are experts in pushing the little trigger on the wall that floods a room with light or summons an elevator, starts machinery going, provides the essential life-energy of our modern days. It's so much a matter of course with us that we do not think of the immense mechanism and the huge organization behind it. The inconspicuous electric button is merely the "outward and visible sign," as the clerical folk have put it, of huge dams and water turbines, or enormous boilers, engines and generators in the case of steam electric plants, the vast network of high-tension lines across the country and the web of smaller wires which carry the tireless, versatile electric power into your dining room, your office or your factory.

This means also an army of men working to organize, maintain and constantly improve all this service. It means that the human element in this great enterprise, which is infinitely more important than the mechanical part, functions smoothly and ceaselessly supplying the intelligence which keeps the wheels going round.

And it means that an enormous number of Americans, 1,400,000 in round numbers, have invested funds in this industry because of their faith in its permanent value. That such a large number of "plain citizens" are the proprietors of the industry is ground for the statement that it is really held by public ownership.

The tremendous power, mechanical, human and financial, which is at your service when you press the electric button exceeds the dreams of any conquerer of old, with hordes of slaves at his command.

Electrically-Driven Yachts

SLOWLY yet surely electric transmission between marine motors and the propellers they have to drive is making headway. Possibly for tugs the advantages of big, slow-running propellers, perfect control from the pilot-house, and an almost unlimited range of speed may be found sufficient to counterbalance the cost. These benefits would be particularly pronounced for tugs of moderate power which are propelled by semi-Diesel engines, as the latter are notorious for their want of flexibility. With big tugs having Diesel engines of 1,000 h.p. and over, the speed range, although not so great as with electric transmission, is good enough for the purpose, while the normal revolutions can be sufficiently slow to allow of using big propellers. In yachts electric transmission is adopted for the sake of the easy control from the bridge, the silent reduction gear, the perfect flexibility, and the ability to move for short distances under electric power; also with it large vessels can be controlled single-handed better than with the ordinary installation. For small cruisers the system is not worth while, since the steersman, being on the same level as the motors, is able to control them direct. It is in the vessel with the engine below and the wheel on deck that the benefits are more apparent. If large auxiliary yachts are to be driven by high-speed engines reduction gear is essential, and electric transmission is ideal for the purpose, while offering the other advantages to which reference has been made already. Admittedly the system is expensive, and, if anything, less efficient than the chain drive; but first cost is often of little consequence for yachts, the owners wishing to have the most perfect type of installation regardless of initial outlay. A not improbable reason for the growing popularity of electric transmission is the desire of some owners to astonish their friends by the possession of unusual machinery, the accruing advantages being a secondary consideration; moreover, when the system is fitted, electric cooking and heating, as well as lighting, become practicable, while small motors can be used to lighten the domestic work. Whatever the cause, it is evident, from the number of recent examples on both sides of the Atlantic, that electric transmission is gaining in favor among yachtsmen.—*Light Motor.*

Detection of Alternating Current

WE have already published in our columns an experiment which consists in bringing a permanent magnet near to an incandescent lamp. If the current is alternating the film will be thrown into vibration and sometimes will even be broken.

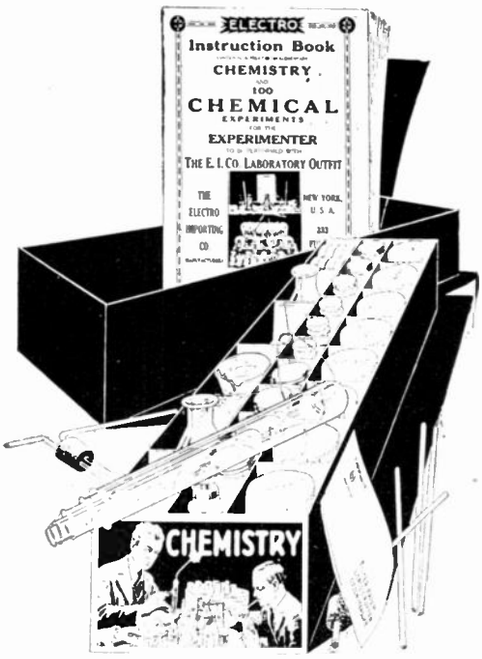
We quote from *La Nature:*

"The light due to a lamp supplied with alternating current appears continuous, on account of the persistence of the images of objects upon the retina; all objects

A Chemistry Laboratory for $7.00

Think of it, fellows! Here is a real chemistry outfit with regular chemical apparatus that performs those fascinating, actual chemical experiments.

This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive amusing experiments.



DESCRIPTION OF THE OUTFIT

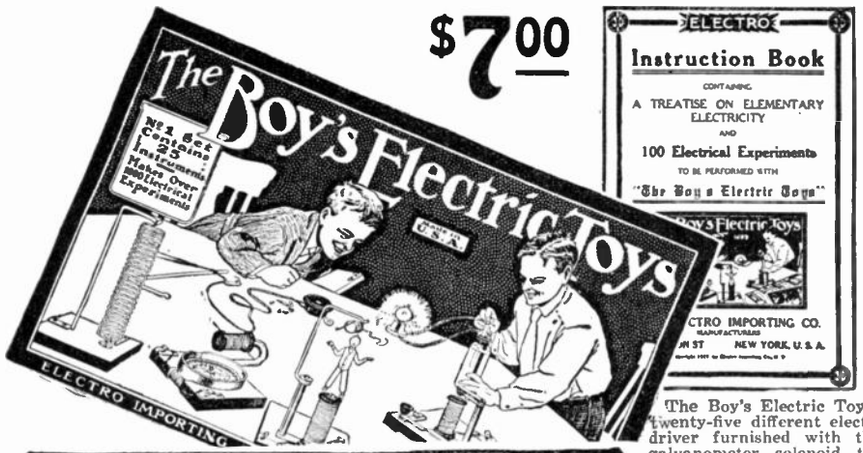
The outfit consists of forty-four (44) chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers, and there is a sufficient quantity of chemicals supplied (mostly one to two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

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

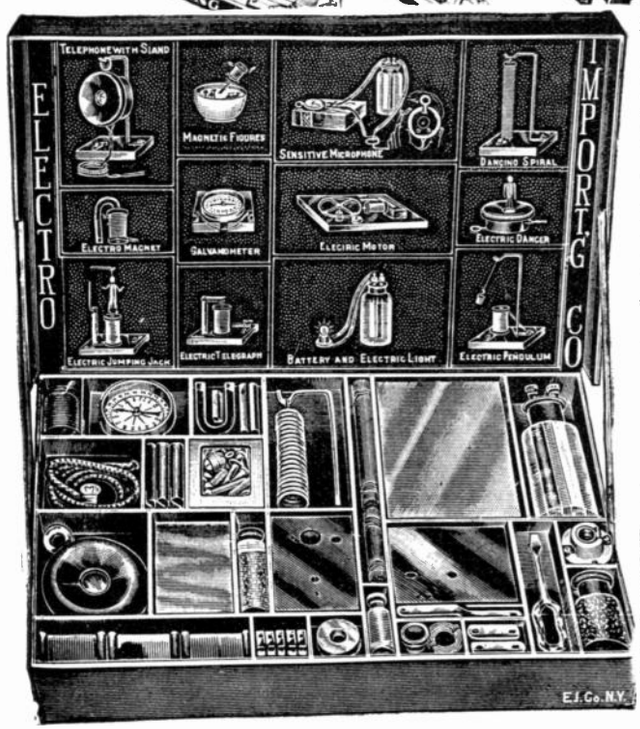
The instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry, and deals with the theory of the Elements, Molecules and Atoms, etc.

100 EXPERIMENTS

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.



$7.00



Every Fellow Wants the

BOY'S ELECTRIC TOYS

The Boy's Electric Toy contains: Enough material to make and complete over twenty-five different electrical apparatus without any other tools except a screwdriver furnished with the outfit. Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

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

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

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

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

We guarantee satisfaction.

The size over all the outfit is 14 x 9 x 2¾. Shipping weight, 8 pounds. "The Boy's Electric Toys" outfit as described, $7.00. Immediate shipment.

SEND FOR YOUR SET TODAY

REMEMBER

JUST CLIP THE COUPON—DON'T SEND MONEY

ELECTRO IMPORTING CO., 233 Fulton St., New York City

ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE CHEMICAL LABORATORY. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

.....
.....
.....

ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE BOY'S ELECTRIC TOYS. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

.....
.....
.....

are lighted by very rapidly intermittent flashes (of high frequency), and it is practicable for any sufficiently bright and sufficiently narrow object to be rapidly vibrated across the beam and with a backing of dark material, for its form to disappear, if the light is uniform; on the other hand, if the light is intermittent, it will appear as a series of bars. But intermittent light from an incandescent lamp means that it is supplied with an alternating current. The effect can be seen with the finger shaken before a very dark background, if the finger is not too thick, and does not belong to a negro with dark skin.

"The effect of radial bars is very apparent, if the object is cylindrical or if it includes a narrow polished or varnished cylinder; a key, a teaspoon, a penknife, a cane, etc., give the effect if arranged so that the reflected light throws a narrow line of high light upon them. Such an object shaken at a high rate in front of a background which may not be so very dark, gives the stroboscopic effect with the greatest clearness."

With a high-wattage lamp, whose thick filament has not time between the cycles to grow materially cooler, this process is inapplicable. In the words of *La Nature*, this thickness acts like a flywheel of an engine.

Thunderstorm Phenomena

DURING a recent thunderstorm at Alverstoke, Hants., the following phenomena were noted in one of the houses:

The telephone lightning discharger, which was fixed just above the lintel of the side entrance, was blown. The telephone instrument, which was about six feet away across a passage, was not damaged. The occupier of the house, however, was in the open doorway at the time, and though unhurt, heard a report like a shell burst. The flash was apparently a spark-across between the telephone lightning discharger and the electric light distribution box, which was fixed about three feet above the telephone instrument. The glass door of the distribution box was shattered, and some of the fuses were blown, though most were undamaged. Three or four of the metallic filaments in the incandescent lamps in various parts of the house broke. The main house fuses, which were close to the side entrance of the house, were quite unaffected.

The electric light supply is underground, and 3-wire D. C. 240-volts from outer to neutral, and the house wiring is all in screwed conduit. The telephone connection is overhead, the nearest pole, a high one, being about 50 yards distant. The earth wire from the telephone lightning discharger was carried through at least eight angles of from 90 degrees to 110 degrees as follows: Round the lintel of the side entrance (2), along the wall (1), round a re-entrant angle in the house (1), then along the side of the house (1), round to the back (1), in through a hole near the lavatory window (2), and thence by a water pipe to earth.

The house is a low semi-detached building about 15 feet clear of the next pair of houses. The nearest tree is about the same height as the house and in the garden of the next pair of houses quite 20 feet away from the side entrance.

A Low-Voltage Generator

HAVING need of a method for lighting a low-voltage lamp for a short period without dry cells or storage battery, I found a telephone generator with a step-down transformer served very well for the purpose.

(Continued on page 91)

"Rasco Has It"

Partial List of Goods Listed In "Rasco" Catalog No. 8

Detectors
Navy Knobs
Switch Handles
Pointers
Lock Nuts
Cord Tips
Copper Ribbon
Switches
Crystal Cups
Sliders
Litz Wire
Rotors
Panel Scales
Switch Levers
Condenser Plates
Carbon Balls
Audio-Frequency Transformers
Bakelon Panels
Name Plates
Crystals
Bornite
Silicon
Radiocite
Condensers
Ground Clamps
Plugs
Contact Arms
Aerial Connectors
Bus Bar Wire
Enameled Wire
Transformer Coils
Copper Strip
Flexible Cord
Knobs
Panel Knobs
Key Knobs
Binding Posts
Lock Posts
Machine Screws
Switch Stops
Telegraph Key Knobs
Hard Rubber Binding Posts
Nickel-plated Switch Points
Zinc Spark Gap Ends
Panel Switches
Mounted Crystals
Tin Foil
Rheostat Windings
Spring Clips
Antenna Connectors
Lock Fork
Spacing Washers
Carbon Grains
Blow Torches
Minerals
Copper Pyrites
Iron Pyrites
Soft Metal (Hugonium)
Threaded Brass Rod
Cord Tip Jacks
Vacuum Tube Sockets
Mica Diaphragms
Radio Cement
Choke Coils
Magnet Wire
Brass Rod
Grid Leak Condensers
Phone Cords
Metal Dials
Universal Panel Bearing Handles
Switch Knobs
Potentiometer Windings
Binding Post Name Plates
Spaghetti-Insulating Tubing
Radio Frequency Transformers
Instrument Posts
Hexagon Nuts
Spring Binding Posts
Switch Studs
Cap Nuts
Brass Lugs
Copper Lugs
Dials
Lubricated Switches
Panel Switch Levers
Mica
Vario-Coupler Rotor
Battery Switches
Switch Blades
Selenium
Diaphragms
Carbon Buttons
Transformer Stampings
Solderall
Galena
Zincite
Mineral Sets
Brass Washers
Copper Braid
Jacks
Rheostat Windings
Vacuum Tube Fuses
Lock Washers
Dial Verniers
Resistances
Silk Wire
Honeycomb Coils
Phone Condensers
Separable Cord Tips
Composition Dials
Plugs
Aerial Insulators
Phones

ILLUSTRATION FULL SIZE

300 Illustrations

This catalog contains over three hundred illustrations. On account of its very great cost, it can not be distributed free of charge.

Mailed only on receipt of 15c. in stamps or coin

Radio Specialty Co.

This business was originated with the sole purpose to cater to the amateur who has small orders. ALL OF OUR ORDERS ARE SMALL and that is why your small order will never be sidetracked by us. A trial order will make you a life customer. "We can only stick you once." Try us with a 50c order.

ALL GOODS PREPAID

DEALERS
Get Our Special Proposition

98S PARK PLACE, NEW YORK CITY

Factories
Brooklyn, N. Y.—Elkridge, Md.

"Build Your Own!"

THE Radio Specialty Company, "RASCO" for short, is probably the most unique radio parts supply house in the United States, if not in the world today. This Company makes a specialty of SMALL ORDERS. No order can be too small to get immediate and prompt attention, for the simple reason that most of our orders are small.

The reputation of this Company was built solely on service. Ask any of your acquaintances what they think of "RASCO" goods, "RASCO" service, "RASCO" promptness! Thousands of unsolicited testimonials on file prove that we serve the public best!

Many houses claim that their orders are shipped within twenty-four hours. A year's record in our Order Department actually shows that over 99% of our orders leave within twelve hours after receipt. We invite you to try "RASCO" service on a 50c order. MAKE US PROVE WHAT WE SAY.

Sixty-eight per cent of all of our customers come back for more goods after they have tried our service once. The reason is very simple, as we specialize in very small orders. We could not stay in business if we had to look for new customers continually.

"RASCO" SERVICE IS WHAT COUNTS!

"Rasco" Catalog No. 8

The new "RASCO" catalog, No. 8, will prove a revelation to the man who "builds his own." In this catalog are listed more parts and more items than you have previously thought possible to obtain.

The new "RASCO" catalog contains over 500 different radio items, and has been greatly enlarged over the preceding one. IT NOW CONTAINS 64 PAGES, INSTEAD OF 40.

Price Reductions

Many items have been reduced to give our customers the benefit of the lower prices that enlarged production makes possible.

Factories in Brooklyn, N. Y., and Elkridge, Md.

These two factories, where our screw machine work, our stamping and our composition work is turned out, make it possible for us to offer the very lowest prices in the country.

75 Vacuum Tube Hook-Ups!

These hook-ups of ALL important vacuum tube connections are given in clear diagrams with complete explanations. This is the one and only catalog containing such a wealth of information on all Vacuum Tube sets, giving all the correct values of all the elements, so that any amateur can readily hook up a set with the instructions furnished.

All Armstrong Circuits: These important circuits are explained clearly, all values having been given, leaving out nothing that could puzzle you.

Just to name a few of the Vacuum Tube circuits: The V.T. as a detector and one-step amplifier; regenerative circuit; DeForest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one-step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; combination V.T. detector one stage amplifier; two stage radio frequency amplifier and detector with feedback coupling (regenerative); regenerative receiver, using single spider web coil; Armstrong super-regenerative circuit; two stage radio frequency amplifier coupled to a two-circuit tuner, using two-slide tuner regenerative receiver; two stage audio-frequency amplifier, using crystal or V.T.; one stage radio frequency detector, two stages audio-frequency with feed-back coupling to first tube; power amplifier with loud speaker; regenerative receiver and one stage amplifier for DX work; one stage radio frequency detector with feed-back coupling; very sensitive circuit with two stages of radio frequency and regenerative detector; one to ten mile radiophone transmitter; three stages radio frequency, two stages audio-frequency loop reception; crystal detector with rectification; one tube super-regenerative receiver; short wave regenerative receiver with two variocouplers, capacity-coupled tuner; trap circuit to eliminate interference; selective circuit to eliminate interference.

In addition to all of this important information, we have added a section of important radio information, giving various tables, etc., for the benefit of the amateur.

The primary—the end which is connected to the 110-volt house current—of the transformer is connected to the generator, and the current is taken from the secondary in the usual manner.

Contributed by WILLIAM E. PATERSON.

Determining Resistance with Micrometer

WHEN no measuring instruments are on hand the resistance of a wire can be determined with a micrometer as easily as with a Wheatstone bridge, although the result will not be as accurate.

After the wire has been measured for its diameter, its diameter is substituted in the following formula:

Resistance = length times 10.79 divided by the diameter squared; the diameter being expressed in thousands of an inch.

For example, let us say that the wire has been measured and its diameter is found to be fifty-thousandths of an inch; then if its length is 1,000 feet its resistance will equal 1,000 times 10.79 divided by 50 times 50, or 4.31 ohms.

The number 10.79 is a constant, and can only be used when determining resistance of a copper wire; for aluminum the length should be multiplied by 18.7 instead of 10.79.

Contributed by AMEDEO GIOLITTO.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of PRACTICAL ELECTRICS, at New York, N. Y. Published Monthly for Oct. 1, 1922.

STATE OF NEW YORK—
COUNTY OF NEW YORK, NEW YORK, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the PRACTICAL ELECTRICS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Experimenter Publishing Co., 53 Park Place, New York City.

Editor, Hugo Gernsback, 53 Park Place, New York City.

Managing Editor, Thomas O'Conor Sloane, 53 Park Place, New York City.

Business Manager, Robert W. DeMott, 53 Park Place, New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Practical Electrics Co., Inc., whose stockholders consist of: Hugo Gernsback, 53 Park Place, New York City; Sidney Gernsback, 53 Park Place, New York City; Robert W. DeMott, 53 Park Place, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is:

(This information is required from daily publications only.) H. GERNSBACK.

Sworn to and subscribed before me this 16th day of October, 1922.

(Seal.) Joseph H. Kraus.

New York County Register's No. 3337.
Queens County Register's No. 2951.
New York County Clerk's No. 439.
My commission expires March 30, 1923.

OPPORTUNITY AD-LETS

You can place your ad in these columns for only 4c a word. It will pay you to read and investigate the offerings made from month to month in these columns, by reliable firms, dealers and individuals from all over the country. You are reading them now—others will read yours. Ad-lets for the February issue must reach us not later than December 25th.

The Circulation of Practical Electrics is more than 57,000

Practical Electrics Company, Inc., 53 Park Place, New York, N. Y.

Agents Wanted

Make $25 to $50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 86, Philadelphia, Pa.

Big Money and Fast Sales—Every owner buys Gold Initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 226, East Orange, N. J.

We wish representatives in every community to secure subscriptions for Practical Electrics, Radio News, and Science & Invention. This is a wonderful opportunity for Amateur Radio Enthusiasts to make big money quickly. Write Experimenter Publishing Co., Inc., 53 Park Place, New York City.

Books

Diseases and Their Innate Healer. Book 50c. A. J. Stevens, Wauseon, O.

Back issues of all magazines supplied by Boston Magazine Exchange, 109 Mountfort St., Boston, Mass.

Vibrations—Light—Color—Sound—Radio—Cold—Lights—Auras Literature Free. E. J. Stevens, Publisher, 242 Powell Street, San Francisco, Calif.

How to Make Radio Frequency Amplifiers. This book is for the more advanced amateur, showing the construction of the Radio Frequency Amplifying Transformer and giving complete constructional data. It shows the application of Radio Frequency to amplifying units that the amateur may already possess and gives 15 hook-ups showing practically every use Radio Frequency Amplifying Transformers can be put to. 32 pages, 15 illustrations; bound in beautiful two-color cover. Prepaid 25c. The E. I. Company, 233 Fulton St., New York City.

Major Armstrong's New Epoch-Making Invention Will Solve Your Loop Antenna Problem. The New Armstrong Super-Regenerative Circuit is a means now that is made possible with two vacuum tubes and an indoor loop antenna to receive broadcasting music up to 100 miles distant. Our engineering department has compiled a pamphlet that gives an exposition of the theory of operation with full working directions, etc. A large blue-print is included with this pamphlet. Your dealer cannot supply you with these pamphlets. Send us 25c and we will mail you this wonderful exposition prepaid. Tell your dealer to ask us for our proposition. The E. I. Company, 233 Fulton St., New York City.

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E.E. Tells you everything you want to know about "Wireless"—theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Stiff cloth cover, $1.75 postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E.E. A course of the theory and practice of Electricity for the Experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New experiments are described and explained, and nearly every application of Electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Exchange

Westinghouse Aeriola Senior For Sale. Absolutely brand new. Outfit includes cabinet, vacuum tube, phones, batteries, complete antenna and insulators. Price $50. Earl J. Runge, South Easton, Mass.

For the Home

"Tin-Pan or Wirey Tone taken out of your Phonograph or Victrola. Easily and cheaply done. Full information, 25c, stamps or coin." Phillips, 512 W. Jefferson St., Springfield, Ohio.

Chemistry

Learn Chemistry at Home.—Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course is a real short cut. You can learn in half the usual time. Gives you the same education as you would get at a college or university. See our full page ad on page ??? of this issue for special 30-day offer. Chemical Institute of New York, 140-B Liberty St., New York City.

For Advertisers

Advertise Country town newspapers. Lists free. Pennel Company, Covington, Kentucky.

Formulas

Formulas have made millionaires. Magic Polishing Cloth, Instantaneous Nail Polish, lasts a month. Roach Destroyer, Aluminum Polish, Chilblain Specific, Tattoo Remover, Magic Washing Powder. Specify your formula 50c (stamps) each. Make and sell your own goods. Automobile Polish, Rat Bait and Poison. Florasynth Company, Chemical Specialists, Chemical Bldg., St. Louis.

Wonderful Discovery; removes tatoo marks, birth-marks. Invisible ink formulas. "Silvrit" coats copper and brass, silver finish. Magic polishing cloth. Instantaneous nail enamel, strokes of brush, lasts fortnight. Simple. Wart remover, ingrowing toe nails, each 25c stamps. Florasynth Company, Chemical Bldg., St. Louis.

Help Wanted

Detectives Earn Big Money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write American Detective System., 1968 Broadway, N. Y.

You Are Wanted. $100 to $195 month. U. S. Government positions. Men-women over 17. Steady work. No strikes. Life positions. Short hours. Pleasant work. Common education sufficient. Experience unnecessary. List positions free. Write today sure. Franklin Institute, Dept. L111, Rochester, N. Y.

Instruction

Mathematics taught by mail. Arithmetic, Algebra, Geometry, Mensuration, Trigonometry, Logarithms and Mechanics' courses. Harding School, 76 Brighton, Highland Park, Michigan.

Languages

World-Romic System, Masterkey to all languages. Primers, 15 languages, $1.94 each language: Arabic, Chinese, Danish, Dutch, English, French, German, Italian, Japanese, Panjabi, Polish, Portuguese, Russian, Spanish, Swedish. Pronunciation Tables, 92 languages, 30c each language. Languages Publishing Company, 8 West 40th Street, New York.

Mail Order Business

$50 Week, evenings, I made it: mail order business. Booklet for stamp tells how. Sample and plan, 25 cents. Free 12 articles worth $3. Alpee Scott, Cohoes, N. Y.

All the Plans, schemes, formulas in America and a thousand other things sold for from one to $1000. All are contained in the wonder book selling for a dollar. Impossible? All right, send for descriptive circular and be convinced. Goldberg Publishing Co., 2367 Second Avenue, New York.

Personal

Are You Self-Conscious? Embarrassed in company, lacking in self-control? Let me tell you how you can overcome these troubles. E. Veritas, 1400 Broadway, New York City.

Tattoo, birth-mark run-over boils, ingrowing toe nails. Wart eradication. Simple, recipes 25c (stamps) each. Invisible ink recipes. Florasynth Company, Chemical Bldg., St. Louis.

Lonesome Club—Hundreds congenial people, everywhere, want to exchange letter, post cards, photos, etc. Particulars free. (Stamp please). Exchange, Box 305-1, San Francisco, Calif.

Exchange cheery letters with new friends! Send stamp. Betty Lee, Inc., 4254 Broadway, New York City.

Motorcycles—Bicycles

Used Parts for All Motorcycles Cheap. State wants. Schuck Cycle Co., 1922 Westlake, Seattle, Wash.

Miscellaneous

Electric Tattooing Machines for outlining and shading, two for $5.00. Guaranteed formula for removing, $1.00. Prof. Watters, 1050 Randolph, Detroit.

Are You Interested in the relationship of Vibration and Color to your Life? Forceful facts free. Robert Knox, Box 728, San Francisco, Calif.

Boys, Attention! "Anzora" "Masters the hair," a non-oily, greaseless preparation to make your hair stay as combed. Gives a nice smooth appearance to the hair. An English firm has made a fortune on this cosmetic. So simple to make. Ingredients at any pharmacy costs 20c per quart. Particulars 20c stamps. Florasynth Company, Cosmetic Specialists, Chemical Bldg., St. Louis.

Christ's Message to Earth through Vibration, Force of Mind 30c. Prof. James, 10c. Barbara Rigler, 3122 Fifth Ave., Chicago.

Patent Attorneys

Patent Application filed on partial payment plan. Trademarks, copyrights, etc. Milo B. Stevens & Co., 694 F St., Washington, D. C. Established 1864.

Inventors Aided. Ideas developed and patented. Practice in all courts and departments. C. E. Richardson, 32 Albee Bldg., Washington, D. C.

Patents—Write today for free instruction book and Evidence of Conception blank. Send sketch or model for examination and opinion; strictly confidential. No delay in my offices; my reply special delivery. Reasonable terms. Personal attention. Clarence O'Brien, Registered Patent Lawyer, 960 Southern Building, Washington, D. C.

Patents—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster & Allwine, 288 Ouray Bldg., Washington, D. C.

Photo Developing

Special Trial offer; any size kodak film developed for 5c; prints 2c each. Overnight service. Expert work. Roanoke Photo Finishing Co., 342 Bell Ave., Roanoke, Va.

Radio Supplies

Wholesale prices on Radio Supplies. Buy from us and save dealers' profit. Standard moulded Variometers and Variocouplers, $3.95, regular $6.00. Supersensitive Receiving sets complete with headphones. $4.95, regular $10. Standard 3-in. dials 25c, regular $1.00. Sockets 35c, regular $1.00. W. A. Dickson, Globe Bldg., 407 E. Fort St., Detroit, Mich.

Wanted to Buy

Used Correspondence Courses wanted. All schools; all subjects. Courses bought, sold, exchanged. Bulletin 1071 free. Instruction Correspondence Exchange, 1966 Broadway, New York.

Wanted—Platinum Magneto Points, old or new. We pay full value, mail or express. Packages returned if our offer is not satisfactory. Highest cash prices paid for old Gold, Silver, Watches, Platinum, Crowns and Bridges, Diamonds, War Bonds and Stamps. United States Smelting Works, (The Old Reliable), Dept. 12, Chicago, Ill.

Wireless

How to Make Wireless Receiving Apparatus. 100 pages—90 illustrations. Only strictly modern radio apparatus are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered, 35c postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Descriptive Details of Rewards

Your selection of the following Rewards will be sent you **absolutely free** of charge and postpaid—upon receipt of one or more yearly subscriptions to

PRACTICAL ELECTRICS

accompanied by the regular subscription price of $2.00 for the 12 numbers. (Canada and Foreign, 50 cents extra.) **Make your own selection—one Reward for each yearly subscription. See order form below.**

REWARD No. 1

RADIOGEM

A complete crystal Radio Receiving Set, will receive up to 25 miles. The outfit consists of all the necessary wire, contact points, detector mineral, catwhisker, tuning coil, instruction book, etc. When you have constructed the Radiogem, all you need is an aerial and a phone.

REWARD No. 2

MICROPHONE BUTTON

The button may be used to amplify Radio Signals by using it in a local circuit. It should be mounted on the diaphragm of a telephone receiver connected to the radio set and in circuit with a battery and a telephone induction coil. You can easily make a highly sensitive detectophone by using a Microphone 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!

REWARD No. 3

EXPERIMENTAL ELECTRICITY COURSE IN 20 LESSONS

By S. Gernsback and H. W. Secor, E.E.

A Course on the theory and practice of Electricity for Experimenters. One of the most complete and comprehensive treatise of this special subject ever published. Written by the same authors as the famous "Wireless Course." The best electrical text book on the market. Size of book is 6 x 9 in. The book contains 128 pages, and more than 400 illustrations. Limp bound.

REWARD No. 4

Complete Patterns, Diagrams and Instructions How to Make Your Own

RADIOPHONE CRYSTAL SET

PATTERN No. 3

Consisting of a 4 page illustrated Direction pamphlet, size 8½ x 11½ in.; one blueprint pattern, size 12 x 16 inches. All contained in two-color printed envelope, 9 x 12 in.

REWARD No. 5

Complete Patterns, Diagrams and Instructions How to Make Your Own

SHORT WAVE REGENERATIVE RADIOPHONE SET

PATTERN No. 1

Consisting of a five-page illustrated direction pamphlet, size 8½ x 11½ in.; one blueprint pattern, size 16 x 22 in., and one blueprint pattern, size 17½ x 22 in. All contained in a heavy two-color printed envelope, 9 x 11 in.

REWARD No. 6

Complete Patterns, Diagrams and Instructions How to Make Your Own

DETECTOR AND AMPLIFIER RADIO UNITS

PATTERN No. 2

Consisting of a four-page illustrated direction pamphlet, size 8½ x 11½ in.; one blueprint pattern, size 16 x 18 in., and one blueprint pattern, size 13½ x 15 in. All contained in heavy, two-color printed envelope, size 9 x 12 in.

REWARD No. 7

14 RADIO FORMULÆ AND DIAGRAMS

All formulae and diagrams are printed on heavy paper in black and blue; and contained in two-color printed envelope 9 x 12 in.

REWARD No. 8

20 RADIOPHONE DIAGRAMS AND HOOK-UPS

Of Crystal and Audion Receiving Circuits, Amplifier Circuits, Regenerative Circuits, Sending Circuits with Key Chart of Symbols, and Pamphlet "HOW TO READ DIAGRAMS"

All 20 diagrams are printed on heavy paper, each sheet size, 8½ x 11½ in., and together with Key Chart of Symbols and pamphlet. "How to Read Diagrams," are contained in a heavy two-color printed envelope, size 9 x 12 in.

REWARD No. 9

WIRELESS COURSE IN 20 LESSONS

By S. Gernsback, A. Lescarboura, and H. W. Secor, E.E.

(10th Edition)

A Course that tells you everything you wish to know about "Wireless," starting in lesson No. 1 by explaining the Principles of Electricity. By simple, easy stages, this wonderful Course takes you into "Wireless" by the use of such simple language so skillfully used that of necessity you must understand every word.

Size of book is 7 x 10¼ in., 160 pages, 350 illustrations, 30 tables. Limp bound.

REWARD No. 10

THE HOW AND WHY OF RADIO APPARATUS

By H. W. Secor, E.E.

This newest book on radio matters fills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time, incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as instruction for teachers and students of the subject in general.

160 pages, 6 x 9 inches. Limp bound.

REWARD No. 11

A THOUSAND AND ONE FORMULAS

By S. Gernsback

A laboratory hand book for the experimenter and for everyone who wishes to "do things." A book brimful with very important and priceless information, collected and selected for years. Invaluable for Students, Engineers, Physicians, Experimenters, etc.

It contains 160 pages. The paper has been especially selected to stand rough handling in laboratories. Size 6 x 9 inches. Limp bound.

REWARD No. 12

(All Three Books)

HOW TO MAKE WIRELESS RECEIVING APPARATUS

The 20 radio constructors who wrote the book know how articles should be made from simple materials.

Book has 100 pages, each 5 x 7 in., 90 illustrations, many of them full page, paper bound cover in two colors.

DESIGN AND CONSTRUCTION OF AUDION AMPLIFYING TRANSFORMERS

Radio and Audio Frequency Type

This book will be of great interest to all radio amateurs. The transformers have never been described before in print.

Size, 5 in. x 7 in. Contains many illustrations, diagrams and working data.

HOW TO MAKE WIRELESS SENDING APPARATUS

Contains information on how to make 30 different pieces of wireless sending apparatus from materials easily obtained.

Book has 100 pages (size 7 x 5 in.), 88 illustrations, paper cover printed in two colors.

Practical Electrics Company, Inc., 53 Park Place, New York City.

Gentlemen: Please send PRACTICAL ELECTRICS for one year (12 numbers) to each of the following addresses:

Name	Street Address	City and State
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

Enclosed you will find $.....in full payment of same. Also please send me the Rewards (one for each subscription) numbered as follows.....

Name.....Street.....

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

Let These Guides *Solve Your Problems*

Electricity at your finger ends

HAWKINS ELECTRICAL GUIDES IN TEN VOLUMES

3500 PAGES
4700 PICTURES

$1 A VOLUME
$1 A MONTH

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity. Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes. Books are pocket size; flexible covers. Order a set today to look over.

LEARN ALL ABOUT

Magnetism — Induction — Experiments — Dynamos—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switchboards—Wiring—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index of the ten numbers.

SHIPPED FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now—today—and get this great help library and see if it is not worth $100 to you—you pay $1.00 a month for ten months or return it.

SEND NO MONEY—SEND ONLY THIS COUPON

THEO. AUDEL & CO.,
72 Fifth Ave., New York City

Please submit me for free examination, HAWKINS ELECTRICAL GUIDE (Price $1 a number). 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.

Name..... .....

Occupation .....

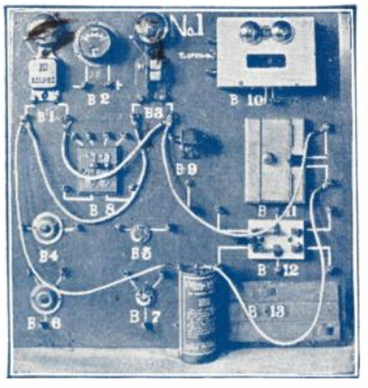
Employed by.....

Home Address.....

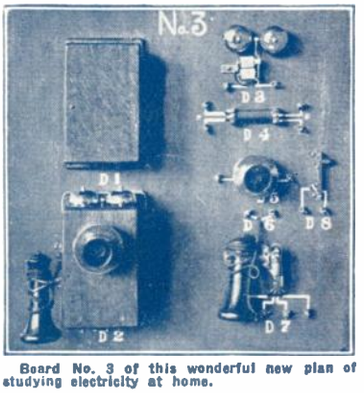
Reference ....

P E., Dec.

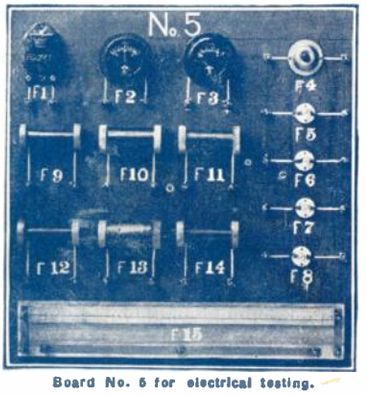
You Get FREE $500.00 WORTH of APPARATUS WITH THIS COURSE



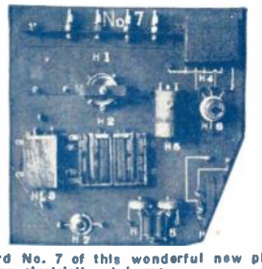
This is Board No. 1 of the Series of Electrical home-laboratory equipment the free use of which is given every student. (Size 24 by 24 inches.)



Board No. 3 of this wonderful new plan of studying electricity at home.



Board No. 5 for electrical testing.



Board No. 7 of this wonderful new plan of studying electricity at home.

YOU learn at home with tools and outfits we send you without a penny of expense to you. You become a high grade electrical expert in a short time through this wonderful easy course of study in your home laboratory—which we furnish free.

Simply worded lessons and wonderful laboratory outfits make study and experimental work a joy. Your absorb the knowledge and experience that will qualify you for a big salary in a shorter time than you can through any other Home Study course—and you get the best training obtainable anywhere when you join our great Home Student body.

Our Diploma will start you in a big paying position.

Learn Electricity at Home in Your Spare Time

EVERY year hundreds of young men from all over the world come to the residence school of the School of Engineering of Milwaukee to learn electricity in all its phases. Yet we know that there are thousands of ambitious men everywhere who aspire to big jobs in the great field of electricity, but who cannot conveniently leave their present work to attend a residence school. It is to train these men that this extension division has been formed.

Just Like Going to School

We knew from our long experience that the ordinary plan of teaching electricity by home-study methods would not measure up to the high standards set by the School of Engineering of Milwaukee, so we originated our home experimental laboratory outfit and

America's Greatest Electrical School is Now Brought to Your Home!

By our carefully perfected plan you can now secure almost every advantage of America's Greatest Institution of Electrical Education right in your own home! In this way this famous school now gives the most thorough practical intensive home-study course in electricity ever offered! It is a specialized, graded course built up on the most advanced ideas of electrical instruction. Thorough, yet simple texts—graphically illustrated give the electrical principles which logically parallel the practical experience gained in using the instrument boards. This amazing new method of extension instruction quickly makes any ambitious man a high-salaried, electrical expert!

Ten of these wonderful cleverly constructed instrument boards—equipped with actual, practical electrical apparatus—are furnished absolutely free to each student while studying. These laboratories are not toys—but include the same instruments and devices which the electrical man meets with in every-day work.

You Can Fill One of These Big Pay Jobs

The field of opportunity for the well-trained electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it—but the demand today is for men who are *trained specialists.* These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. Why don't you get into this fascinating, highly paid field of work?

The Milwaukee School of Engineering is the largest and best equipped electrical school in the U. S. We have 1100 students who are now taking residence courses.

EXTENSION DIVISION

SCHOOL of ENGINEERING of Milwaukee

Dept. F 12, 137-147 Broadway, Milwaukee, Wisconsin

Extension Division,
School of Engineering of Milwaukee,
Dept. F 12, 137-147 Broadway, Milwaukee, Wis.
Please send me free and without any obligation on my part full details of your special new home-study course in Practical Electricity.

Name.....

Address.....

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

Age.....Education.....