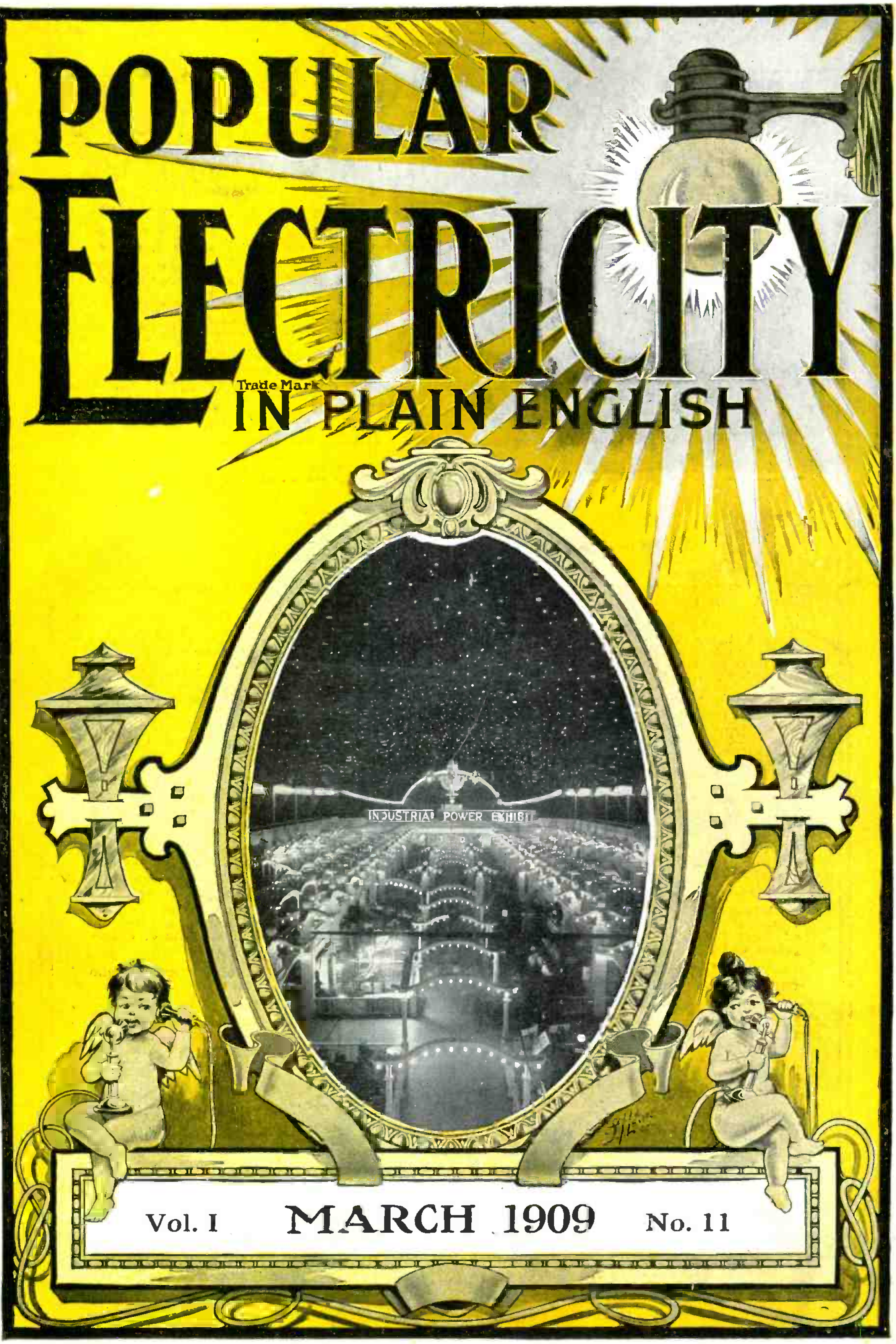
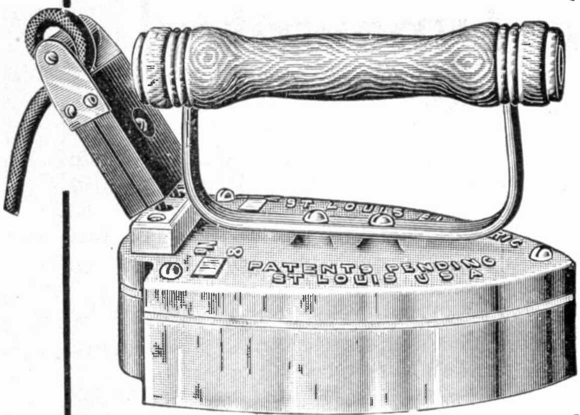
PRICE 10 CENTS

IN THIS ISSUE { A VISIT TO THE ELECTRICAL SHOW
THE "WHITE COAL" OF SWITZERLAND



# THE PEACEMAKER




## AN ELECTRIC IRON

COMBINING
PERFECT HEAT DISTRIBUTION
THE HIGHEST CHARACTER OF WORKMANSHIP
PRACTICAL INDESTRUCTIBILITY
THE HANDSOMEST FINISH

¶ Covering all the points of the perfect iron, and of such simple construction that the highest electrical sad iron value is delivered for the least money.

¶ On ordinary work it can be used with the current turned off half the time, yet the iron is so built that the grip is always cool.

¶ Made in all weights from 4 pounds to 27 pounds.

¶ Continuously used in every place where an Electric Iron can be used, rendering the highest service to the user, and a clean satisfaction to the dealer.

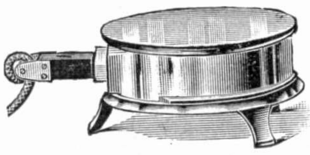
¶ You will not be satisfied until you have a

## "PEACEMAKER"

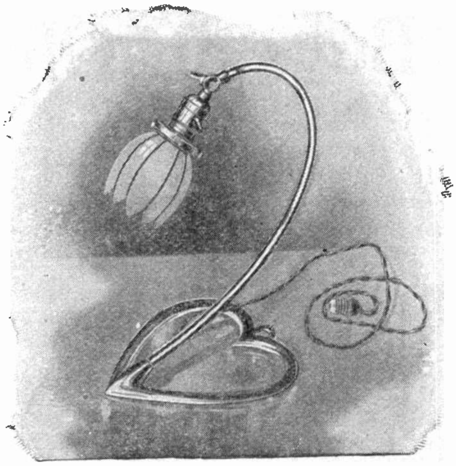
¶ Possibly your Electric Light Plant or Dealer may not have them. If not write us direct.

**SPECIAL INTRODUCTORY PRICE**

Central Station Managers and Dealers it will pay you to know our Special Introductory Proposition.



**ST. LOUIS ELECTRIC HEATING CO.**
ST. LOUIS, MO.



## This Beautiful Art Lamp

## $3.75

**Express Prepaid and Your Money Back if Not Satisfactory.**

The Old Vienna Portable Electric Lamp is not only artistic but wonderfully useful as well. It makes a remarkably graceful library, hall or bedroom electrolier. Then too it may be hung by the little ring at the top of the heart shaped base and used as a wall light. The shade is of art glass and may be tilted at any angle. Entire lamp is finished in brush brass. Complete with cord and plug, shipped anywhere, express prepaid, only $3.75. Remember you run no risk—we guarantee satisfaction or your money back.

Manufactured Exclusively by the

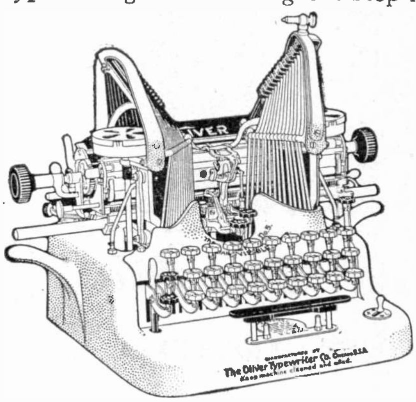
**Federal Electric Company**
**Lake and Desplaines Street, Chicago.**

# Seventeen Cents a Day

## Buys an Oliver Typewriter!

This amazing offer—the New Model Oliver Typewriter No. 5 at *17 cents a day*—is open to everybody, everywhere.

It's our new and immensely popular plan of selling Oliver Typewriters on little easy payments. The abandonment of *longhand* in favor of clean, legible, beautiful *typewriting* is the next great step in human progress.



Already—in all lines of business and in all professions—the use of *pen-and-ink* is largely restricted to the writing of *signatures.*

Business Colleges and high schools, watchful of the trend of public sentiment, are training a vast army of young people in the use of Oliver Typewriters.

The prompt and generous response of the Oliver Typewriter Company to the world-wide demand for *universal typewriting*, gives tremendous impetus to the movement.

The Oliver, with the largest sale of any typewriter in existence, was the logical machine to take the initiative in bringing about the *universal use* of typewriters. It *always* leads!

## Save Your Pennies and Own an Oliver

This *"17-cents-a-Day"* selling plan makes the Oliver as easy to *own* as to *rent.* It places the machine within easy reach of every *home*—every *individual.* A man's "cigar money"—a woman's "pin money"—will buy it.

Clerks on small salaries can now afford to own Olivers. By utilizing spare moments for practice they may fit themselves for more important positions.

School boys and school girls can buy Olivers by saving their *pennies.*

You can buy an Oliver on this plan at the regular catalog price—$100. A small first payment brings the machine. Then you save 17 cents a day and pay monthly.

And the possession of an Oliver Typewriter enables you to *earn money to finish paying for the machine.*

## Mechanical Advantages

The Oliver is the most highly perfected typewriter on the market—hence its *100 per cent efficiency.*

Among its scores of conveniences are:

- **—the Balance Shift**
- **—the Ruling Device**
- **—the Double Release**
- **—the Locomotive Base**
- **—the Automatic Spacer**
- **—the Automatic Tabulator**
- **—the Disappearing Indicator**
- **—the Adjustable Paper Fingers**
- **—the Scientific Condensed Keyboard**

## Service Possibilities

The Oliver Typewriter turns out more work—of better quality and greater variety—than any other writing machine. Simplicity, strength, ease of operation and visibility are the corner stones of its towering supremacy in

- **—Correspondence**
- **—Card Index Work**
- **—Tabulated Reports**
- **—Follow-up System**
- **—Manifolding Service**
- **—Addressing Envelopes**
- **—Working on Ruled Forms**
- **—Cutting Mimeograph Stencils**

**Can you spend 17 Cents a Day to better advantage than in the purchase of this wonderful machine?**

Write for Special Easy Payment Proposition or see the nearest Oliver Agent. 4166

**The Oliver Typewriter Co., 47-55 Dearborn Street, Chicago.**

# Any Central Station

can increase its sales of "juice" by advertising that strikes the right note. Our ability to advertise **productively** is not problematic—it is proven by what we **have** done. We'll be glad to show you.

**Wm. D. McJunkin Advertising Agency**

**Business Builders**

**167 Dearborn Street, Chicago**

# Do You Want to Be WELL?

Do you lack that vigor and strength that comes with abundant health? Need of vitality causes most disease. ELECTRICITY will give you better blood and splendid regular circulation—fresh energy—NEW LIFE. Don't depend on drugs.

THE NEW

WIZARD

## Wireless Battery

(Electricity in Tabloid Form)

is the new invention that physicians use and prescribe because it is compact, simple, safe and DEPENDABLE. A Pocket Battery in a polished metal case—no wires, cords, plugs or liquids—just fits the hand. Small but potent: lasts a lifetime and cannot get out of order.

INVALUABLE FOR RHEUMATISM, NEURALGIA, ASTHMA, INSOMNIA and all nervous troubles and diseases caused by sluggish circulation.

BEAUTY MASSAGE and ELECTRIC BATHS administered by means of the WIZARD WIRELESS are effectual, pleasant and enjoyable. The finest natural complexion beautifier ever discovered. Healthy, active skin is necessary to both health and beauty.

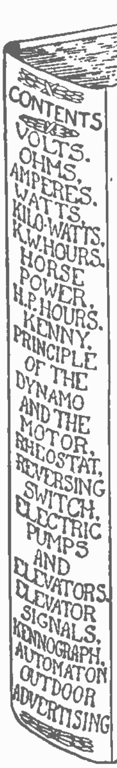
FOR HAIR AND SCALP a special electric brush goes with every Wizard Wireless. Better than gallons of tonics—clean, quick and easy to use.

## Will You Try One Free?

We have a special offer to make responsible people. WRITE TODAY for our free approval plan and our new booklet on Home Treatment.

The Genesee Electric Mfg. Co.

106 Sterner Bldg., FLINT, Mich.




ELECTRICITY IN PLAIN LANGUAGE.

BY PAUL T. KENNY. COPYRIGHT

# Just to become

acquainted, we'll send this booklet, published at 50c, to any address for 6 2c stamps

**KENNY ELECTRICAL MFG. CO.**

**140 Nassau Street**

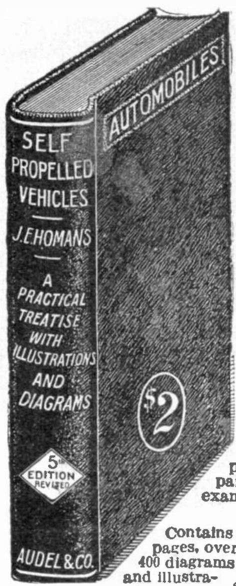
**NEW YORK**

Mfrs. and dealers in Electrical Machinery, Engines, Dynamos, Motors, Elevators.

Experimental work for amateurs.

# How to Run an Auto

**Are you interested in Automobiles?**




If you are, an early purchase of "Homan's Self Propelled Vehicles" will prove a good investment.

This work is now the accepted standard on the practical care and management of motor cars—explaining the principles of construction and operation in a clear and helpful way, and fully illustrated with many diagrams and drawings.

The presentation of subjects has been determined by consideration of the needs of the man behind the wheel. It is clear and concise in its treatment, and comprehensible to the most inexperienced automobilist, at the same time it is so thorough that the expert will learn much from its pages.

This good book will be sent to any address in the world, postpaid, upon receipt of two dollars, or if desired, will be sent on approval, to be paid for after examination.

Contains 608 pages, over 400 diagrams and illustrations printed on fine paper size 5¾x8½ inches, with generously good binding. Highly endorsed.

No money in advance required. Sign and return.

Theo. Audel & Co., 63 Fifth Ave., New York.

Kindly mail me copy of "Homan's Auto" and if found satisfactory I will immediately remit $2, or return book to you.

Name.............

Address.............

Date.............

P. E.

# POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. 1. MARCH 1909. No. 11.

## CONTENTS



ISSUED MONTHLY BY POPULAR ELECTRICITY PUBLISHING CO., Monadnock Block, Chicago, Ill.

YEARLY SUBSCRIPTION, $1.00 CANADIAN AND FOREIGN, $1.50; SINGLE COPY, 10 CENTS.

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Entered as Second Class Matter April 14, 1908, at the Post Office at Chicago. Under the Act of March 3, 1879.

# STOP

long enough to

## Cut This Out

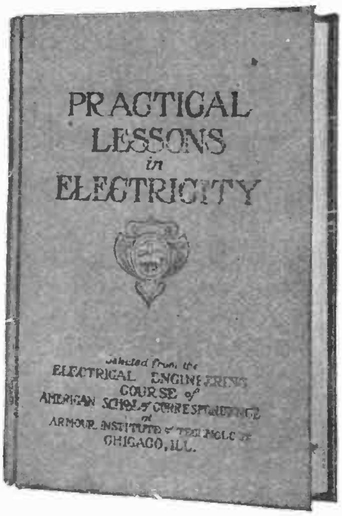
**and send to us with $1.25**

Which gives you one year's Subscription to

**Popular Electricity**

and this book

**Practical Lessons in Electricity**




This Text book cannot be purchased under $1.50.

It is the most complete and concise practical book ever published on Electricity.

**Every Electrician and Student ought never be without it.**

**Last chance at this price.**

**Popular Electricity Publishing Co.**
1280 Monadnock Block, Chicago, Ill.

# LEARN To DRAW

You can become a newspaper magazine illustrator by learning at home—learn the illustrating business from the biggest and most substantial school of its kind in the world—the institution that is the one school endorsed by all leading artists of the country. If you are ambitious and energetic we can teach you thoroughly by mail.

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and earn from $18.00 to $20.00 per week. If you want a pleasant, profitable position in a big, substantial house where opportunities for advancing always exist, let us make you a competent *Show Card Writer*. We can teach you thoroughly by mail in five to six months, qualifying you to do every kind of card writing from plain price cards to artistic posters. The work is clean, refining and free from the wear and tear of a commercial life, and card writers are always in demand.

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We will teach you by correspondence the most fascinating and profitabl profession in the world. Send for our beautiful prospectus. It's FREE.

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A fascinating, high-salaried and easily learned trade, taught thoroughly and practically by correspondence. We will teach the beginner better engraving by correspondence than he can gain in years of rigid apprenticeship. We will improve the skill of any engraver one hundred per cent and make him master of the trade. The demand for competent engravers far exceeds the supply. Send for handsome illustrated prospectus.

# PUBLISHER'S PAGE

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Portland, Me.

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Chicago, Ill.

CHAS. SAGER
East Pittsburg, Pa.

E. B. MILLER
Boston, Mass.

## OUR AGENTS' PRIZE CONTEST.

The "Trip to the Show" agents' prize contest ended very satisfactorily and the result proves what we have always claimed that Popular Electricity is a magazine for intelligent readers everywhere, and that the number of sales depends practically upon the number of people to whom the the magazine is presented. The photographs of four of the prize winners are reproduced herewith, that of the fifth, Mr. D. Redfield, of Seattle, Wash., did not arrive in time for publication. As will be noted, both the Atlantic and Pacific coasts are represented by the winners, and only one prize went to Chicago.

All participants in the contest we believe are well satisfied with the results. We certainly are, because it brought us a great deal of new business, and helped materially to make January the best month in our history. Our agents received their usual commissions, so they were all well paid for their efforts and the prizes were so much "velvet" for the winners. Our regret was that we did not have an opportunity to entertain the out-of-town hustlers. We had made all arrangements to give them an enjoyable time in Chicago, but for one reason or another they were all unable to attend the Electrical Show, so accepted the fifty dollar cash prizes instead.

We extend our thanks to all those who participated in the contest and trust they will continue their work in behalf of Popular Electricity.

Now gentlemen—and ladies (for we have many of the fair sex doing efficient work for us)—don't let your interest lag. Popular Electricity is taking better and offers you greater opportunities with each issue. We make the same liberal proposition regarding commissions—or valuable premiums if you prefer. And listen! in addition we are going to give every agent who sends us fifteen NEW subscribers between February 20th and April 20th, a handsome gold fountain pen and to the one sending us the most subscriptions during that time, we are going to give a fine gold watch. Our circulation department is at your service to help you win these prizes. Supplies and sample copies will be furnished free upon request, and we will also mail sample copies direct to your prospects, if you wish.

We want every one of our agents to take advantage of this opportunity and we can use a few more LIVE representatives in every city and town in the United States. Every agent ought to be able to get at least fifteen subscriptions during the sixty days of the contest, and remember that besides the gold fountain pen (and the watch, if you are the highest) you get your regular commission on every subscription you send us.

Don't waste a minute, but start in at once to make a showing. Our paid subscription list has been growing recently at the rate of 3000 a month. Help us make the next two months record breakers.

For application blanks and particulars address Circulation Department POPULAR ELECTRICITY PUBLISHING COMPANY, 1252 Monadnock Block.

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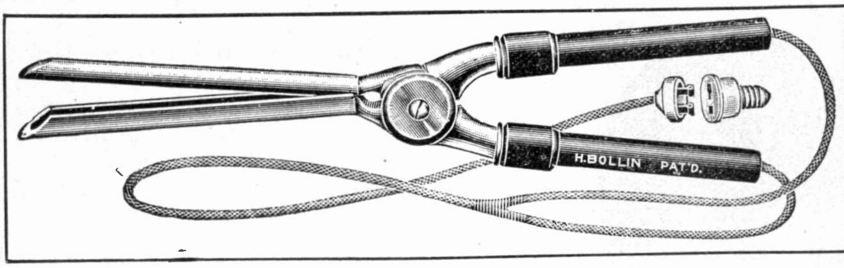
**RENEWALS: The date on the wrapper of your magazine shows the issue with which your subscription expires. No additional copies will be mailed after the expiration of a subscription except upon renewal. Since each issue is printed a month before the date which it bears, renewals should be sent in at least four weeks in advance, in order that no copies be missed.**

# The "BOLLINS" PROFESSIONAL CURLING IRON




**Protected By World Patents**

THE Bollins Iron is necessary in every Hairdressing Parlor, being quick to apply, economical in use, and more satisfactory in curling the hair than any iron now in use.
Both Tongs heated uniformly, giving a most perfect curl. Pressure applied as desired. Cannot over heat. Uses either direct or alternating current.
The Bollins Iron is the acme of perfection in Curling Irons, being the result of many years' experience of a hairdresser of National Reputation.

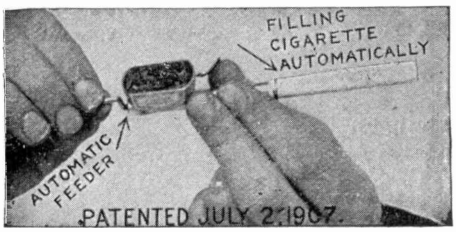
**Pays You to Investigate.** **Can be Bought from Wholesale Hair Trade.**

**H. BOLLINS STEWART BUILDING CHICAGO**

# Automatic Cigarette Maker

## Makes 50 Perfectly Formed Cigarettes from a 5c. Package of Tobacco

**AGENTS AND DEALERS WRITE FOR TERMS.**




Why smoke impure cigarettes when you can make them yourself and know their contents? Enjoy a smoke that will not injure your health. A fresh, pure cigarette made perfectly in a few seconds with any kind of tobacco. Fits vest pocket. Thousands in use, all giving satisfaction.

**Nickel or Gun Metal, 50c. Prepaid.**

**ESRICH MFG. CO., 28 E. 23rd St., Dept. 51, New York**

DENVER, Colo., December 22, 1908.

ESRICH MFG. CO., New York.
*Gentlemen:*—The sample dozen machines received and sold in about 15 minutes. Please send me 500 machines at once and oblige,
Very truly yours,
A. A. KING.

**Wireless Telegraphy.** Using a Crow-Bar on a Watch is like trying to work your wireless without our new THERMO-SILICON DETECTOR. It is as sensitive as any, yet so hardy that you can receive while you toss it in the air. No Adjusting—No Battery—No Bother. It Works Where Its Put. Price, $1.00. Telephone Receiver with cord, 1000 ohms $2.75. "The Five-Mile Outfit," a complete sending and receiving station in miniature. Price $6.15. Includes 1½ inch coil, Thermo-Silicon Detector, etc. 2 inch coil, each $7.75. 1½ inch coil, each $5.00. Send stamp for our large illustrated circulars.
INTERNATIONAL WIRELESS CO., Dept. E., LIMA, OHIO.

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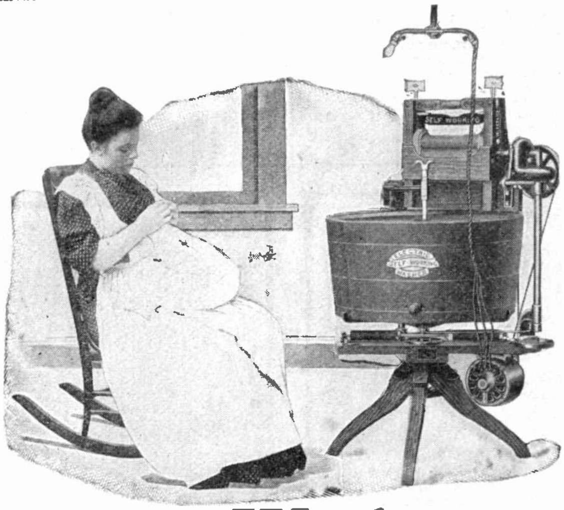
# HAWAIIAN DIAMONDS

Retailed at wholesale prices. We guarantee the Hawaiian diamond to hold its briliancy. It is far superior to any imitation diamond on the market. Large assortment of designs. Send for catalogue. Tiffany, 14 karat gold filled, set with 1 karat Hawaiian diamond. Price each, $1.75. Dozen, $18.00.
W. H. HOLLISTER & CO., Dept. M. 42-44 River St., Chicago, Ill.

*"She sits and sews as the Washer goes."*



*—"In just six minutes, a tub of clean clothes!"*

# The Electric Washer at Work

## A Marvelous Machine that for 2 Cents a Week Does All the Family Washing and Wringing

This machine we consider the greatest labor-saver for women since the sewing machine was invented. And even the sewing machine must look to its laurels now.

The 1900 Electric Washer does *all* the *washing* and *wringing*.

It cuts the cost of washing and wringing to 2 cents a week—*for electricity*.

It's as easy to *start* or *stop* as to turn an electric light on or off.

And it is so simple and complete that no electrician is needed to install it.

Women who see the Washer at work just rub their eyes in amazement. *Yet here it is*—actually doing the washing quicker and better and cheaper than it was ever done before—*without a hand to touch it!*

Another triumph for Electricity—taking rank with the Telegraph, the Telephone, the Talking Machine and the wonders of "Wireless."

# The 1900 Electric Washer

## Sent Anywhere On Trial at Our Expense and Risk

We claim that this machine will wash a tubful of clothes in *Two to Six Minutes*

—That it will wash clothes spotlessly clean without injuring the most delicate fabrics

—That it makes boiling clothes unnecessary

—That it saves soap, saves fuel, saves wear and tear on the clothes—and, best of all, *saves the woman*.

It goes far toward solving the Servant Problem, by cutting out wash-day drudgery. And, to the woman who does her own work or depends on public laundries, it is an inestimable advantage.

Think of being able to sew or read while the Washer is doing its work! None of the fuss and worry that has been a part of wash-day. Everything quiet and orderly, instead of all topsy-turvey. The washing done and out on the line *hours* ahead of the old way.

Just remember, please, that we are not painting a "word-picture," but stating simple facts.

We are so deeply in earnest about it that we will gladly send you an Electric Washer and Wringer—the complete outfit—for a month's free trial. Yes, and we will pay the freight. We furnish a splendid 1900 Electric Wringer FREE with every Washer. This free trial offer is to any responsible person anywhere in the world.

If you don't fall in love with the Electric Washer after giving it a four weeks' test, we will take it back. The trial will cost you not a cent. It will not place you under any obligation. Feel just as free to *return* the Washer as you are to *keep* it if *suited*.

### Ask Your Electric Light Company

Call up your Central Lighting Station on the telephone. Ask for the Manager. He knows all about the 1900 Electric Washer. It is part of his business to keep posted on all the new uses of electricity. He will tell you that the "1900" Electric is an immense success—that thousands are in use in the best homes throughout the country.

### Write for Free Book, "Electric Wash Day"

The story of the Electric Washer is one of absorbing interest. It strikes a responsive chord in the heart of every woman to whom wash-day is now a dread. You owe it to yourself to look deeper into the subject. Send for the free book, while you have our address before you:—

The 1900 Washer Co., 3285 Henry St., Binghamton, N. Y. Or, if you live in Canada, address the Canadian 1900 Washer Co., 355 Yonge St., Toronto, Canada.

*(We supply a Water Motor instead of Electric Motor, if desired. Only 50 pounds of water pressure needed.)*


THE GRAND CENTRAL AISLE AT THE CHICAGO ELECTRICAL SHOW.

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. I MARCH 1909 No. 11

# A VISIT TO THE ELECTRICAL SHOW.

BY WILLIAM KEILY.

Chicago is sometimes accused of being boastful, often when it should rather be praised for being energetic and enthusiastic. In the case of its annual Electrical Show, however, it is surely entitled to felicitate itself for establishing an exhibition which is not only highly instructive, both to the technical man and the layman, but also furnishes a brilliant spectacle, with good music and many features of general novelty and interest.

It was in Chicago that the first successful electrical show was held, and the excellent example has been followed in many other cities and towns. Chicago made a success of the show owing to its prominence in the industry and its favorable geographical position, but, most of all, from the fact that the electrical men of the city worked together as one man to make it a success, laying aside all competitive distrust to labor for the common end—the good of the industry. The show is genuine—a real electrical exhibition, made by electrical men. Honesty is manifest in it, and, like most honest efforts, it is recognized and appreciated.

The fourth annual Chicago Electrical Show was held at the Coliseum on January 16 to 30, 1909, and it was a beautiful, educational and successful exposition of the lighter applications of electricity, with some examples of comparatively heavy machinery. Space is available for reference to only a few of the features of more particular interest to the average visitor, and no attempt will be made to describe the exhibits in detail. There were more than a hundred of them, and every one could be studied with profit.

### ILLUMINATION AND DECORATIVE LIGHTING.

Unstinted praise was lavished on the plan of general illumination. No arc lamps were used for this purpose, tungsten lamps being relied upon exclusively. These were placed on posts of artistic design and upon graceful low arches over the aisles, in the manner shown in the illustrations, producing charming vistas with pergola-like effect. All railings, posts and signs were uniform in design and of light color. There was a line of lights around the interior of the large building, above the gallery level and outlining the "sunbursts" of delicate-tinted bunting at each end. In the center was suspended a large and handsome fixture supplied with many white and colored lamps.

Spanning all was the deep, dark vault of heaven, with a thousand twinkling stars—stars of different magnitude, some blue-white, some yellowish-white, some ruddy, but all, or apparently all, "winking" at the lowly observer in the most friendly and natural manner. It was an illusion, of course, but very effective—the best thing in the show from a spectacular point of view.

The "sky" was very dark blue bunting fastened on the roof arches, which it concealed. It was not itself visible save as the blackness of night, but it formed the background for the "stars," which were two-candlepower incandescent lamps with carbon filaments. These little lamps were placed irregularly and were visible only as tiny points of light. Some

UNITED STATES BATTLESHIP "ELECTRA" AND HER CREW.

SOME OF THE LATEST LAUNDRY APPLIANCES.

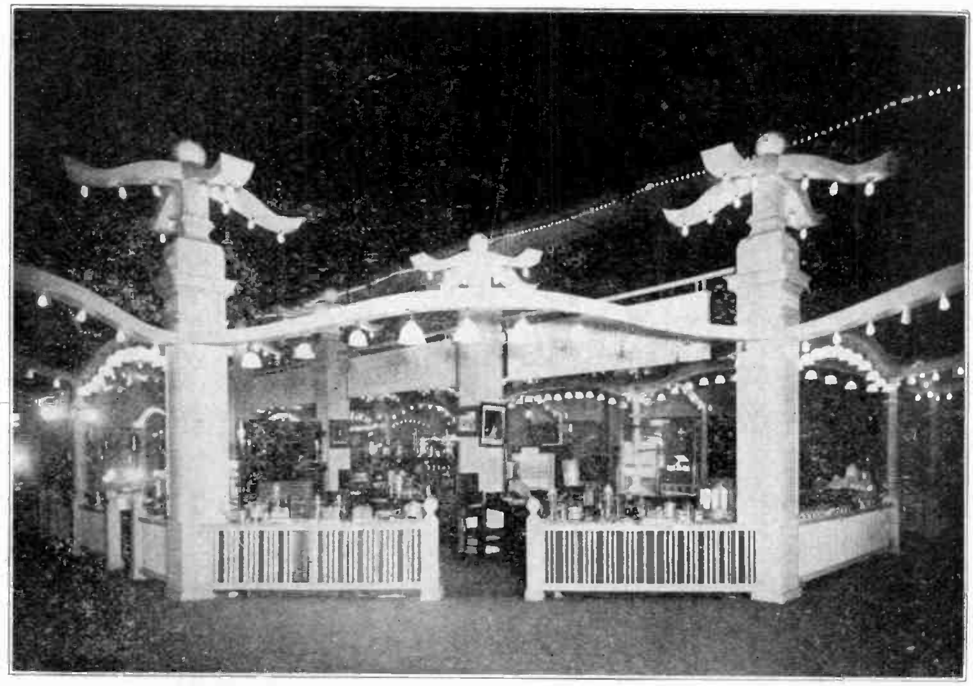
were more brilliant than others and some were made to twinkle by an automatic flasher arrangement. The whole effect was most natural and did great credit to those who planned it and carried it into execution.

NAVAL DISPLAY.

Acting in concert, the United States Navy Department and the Illinois Naval Reserve caused the U. S. S. Electra to cast anchor in the Annex to the Coliseum during the progress of the Electrical Show. This exhibit was the simulation of the deck and bridge of a gunboat. The "ship" was outlined in electric lights, smokestack and all, and carried seven Hotchkiss, Colt and Gatling rapid-fire and automatic guns. The running lights, side lights and masthead lights of a warship were represented, and there was an 18-inch searchlight. Other features were an electrically lighted semaphore for signaling, the Ardois signaling system (in which electric lights of two colors spell out words by "Morse"), Stone wireless telegraph and telephone apparatus, electric ammunition hoist, electric helm indicator, electric steering gear, engine-room telegraph, and electric truck-light control (giving a quick signal to a following ship, from a mast-truck, in case of necessity).

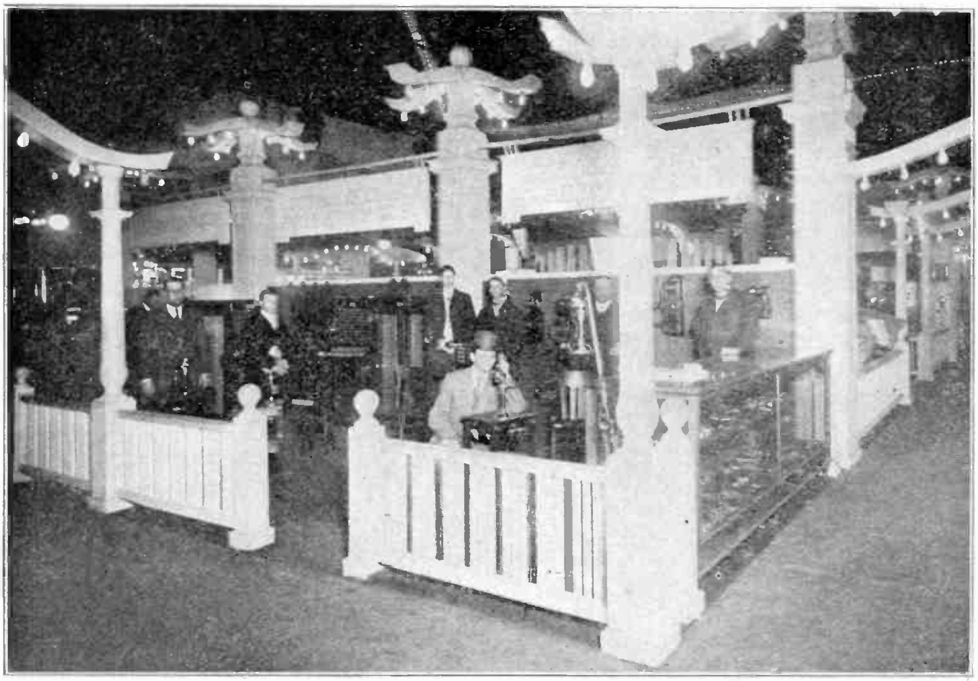
On one side of the Electra was a fine model, in a glass case, of the United States battleship Illinois, while on the other was a full-sized and fully equipped six-oared captain's gig—one of the rowing boats carried by a warship. The exhibit was in charge of Lieutenant-Commander E. T. Witherspoon of the Navy and W. F. Purdy of the Reserve, while Chief Gunner Olssen had much to do with the actual installation of apparatus. Literature setting forth the attractions of the service and describing the training of electricians for the Navy was distributed, and Lieutenant-Commander Witherspoon gave an appreciat-

EXHIBIT OF LAMPS—THE NEW TUNGSTEN PREDOMINATES.

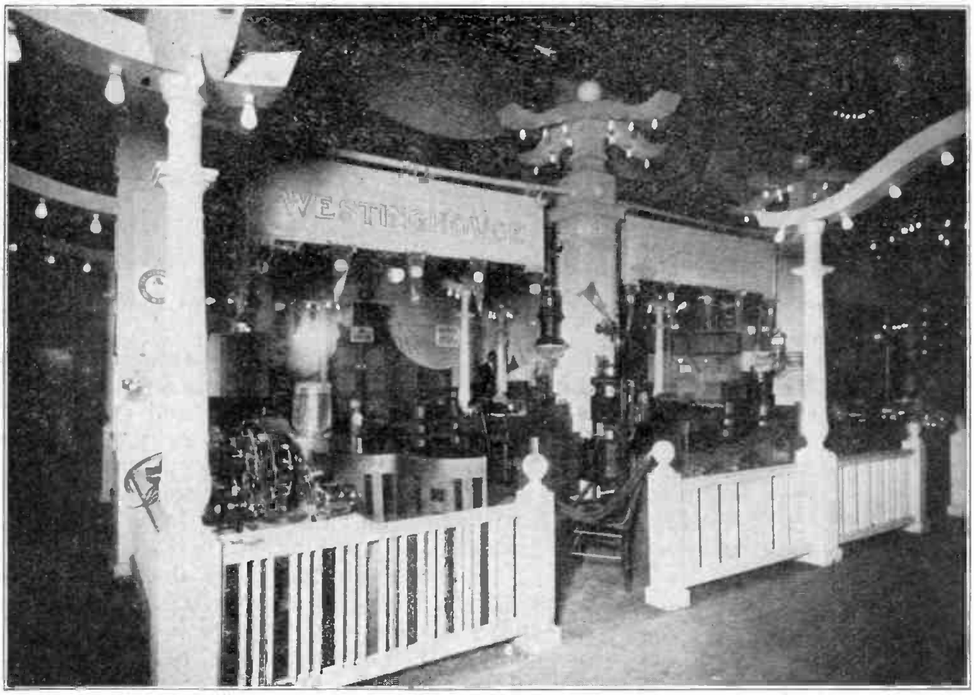


EVERY FORM OF ELECTRIC COOKING UTENSIL ON DISPLAY.


THE LATEST IN ELECTRIC SIGNS



FROM SUBSCRIBER TO "CENTRAL"—RECENT TYPES OF TELEPHONE APPARATUS.



A VARIED DISPLAY OF ELECTRICAL MACHINERY.

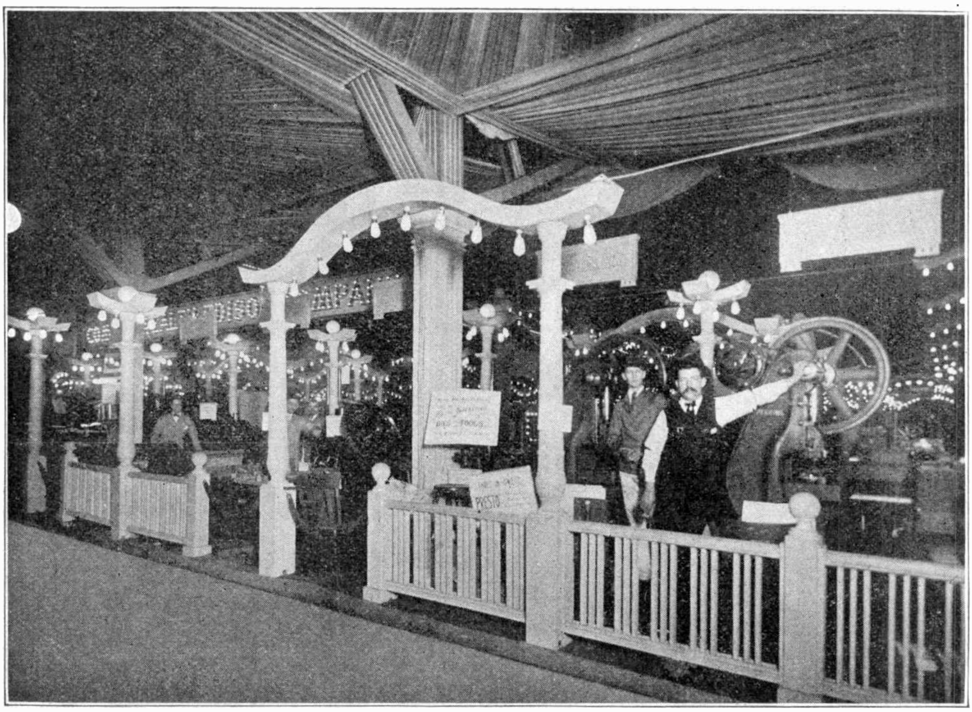
ed talk on "Electricity in the Navy" at a meeting of the Electric Club of Chicago at the Coliseum during the show.

INDUSTRIAL POWER.

Probably the most instructive display at the Electrical Show was that made by the Commonwealth Edison Company of Chicago illustrating the application of electric power to various industries. A large space at the north end of the building was devoted to this collective exhibit. The various machines were shown in actual operation, and they were watched with lively interest, because they were new to most of the spectators and indeed some of them would be new to experts, being of recent design. Wherever practicable, individual motors were used. The exhibit was arranged by the central-station company in conjunction with some of its power-using customers, and it was of benefit to all concerned in it.

At one end of the exhibit was a line of shoe-repairing machinery embracing every really essential process in resoling shoes, from stitching to the final brushing, all apparatus mounted on one frame and driven by a three-horsepower motor.

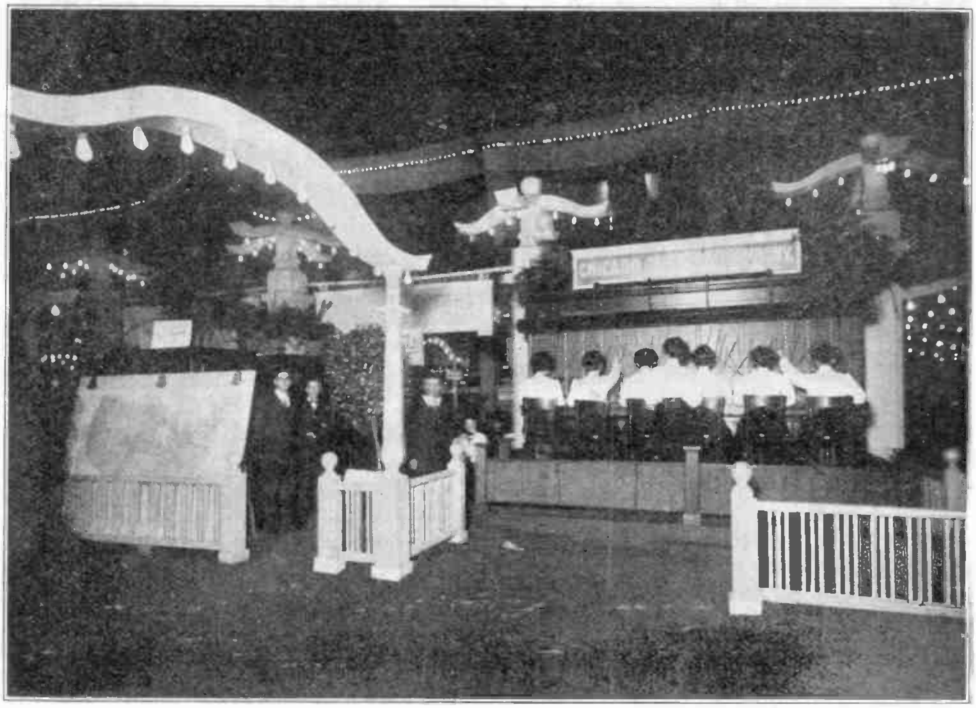
Near by was an outfit of knitting machinery, with operatives busily engaged in making knitted fabrics. The machines work at high speed and seldom make a false stitch. Adjoining was a section devoted to cloth-cutting by electricity. A keen knife, motor-driven, enables the cutter in a clothing factory to cut as many as 16 thicknesses of heavy goods at one operation. This represents a great saving of labor.



INDUSTRIAL EXHIBIT SHOWING APPLICATIONS OF EDISON POWER.

In iron and steel working some exceptionally interesting apparatus was shown, all in operation, like the rest. Two small punch presses cut out and shaped metal specialties for souvenirs. A rivet-spinning machine made heads on rivets. A rotary bevel shear for cutting iron plates one inch thick on the bevel was a ponderous machine, but perhaps most attention was attracted by the Ryerson friction saw for cutting cold metals. This machine was operated by a specially designed 25-horsepower motor. It will cut a 15-inch I-beam in 28 seconds, it is said. A massive punch for cutting holes in,

BEAUTIFUL DESIGNS IN ELECTROLIERS AND BRACKET FIXTURES.



VISITORS NEVER TIRED OF WATCHING THE BUSY "HELLO" GIRL.

say, boiler plate was also included in the exhibit. Near at hand was an electric welder, by which wire hoops were welded by electric heat.

Other features of the industrial power exhibit were electric potato parers, such as are used in the Navy, and electric dough mixers for bread and cake. The latter were very popular, for white-clad bakers made little cakes shaped like incandescent lamps, cooked them to a turn in electric ovens and handed them out, piping hot, to the nothing-loth spectators.

There was also a wood-working shop with a most interesting multiple wood-carving machine by which four objects may be carved at one time, and all are faithful copies of one hand-carved original. The great utility of this machine in fine cabinet-making and interior decoration is obvious. In this shop were also a wood-embossing machine, a lathe, a band-saw and blowers for removing shavings and chips.

Adjoining was a small but modern "print shop," headquarters of The Electric City, the attractive publication of the Commonwealth Edison Company. Here were a linotype machine, a printing press and other paraphernalia of the printer. A moving-picture machine, embossing machines for printers and binders and a Marconi "wireless" outfit completed this extremely interesting industrial power exhibit.


HOUSEHOLD APPLIANCES IN PROFUSION.

SOME DISTINGUISHING FEATURES.

Electric lamps of all kinds were shown, of course, but most attention appeared to be paid to the tungstens, among incandescents, and the flaming type, among arcs. In one handsome booth all kinds of tungsten lamps were shown, from the 1½-volt pocket lamp, which will burn on one cell of dry battery, to the 250-watt multiple lamp, which gives 200 candlepower. A demonstration showed that voltage variation affected tungsten lamps comparatively little. In another exhibit carbon, magnetite and flaming arcs were projected on a screen, after being magnified, so that their characteristics could be studied. Near by was a very modern outfit for measuring light, including a new German photometer for taking spherical candlepower, the first of its kind to be used in this country. Anchored-filament tungsten lamps were a novelty shown in another space.

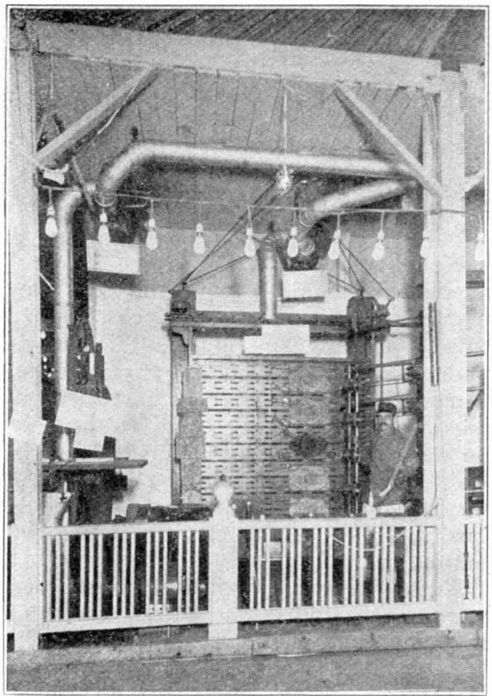
There were electric signs, of course, and flashers for signs and all kinds of shades, reflectors and fixtures, some of the last-named being very beautiful.

Small motors were there in all sizes and types and for all applications, from little telephone-booth fans and electric vibrators in the hands of skillful demonstrators, up to new types for driving heavy machinery. There were also dynamos, wire, instruments, electric railway material, conduit, controlling devices, fuses, small tools and machine tools, primary and storage batteries, transformers, sockets and switches, electric clocks, time stamps, sound magnifiers for the partially deaf, circuit breakers, insulators, electrical books and periodicals—electrical appliances without end almost.

Particular attention was paid to the uses of electricity in the household. There were literally heaps of electric flatirons. Some of them were in the new gunmetal finish, and all had some particularly good quality, according to the various attendants. In one booth a quiet Chinaman was placidly ironing towels with the electric iron. Electric washing machines, sewing machine motors, electric curling irons and all kinds of electric heating and cooking apparatus were shown in profusion, and usually demonstrated. There were the new flat heating units for water heaters and the like, new tubular electric air heaters for rooms, radiant heat bread toasters, new forms of electric cigar lighters and other novelties in this line.

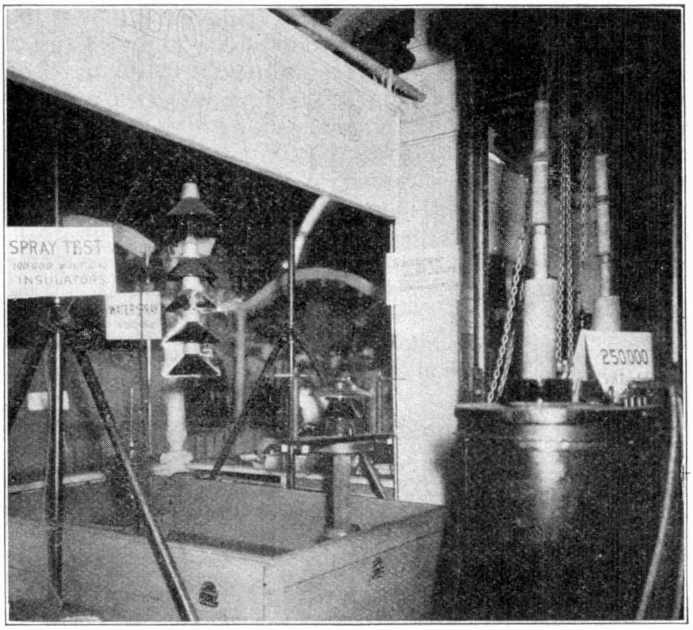
The various types of vacuum cleaners and electric sweepers were objects of attentive study and general interest. No less than ten exhibitors had displays of this character, and the use of the devices was being constantly demonstrated. One test shown was to remove the tool at the end of the suction hose and pick up a lead-pencil from the floor by the draft of in-rushing air. The number of exhibits and the interest shown indicated clearly the present-day importance of mechanical cleaning.

Telephone apparatus was shown in great variety, including apparatus made for naval and shipboard use and ingenious intercommunicating systems. Special sets for use in telephonic train dispatching were a novelty. The Chicago Telephone Company had in actual operation a multiple switchboard of its latest type with six attractive operators.



ELECTRICALLY DRIVEN MACHINE THAT CARVES WOOD.

Brand new was the "time-a-phone," first disclosed at the 1909 show. Mr. M. M. Wood is the inventor of this device, by the use of which one may know the time at any hour of the day or night by picking up a small telephone receiver, holding it to his ear and pressing a button attached to the receiver. The hours, quarters and minutes are struck in musical tones for that instant. The principle is that of a minute-repeater watch




TESTING A HUNDRED THOUSAND VOLT INSULATOR.

applied to standard time and the telephone. From one master clock or other source of time any number of time-a-phones can be connected at any distance. The device may be used in hotels, sleeping cars and hospitals. It gives the time on demand in the dark when one is in bed. All that is to be done is to draw the little round disk from under the pillow, apply it to the ear and press the button.

Technical and practical electrical men were much impressed with a new and really original device, the Murphy rectifier, invented by Mr. T. J. Murphy of Rochester, N. Y. No vacuum tubes, electrolyte, inductance or resistance are used in this rectifier, which is an apparatus to convert alternating current into direct, or, more accurately speaking, unidirectional current, so that it can be used for charging storage batteries, for instance. Without attempting to describe the device in non-technical language, which would be difficult, it may be said that the machine is radically different from preceding types of rectifiers and was examined with minute attention.

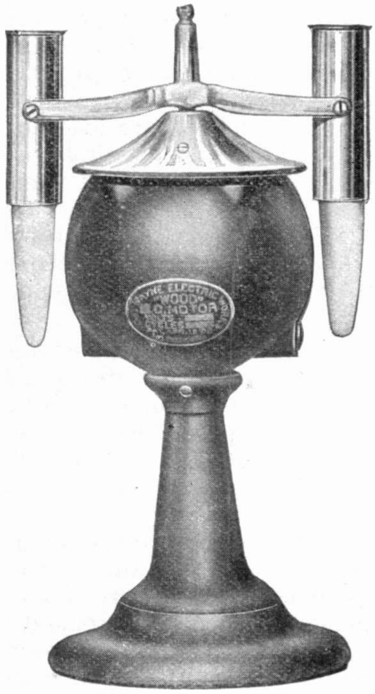
A demonstration that was both scientific and spectacular was given in one of the exhibits. A transformer built to give the high pressure of 250,000 volts was part of the display. From this, electric energy was obtained to test some large insulators of the suspended type, one disk hanging below another, something like beads on a string. These insulators are made to withstand 100,000 volts, and they were tested under a spray of water, as in a driving rain storm. The transformer was so arranged that the voltage could be gradually raised and lowered. Popular interest was excited when the discharge "arced" over at the very high potentials. There would be a wavering line of fire, like miniature lighting, perhaps three feet long, accompanied by a series of reports, making a loud crackling sound. At other times there would be a shower of sparks between the two extremes of the insulator under test. The exhibition never failed to draw a wondering throng.

There were also an electric incubator and brooder where chickens were hatched and cared for by electric heat. Plenty of little chicks were running about in their enclosure, to the delight of the little folks.

In this visit the reader has only touched the "high spots" in the Electrical Show, but, like all visits, it must come to an end. There is no time to touch on the excellent music, the special days, the out-of-town visitors, the souvenirs, the many other things that could be mentioned. But it was a good show, carried out with good judgment and good taste. The Electrical Trades Exposition Company is fairly entitled to commendation for producing an exhibition of such well-balanced excellence. This company is representative of electrical Chicago. Its officers are: President, Samuel Insull; vice-president, E. B. Overshiner; secretary and treasurer, Stewart Spalding; manager, Homer E. Niesz; assistant manager, John J. Schayer.

### THE CENTRIFUGE.

Various tests made by physicians on blood, milk and other liquids are performed by the centrifugal process; that is, by rapidly whirling tubes that contain the liquid to be tested. The heavier constituents of the liquid tend to flow to the parts of the tube farthest from the center of rotation.



CENTRIFUGE.

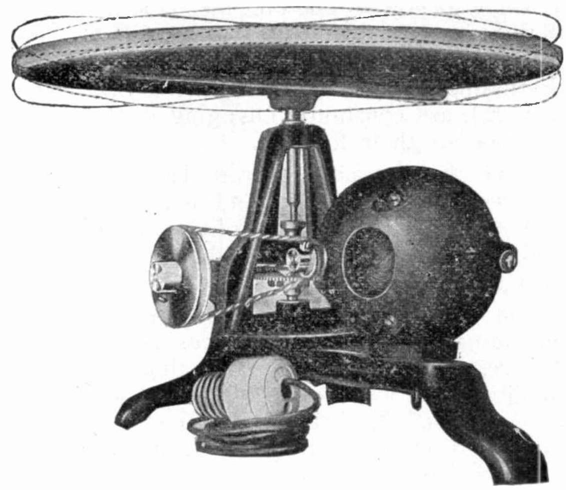
The Centrifuge is an inexpensive and efficient device for performing such tests. It consists of a small vertical motor on a suitable stand which carries on the upper end of the shaft two horizontal arms with receptacles for the test tubes. The test tube and receptacle hang from a point considerably above the center of gravity so that as the arms revolve the tubes are carried out in a horizontal direction and the heavier portions of the liquid are carried outward.

Below the point of suspension of the arms is a concave disk which acts as a fly wheel. This revolves on the principle of a gyroscope and steadies the motion of the arms; it also causes a more gradual starting and stopping, which is a desirable feature.

For testing blood the machine is operated at 10,000 revolutions a minute.

### MOTOR DRIVEN TITUBATOR.

All X-ray photographers have felt the need of some kind of mechanical device that would relieve them of the monotonous task of "tray shaking." This little motor driven device called the titubator will do the work. The revolving table in addition to its rotation movement is at the same time given a tipping movement similar to the "Ocean Wave," which furnishes so much amusement at summer resorts. This effectually shakes the plates while they are being developed.



TITUBATOR.

Several plates may be developed at the same time.

### FAILURE OF MOTOR "LEADS."

Inspectors of elevated railway equipment sometimes have trouble with a rather peculiar failure of the conductors in the insulated wires supplying current to the motor, and at the point where the wires enter the motor. A rough examination of the "lead," as it is called, discloses nothing wrong, as the insulation is generally in fair condition, yet there is no electrical connection. In truth the conductors have become broken or worn through, due to the repeated movement and turning of the wires as the car takes curves.

# ELEMENTARY ELECTRICITY.

BY PROF. EDWIN J. HOUSTON, PH. D. (PRINCETON.)

## CHAPTER XI.—PHYSIOLOGICAL EFFECTS OF ELECTRIC DISCHARGES.

When an electric discharge is passed through the muscles or nerves of an animal, various physiological effects are produced that markedly vary not only with the direction of the discharge and the value of the electromotive force, but also with the steadiness or constancy of the current strength. The powerful discharges of high electromotive forces produce effects that differ from the weak discharges of feeble electromotive forces. So, too, direct currents, or those that continue to flow in one and the same direction, produce effects that differ markedly from discharges that are of an alternating or oscillatory character, that is, which are constantly changing in the direction of their flow.

Since the character of the electricity produced varies with the kind of electric source that produces it, the physiological effects must vary also with the kind of electric sources employed.

The passage of electricity through the human body often produces effects that result in the curing of its diseased conditions, as well as in the general improvement of the health. Consequently electric discharges are now generally employed for such purposes, this application being known as electrotherapeutics.

Some of the more important electric sources employed in electrotherapeutics are the Leyden jar, the induction coil, the voltaic battery, the dynamo-electric machine; or, as it is generally called when employed for this purpose, the therapeutic generator, the Franklinic or electrostatic induction machine, apparatus for high frequency alternating discharges, as well as many others.

The electric currents produced by the discharge of a Leyden jar are rapidly alternating or oscillatory, consisting of discharges that follow one another at the rate of hundreds of millions of complete to-and-fro motions per second. These discharges, however, continue but for a very short time, the jar being completely discharged according to the conditions of the circuit after from two to thirty complete to-and-fro discharges.

On the contrary, the voltaic cell or battery produces a steady discharge that retains both the direction of its flow and the value of its electromotive force.

As the name indicates, electrotherapeutic generators or alternators produce currents that alternate or vary in their strength. These machines are made of different sizes and consist practically of dynamo-electric machines without commutators. So that the alternating currents produced in the armature coils are sent into the external circuits without being caused to flow in one and the same direction.

Frictional electric machines are employed either for producing disruptive discharges or for obtaining convective or brush discharges. In either case the discharges are applied at or near the portions of the body that are to be treated.

Induction coils produce currents that rapidly alternate or vary in their direction, and produce electromotive forces differing greatly from the electromotive forces of the electric sources employed for their operation. As a rule, the electromotive forces produced are much greater than those that produce them. The induction coils, together with the battery that furnishes the current necessary for their operation, are placed inside a small portable box provided with terminals or electrodes for applying the current to the different parts of the body and a device called an ampere meter, or ammeter, for measuring the current strength. The relative strength of the two opposite currents will be discussed in the article on electro-receptive devices when the construction and operation of the induction coil will be more fully described.

The apparatus for producing the high-frequency alternating discharges consists of Leyden jar batteries, the discharges of which are passed through especially wound induction coils. In this way are produced the very high-frequency discharges that, within comparatively recent dates, have come into somewhat extended use in electrotherapeutics.

The electric sources or electro-receptive devices, above referred to, will be described in detail in other chapters.

The passage of an electric discharge through the muscles of a living animal generally contracts the muscular fibres. When the electrodes or terminals of a strong voltaic battery are held in the two hands, what is known as physiological shock is produced. This shock varies with the number of cells employed; or, in other words, with the value of the electromotive force.

In the direct currents produced by a voltaic battery that do not alternate or change in direction, it is only at the moment of making or breaking the circuit that the contractions occur. As soon as the currents are established, and the flow of electricity is uniform, contractions cease, and although chemical and other effects are produced by the current, yet these effects are not so immediately apparent. The muscular contractions are produced at every opening or closing of the circuit, and the more sudden these openings or closings, the more pronounced are the contractions.

When the openings and closings of the circuit are rapid, the muscles may be thrown into a condition of permanent contraction, known as tetanus, in which a new contraction takes place before the disappearance of the previous contraction.

But it is not only in the muscles of animals that electric discharges produce contractions. They are also produced in the protoplasm of plants, the protoplasm being what may be regarded as the physical basis of life in both animals and plants. Protoplasm exists in the lowest forms of life, such as in the amoeba, an animal so simple that it has been described as a living mass of transparent matter. This animal is especially sensitive to electric discharges. Ordinarily, it is continually undergoing changes of shape. On the passage of an electric discharge it immediately contracts, draws itself up into as small a space as possible, assuming the shape of a rounded globe.

The physiological effects of electric discharges are not limited to the muscles of animals. Their passage through a living nerve throws it into a state of increased activity and sensibility. If the nerve is connected with the muscles, the latter will contract, only in this case the contraction is entirely involuntary. If the nerve is a sensory nerve the passage of a discharge may produce a sensation of pain. If the nerve is connected with some special organ, such as the eye, the ear, the tongue, the nose, its electric excitement will be attended by the sensation of light, sound, taste or smell. As in the case of the passage of a discharge through the muscles, the effects are produced only on the opening or the closing of the circuit.

During the normal and healthy life of an animal, an electric current is constantly flowing through its nerves and muscles.

In some cases as in the electric ray or torpedo, the amount of electricity produced is so great that the animal can employ it as a means for defense against its enemies by giving serious shocks to any animal that comes in contact with its body.

That electric currents are constantly passing through the nerves can be shown as follows: If the terminals of a galvanometer are connected with two parts of a nerve, the needle will be deflected. If, now, an electric source is so connected to one part of a nerve that the current passes in the same direction as the normal nerve current, the latter current is increased in strength. It can be shown that this increase occurs without any of the battery or extraneous current being permitted to enter the galvanometer circuit along with the nerve current.

The alteration in the natural electromotive force of a nerve by the passage of an extraneous current through it is called electrotonus and is most intense near the extraneous or exciting current. This change in sensibility continues as long as the exciting current is passing and results in important changes in the excitability of the nerve, or in the readiness with which it is thrown into functional activity by the application of a current.

The alteration in the sensitiveness of a nerve, or in its condition close to the anode or positive terminal, is called the anelectronus, while that near the negative terminals, is called the cathelectronus. Since the excitability of a nerve near the anode is decreased, it is necessary to apply a stronger stimulant in this part in order to obtain a muscular contraction. In the same way near the cathode region, where the excitability of a nerve is increased, a strong contraction is obtained by a comparatively weak current.

The first case on record of physiological effects produced by Leyden jar discharges is that of Von Kleist in 1746, when the Leyden jar was discovered. It appears Von Kleist was endeavoring to fill a bottle with electricity, when he accidentally constructed a small Leyden jar.

As illustrated in Fig. 74, the first Leyden jar consisted of a glass flask partly filled with water and so held in one hand of the experimenter that a bent metallic wire suspended from a bar of iron that formed the conductor of the frictional electrical machine dipped into the water. Under these circumstances, the water in the flask formed the inner coating of a Leyden jar, and the right hand of the experimentor, who held the flask, the outer coating. When the experimentor endeavored to remove the flask from the machine, he necessarily touched the inner and outer coatings of the jar simultaneously, and, therefore, received the discharge through his body from one hand to the other.

The unexpected and severe character of the shock, as well as the violent muscular contraction accompanying it, attracted the attention of the curious, so that the experiment was repeated in various parts of the world.

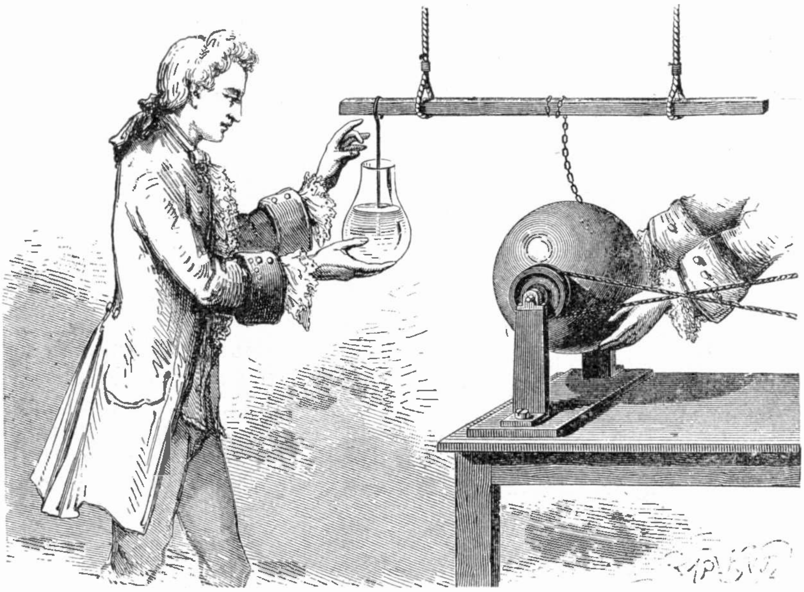


FIG. 74. THE FIRST LEYDEN JAR.

The discharge of a Leyden jar is readily passed through the body by holding the jar in one hand, say by the outer coating, and touching a finger of the other hand to the knob connected to the inner coating. When the jar is small, the shock is felt in the elbow; when larger, say a quart jar, the discharge may be felt across the chest; with a battery of large jars, it may be felt in the stomach.

The discharge of a Leyden jar can be sent through a long chain of people who are holding on to one another's hands. In this way the Abbe Nollet, of France, sent a discharge through a chain of 600 people in his convent. At another time he sent a discharge from a large Leyden jar through a regiment of 1,500 men. In these experiments the people near the middle of the chain were as much affected as those near the ends.

The shock caused by the discharge of large Leyden jars may cause death. Von Marum found that eels were almost instantly killed by comparatively small Leyden jar discharges. When the glass employed in the jar is of ordinary thickness the discharge of a jar containing a coated surface of seven square feet instantly kills a rat, while a battery of 4½ square yards will kill a cat.

A lightning flash does not essentially differ from the discharge of a Leyden jar, for a lightning flash consists of a discharge between a neighboring cloud and the earth that forms the two coatings of a jar. As is unfortunately too well known, the passage of a comparatively feeble lightning flash through the human body will cause death.

Death by lightning flashes appears to be instantaneous. In cases where the death has only been apparent, the one receiving the discharge had no memory whatever of ever having been shocked. In cases where death has been real, the bodies generally retain the positions they occupied before death. An instance of this character is cited in France where a number of harvesters, who had sought refuge from an approaching thunderstorm under a tree, were killed by a lightning flash while they were eating lunch. So instantaneous was their death that the bodies remained so exactly in the positions assumed during life, that some little time elapsed after the storm was over, before it was discovered that the people had been killed.

The physiological effects produced by alternating currents depend on their frequency, the severity increasing up to a certain extent with the increase in frequency. It is a curious fact, however, as has been observed by Elihu Thomson, Nicola Tesla and others, that when the frequency of the discharge exceeds certain limits, the severity of the physiological effects decrease and finally disappear. The alternating currents employed commercially, with frequencies up to 1,000 cycles per second, may produce instant death, under pressures of but a thousand volts or less. When, however, the frequencies are greatly increased, it is possible to send the discharges through the body without any serious effects, although the electromotive forces may be as high as several hundred thousand volts. On the contrary, high-frequency alternating discharges may produce highly beneficial effects on the human system and are now extensively employed in electrotherapeutics.

Attention has been called in a previous article to the fact that in electric osmose the passage of a discharge through the capillary pores in the walls of a diaphragm may be accompanied by a movement of the liquid in the direction in which the electricity is passing. Advantage has been taken of this fact for the introduction of such substances as iodine, cocaine, quinine, etc., through the skin to the interior organs of the body. It is only necessary to place the medicinal substance in a liquid condition on a moistened electrode. On the passage of the current the liquid is carried through the skin and in this way may reach some distant part of the body. Since electric osmose is sometimes called cataphoresis, this process is generally known as cataphoretic medication.

In the electrotherapeutic application of electricity the current is led into and out of the body by means of terminals or electrodes, consisting generally of polished metals shaped so as to be readily applied to different parts of the body. These electrodes are called electrotherapeutic electrodes. When the electric pressure is comparatively small, as when voltaic batteries are employed, in order to decrease the resistance offered by the skin the surfaces of the electrode are covered with absorbent cotton, or with cotton or linen fabrics moistened with salt water. Moistened sponges are sometimes placed over metallic electrodes for similar purposes. Owing to their higher electromotive forces, the discharges of Leyden jars or induction coils can be applied directly to the surfaces of the skin.

It is sometimes necessary to introduce electrotherapeutic electrodes into the different cavities of the human body. In this case they are formed of polished metals, so shaped as to be readily introduced.

The most curious fact concerning the physiological action of electric currents is that the contractions may continue after death, provided too long a time has not elapsed.

In a similar manner the hind legs of a frog that have been separated from the body shortly after death are thrown into violent contractions on the passage of an electric discharge from the nerves to the muscles. This experiment, first made by Galvani, in 1780, led to the discovery by Volta, of a new electric source that is named after its inventor, the voltaic cell.

The frog's legs employed in the above experiment were prepared as shown in Fig. 75. The lumbar nerves, on each side of the vertebral column, are exposed in the shape of white threads.

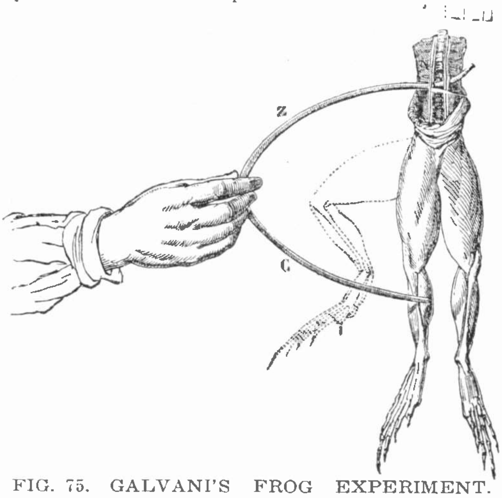



FIG. 75. GALVANI'S FROG EXPERIMENT.

When metallic conductors (Z), (C), consisting respectively of zinc and copper wires, are held as shown, with one set of ends together in one of the hands, while the free ends are brought into contact with the nerves, at each contact a sudden convulsive movement of the legs occurs.

But this ability of being affected by an electric current is not limited to the legs of a frog. Any of the muscles of a recently killed man or other animal can also be made to move as in life by the passage of electric discharges. This can be shown by the following experiment made by Aldini, a nephew of Galvani. The lumbar nerves of the hinds legs of a recently killed frog were brought, as shown in Fig. 76, into contact with the head of a recently slain ox, through its tongue. An electric circuit was established between the frog's legs and the ox by the experimentor grasping the legs of the frog in one hand and one ear of the ox in the other hand. Under these circumstances, the current produced in the head of the ox, passing

FIG. 76. EARLY EXPERIMENT IN THE PHYSIOLOGICAL ACTION OF ELECTRICITY.

through the legs of a frog set up convulsive motions in them.

(To Be Continued.)

## UNDERGROUND HIGH-VOLTAGE WIRES.

It is only in comparatively recent years that engineers have deemed it safe to carry electric currents of high potential or voltage in underground cables buried under the streets of cities. But nowadays systems of 9,000, 11,000, 13,200 or even 20,000 volts are employed with entire reliability and safety. It is said that when local and commercial conditions justify, pressure as high as 25,000 volts can be used satisfactorily underground, even for systems aggregating 100 miles of cable. But no single line of such a system should be longer than about 20 miles. On comparatively short lengths underground or under water, as a part of a long overhead transmission line, cables operating at 40,000 volts may be used.

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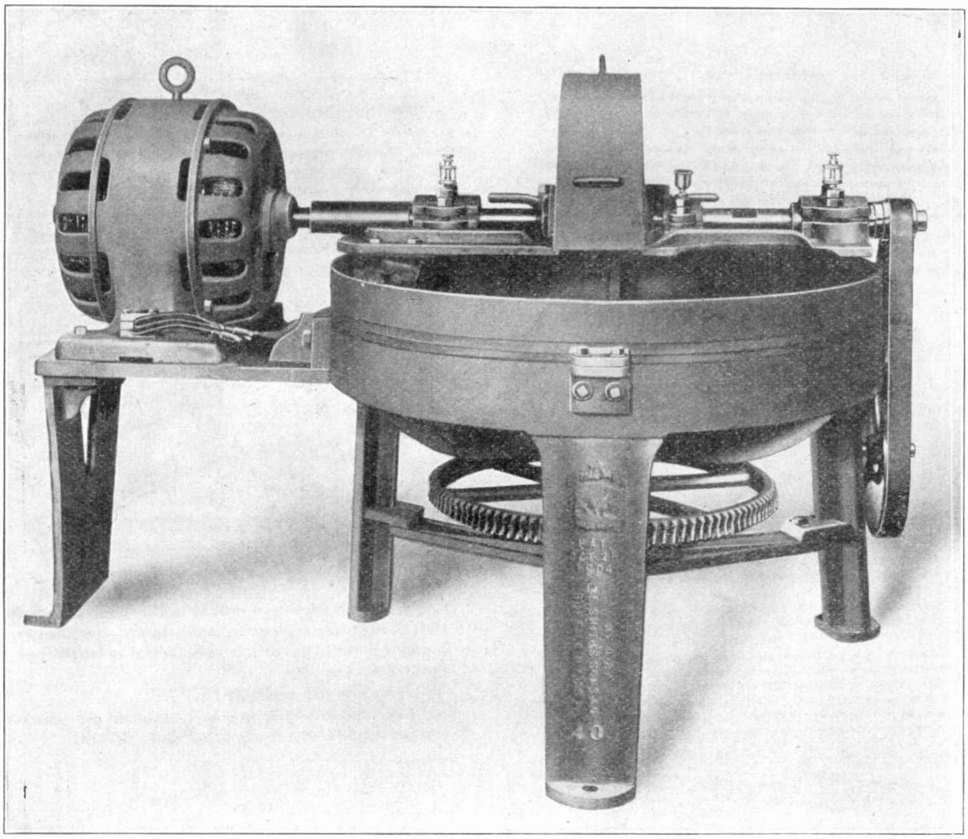
A chain of 250 stores throughout the country will soon be lighted with the new tungsten lamps. It will take 25,000 lamps to illuminate the interiors of these places of business.

## LARGEST MEAT CUTTER IN THE WORLD.

It is interesting to note that a meat cutter, which is claimed to be the largest ever made, has been recently changed from steam equipment to direct connected motor drive, because of the delays formerly experienced in getting up steam, which materially reduced the output of the grinder. The meat cutter in question has a 43-inch bowl and six knives, each of which has a cutting edge 18 inches long. The power is supplied by a 20-horsepower motor.

In the factory where this outfit is installed the capacity is 25,000 pounds of sausage a day. This cutter can handle the entire output if desired, as it has a capacity of 250 pounds in five minutes.

One of the main reasons for the change from steam to motor drive was the saving in the expense for attendance of an engineer, as well as the greater convenience when motor driven. The direct connection of the motor to the cutter eliminates belts, shafting, pulleys, etc., and effects a substantial saving in wear and tear.



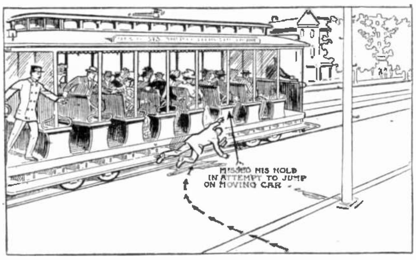
LARGEST MEAT CUTTER IN THE WORLD.

## TO DETERMINE THE KIND OF CURRENT.

At times it is necessary to know whether the current in a circuit is alternating or direct, and as the generator may be miles away at the other end of the line an easy method of determining this on the spot is desirable. A reader of Popular Electricity suggests the following method: Hold a small magnet near an incandescent lamp burning on the circuit. If the current is alternating the filament will vibrate. If it is direct the filament will bend slightly toward the magnet but will not vibrate.

# HOW IT MIGHT HAPPEN.

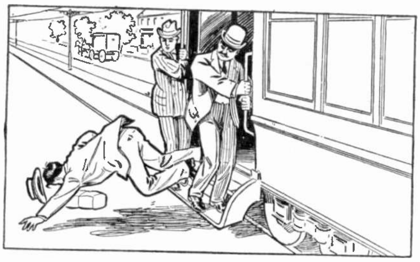
Below are reproduced several more of the series of newspaper advertisements being used by Stone & Webster in the various cities in which their electric lines are operated. Part of this series appeared in the February issue of Popular Electricity. These pictures and the little "talks" under them set forth graphically the dangers which result from pure carelessness on the part of street car patrons and others. It is safe to say that if this carelessness, to which we are all more or less prone, could be eradicated street car accidents would be almost unknown.




Lots of persons who cannot get a car while it is standing still will run after it and try to get on, or "jump it" in the middle of the block. What do you get for it? What may it cost?

The man who wrote this advertisement "jumped" electric cars for several years before he got his fall. LUCK kept him from under the wheels. The conductor called him several names and it did him a lot of good. He picked himself out of the dirt and asked the conductor why in the name of safety he had not called him those names BEFORE it happened!

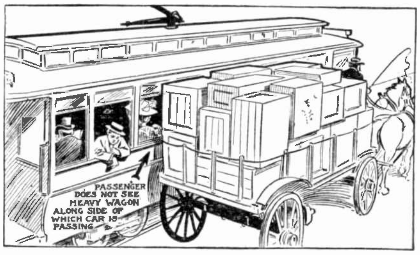
It's sure to happen in the long run. It may happen tomorrow. Call yourself the names today.



There was room inside the car—even on the platform—but these two men wanted to ride on the steps. It was risky for them to ride on the steps, anyway.

But some one wanted to get off and in the narrow space, without a chance to reach for the hand rails, this some one tripped forward and was hurt. It might happen exactly that way.

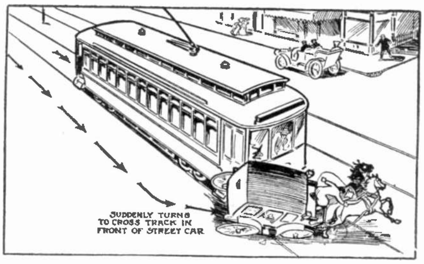
The steps are put on a car so that people can get on or off. When you stand on the steps you cause the Company some ANXIETY. But you cause the other passengers DISCOMFORT and DANGER. Suppose you are one of the other passengers? Then be cautious—wait till the way is clear, so that you can get off without a CONTORTION. Make it INCONVENIENT for the persons who insist upon riding on the steps.




A man who has lost his left hand by letting it hang out a car window always is careful to keep his right hand inside. Unfortunately he only has one HEAD. A wise head was never broken while it was thrust out a car window.

Some persons never can be convinced that a wagon, or fire engine, or some moving or stationary object is sure to appear sooner or later and spoil the view.

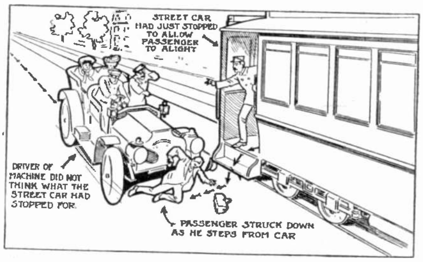
At least tell the children to keep their heads and arms inside. MAKE them do it.




This accident happens often in this country.

If you are driving a vehicle do not forget that our cars are running on tracks. Our motormen cannot turn aside. Look behind you before you run your vehicle sharply across our rails. Otherwise it will be your own fault that you are broken and torn.

If you are not driving yourself, tell your employee this. Caution him to look back. Perhaps some day your coachman or your driver of truck or delivery wagon will turn his vehicle so quickly across our tracks that no motorman could stop in time. Crash!

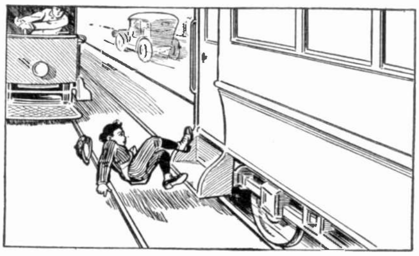



When an electric car stops some one usually gets off.

If you are driving a vehicle in the same direction that the car has been going and you are near the car, remember that the car has not stopped to let the passengers see the view.

Some one will probably GET OFF.

Slow down! NOT after you have run over one of our passengers who is alighting, but BEFORE.



The campaign that this company is making for the prevention of accidents can be assisted in no greater measure than by the warnings that parents and teachers give to the children against "stealing rides."

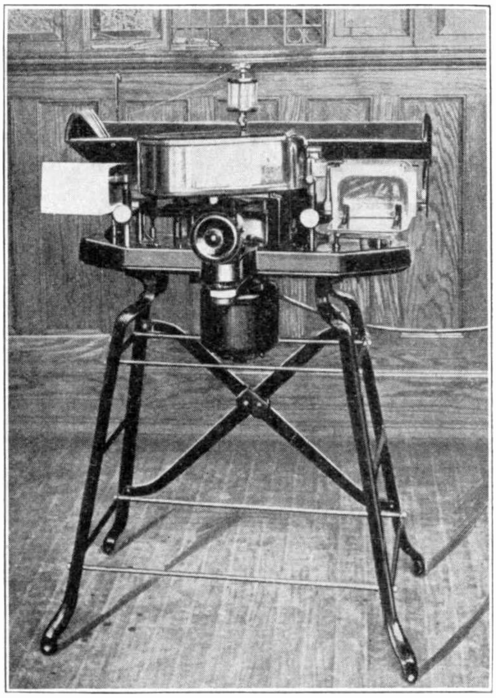
The accident illustrated here would not happen if you would warn the children—if you could prevent them from courting DANGER by jumping on our cars. They do it for fun—OR DEATH.

The conductor is the man who knows. You will not find HIS children "stealing rides."

**MAILING MACHINE.**

A labor and time saving device which finds a wide application in business houses, in handling the outgoing mail, is the electrically driven envelope sealer, stamper and counter. The machine will readily perform its various operations on 150 letters per minute, and may be speeded up to turn out considerably more when required.

The letters in bunches are held against an automatic feed which permits only one envelope at a time to pass its flap over a metal disk which revolves in water. As the envelope advances the stamps are fed forward, cut off, moistened and rolled upon the passing letter. After the envelope flap is moistened and the stamp simultaneously attached, the letter passes between a series of rolls under pressure, and then emerges and is automatically stacked. A counter records



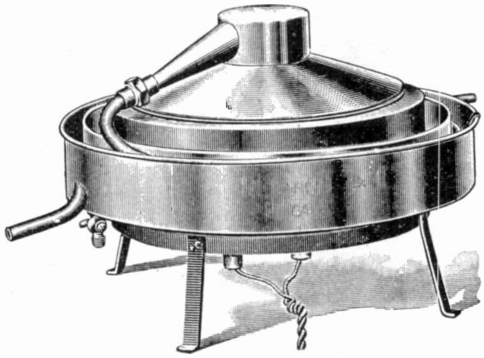
MAILING MACHINE.

each stamp as it passes upon the envelope, and thus furnishes a check upon the amount spent for postage. Moreover, the stamps cannot be removed from the machine except by the clerk to whom the key is entrusted.

The source of power being furnished by an electric motor, no labor is involved in the operation of the machine except the feeding of the letters in bunches. The motor is attached by a flexible lamp cord to an ordinary electric lighting socket, and to start the machine it is only necessary to turn the switch. A ⅛-horsepower motor will do the work, so that the charge for current is negligible.

**ELECTRIC WATER STILL.**

One of the latest applications of electric current in the laboratory is the water still. This device has a capacity of one gallon of distilled water per hour and



ELECTRIC WATER STILL.

operates on 110 or 220-volt direct or alternating current.

The device consists of a resistance element, superimposed on which is a very shallow retort properly insulated, so as to use up all the heat energy obtainable. The dome and the inside of the retort throughout are block tin lined. Surrounding the retort is a condensing trough into which cold water is allowed to run. The condensing tube leading from the retort is immersed in this trough, and has sufficient fall to deliver the distilled water rapidly. The water supply is allowed to come in at the bottom of the trough, and absorbs the heat from the condensing tube; the upper layer of water, therefore, being warm, is utilized for filling the retort, the excess being allowed to go to waste. In this manner the water is pre-heated, and 98 per cent of energy of the still is utilized.

# ANNEALING AND TEMPERING BY ELECTRIC FURNACE.

Best results in annealing and tempering can only be obtained by constant temperature in the furnace. Temperature requirements also vary and it is therefore essential that the heat be easily regulated. The large area exposed to the air by gas or coal furnaces permits rapid radiation of heat and consequently poor regulation, but the application of electricity has solved this problem.

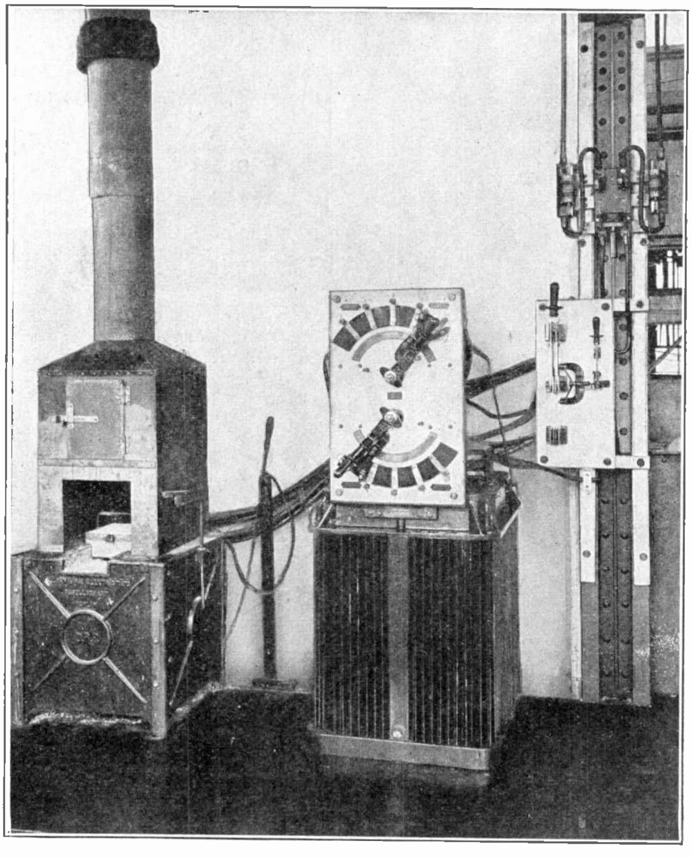


FIG. 1. ELECTRIC FURNACE AND TRANSFORMER.

In the type of electric furnace illustrated, which operates on alternating current, metallic salts are reduced to a liquid state by the heating effect of the current. When the salts reach a liquid condition the temperature can easily be regulated by varying the amount of current passing through the bath. Any temperature from 250 to 1350°C. may be obtained.

As shown in Fig. 1 the outfit consists of a furnace at the left, with hood suspended above; a regulating transformer in the middle, and a switch-board with current measuring instruments at the right. The regulating switch on the transformer is for varying the amount of current to the furnace.

Fig. 2 is a sectional view of the furnace. A fire clay crucible is surrounded by insulating material, such as asbestos, and rests on a fire clay box, all inclosed in the middle. Suitable electrodes enter opposite sides of the crucible and are connected by heavy leads one to each terminal of the low voltage side of the transformer, the function of the transformer being to take the ordinary lighting or power current and reduce its voltage to the proper amount to operate the furnace.

After the bath has reached its proper temperature, that portion of the material to be hardened is placed entirely in the liquid bath, and is allowed to remain there until it attains the same color as the bath, when it is removed and tempered in water or oil as the case may be.

The bath for hardening or annealing completely fills the crucible, and may consist of equal portions of barium and potassium chloride. The ultimate temperature depends on the relative proportions of the two chlorides, the higher the percentage of barium chloride, the higher the temperature may be carried.

In addition to hardening, the furnace

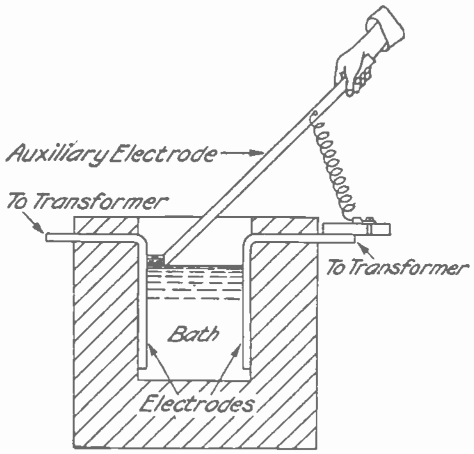



FIG. 2. CROSS SECTION OF ELECTRIC FURNACE.

may be used for softening tempered steel, the bath being maintained at a temperature of about 250°C. for this work.

## LONG TRANSMISSION LINE FOR SMALL POWER.

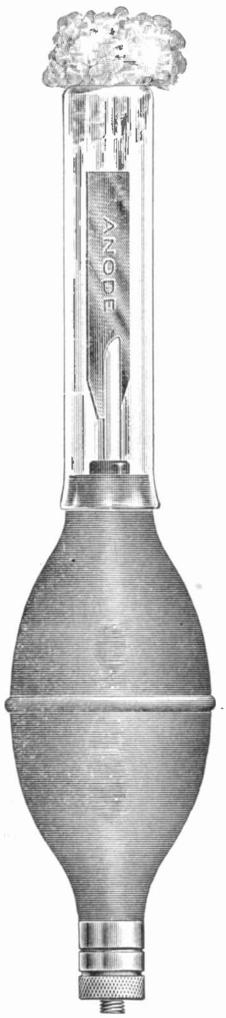
The Famatina Development Corporation, which is interested in the development of copper mines near Chilecite, Argentine, is installing a hydro-electric plant and transmission line to carry the power 20 miles away to the mines. This installation is interesting from the fact that only 100 horsepower, and ultimately twice this amount, are to be transmitted over such a comparatively long line. The expensive line was made necessary by the scarcity of fuel in that region.

## ELECTROPLATING WITHOUT IMMERSION.

It is sometimes desirable to electroplate a part only of some object, or the character of the object is such that it is impracticable to immerse it in the solution. The "sponge plater" makes this work easy of accomplishment and the result is very satisfactory.

The device consists of a split anode holder in a glass tube, a sponge being inserted in the open end of the tube and the other end of the tube bearing a rubber bulb with which to produce suction in the tube.

To operate the sponge plater connect the positive terminal of the battery or generator to the terminal at the bulb end and the negative to the article to be plated. Slightly compress the bulb, dip the sponge into the solution and draw enough up into the tube to partly im-




ELECTROPLATING DEVICE.

merse the anode. Now if the sponge is applied to the article to be plated, deposit will immediately take place. The sponge is kept saturated with solution while in use, by slight compression of the bulb.

Anyone who can plate in the regular way can use the sponge plater and the usual plating solutions are employed.

# ELECTRIC LIGHT IN A CITY'S UPBUILDING.

BY JOHN M. CONNELLY.

**That Denver has become widely known as "The City of Lights" is the result of strictly educational methods employed by the local lighting company through advertising and solicitation. The people of Denver take just pride in this name which has been applied to their city, and instead of a feeling of hostility toward the lighting company, which was once prevalent, enthusiasm is now the rule, over any movement that purposes the intelligent unfolding of the advantages of electricity. The story of this "change of heart" is an interesting one.—Editorial Note.**

Not so many years back it took a good deal of courage and indifference to ridicule, to seriously contend that electric light used liberally by the business men and government of a fair-sized municipality, could be made to play a prominent part in its upbuilding. The electric sign was here, but there were few who thought its influence extended much beyond the limits of its aggregate candle-power, and fewer still who cared to bare their convictions on the efficiency of an advertising medium not yet thoroughly tested.

One of the best all-around tests ever given electric light to prove its many-sided value for advertising, had its inception and setting in Denver less than a decade ago. A young man given to the scientific world by the state that has supplied the country with so many presidents, went to Denver to rehabilitate the decaying affairs of a broken-down light company thoroughly despised and cordially cursed by an irritated public and hostile press. It was an Herculean task to face, and to meet it successfully required a great intellect. To turn the flank of an overwhelming public prejudice is a strategical feat not easily or often accomplished, but Henry L. Doherty, the youthful president of the reorganized Denver Gas and Electric Company, displayed his abilities as a tactician by saving a serious situation. He is endowed with that rare power of "spotting" the psychological moment with clock-like precision, and has a secret service instinct when it comes to penetrating any disguise in which opportunity may masquerade.

HENRY L. DOHERTY.

Just about this time Denver was beginning to poke her head above the ruins of the '93 panic. The spirit that raised a great city on the plains at the foot of the Rockies gave signs of life and the chaos created by the blow of hard times was lifting. Back came the fervency of the old enthusiasm born of the knowledge that Denver is the heart of an empire stored with inexhaustible wealth, and the timidity of a panic-stricken people vanished before a lusty movement to boost the advantages of the city and state.

Mr. Doherty discerned in this awakening his opportunity and he was quick to strike with a "great idea" at the psychological moment. Given the mark to shoot at and what you want the shot to do, you need the right kind of ammunition and the proper brand of firing piece. At this time a controversy was sizzling with reference to restrictions on the hanging of electric signs and Mr. Doherty used a letter on this subject to the city authorities as a 13-inch gun to fire his "great idea." It is entirely original in corporation annals and has reached the stature of a classic in the electrical world. Here is the gist of it:

"The whole West stands for progress and originality. Denver is the most progressive city of the West and is the best known. The whole country is interested in Denver, for we have given health back to people from every state. Denver's population is made up from every state in the Union, and these people are in active touch with the people of their old homes. Let them have something distinctive about which to boast of Denver's progressiveness, and we will attract people here to invest in Denver's industries and real estate, because we are known as enterprising people. Denver's motto, 'Forward,' would be merely a pitiful joke, if some people's views were general. Does Denver live up to her motto? The motto is an ambitious one. It means progress, and progress does not spring from inaction. This company by its work can make Denver known as the 'City of Lights.' We can help make Denver's motto truly fit.

"When the promoters of the Pan-American Exposition wanted to attract the attention of the whole world, they did not depend upon parks and boulevards. They used *lights* and *lights,* and lots of them. They had to spend millions for buildings and ground improvements, but the few dollars spent on lighting were what made the tongues of the whole world wag. We have put more lights on Denver's streets in the past three years than the entire number of lights on the electric tower at the Pan-American Exposition.

"What display lighting does for expositions, it will do for Denver. If you can attract visitors to these international expositions and make the whole world advertise them by the liberal use of lighting, you can do the same thing for Denver. These expositions pay many thousands of dollars for this lighting. Denver as a city is not asked to pay anything. Her merchants are perfectly willing to do this. Liberality in electric sign regulations is necessary.

"There are some people who do not want to progress, who have not enough civic pride to want to see their own city go ahead. They are holding back for fear of spending a few dollars. They see their neighbor go ahead and they at once have a protest to make. The attitude of these people is diametrically opposed to the sentiment of Denver's motto.

"There is another class that does not know what progress means. The atmosphere of their minds is ethereal and they have learned none of the lessons of building up industries and commerce. They are commercially anemic. I may not be entirely able to divorce myself from a prejudicial viewpoint. I am a believer in light, the same as the promoters of expositions, and for the same reasons. They may be radical and may not have the true sense of art, but they are builders and their work is synonymous with Denver's motto. I have tried to be unprejudiced and I have tried to look at the question from a citizen's viewpoint. I am forced to look at it at times from the viewpoint of a responsible representative of a large public industry, whose future depends almost entirely on the future prosperity of this city.

"I have also said to myself, 'What would I do if I were mayor of Denver?' And my best judgment has answered: 'If I were mayor of Denver I would say, I want to make Denver the best lighted city in the world.' If light can make expositions attractive; if it can draw people from all over the world; if it can make people wonder and can make the tongues of the world wag; then 'me for *light*' and lots of it. When Mr. Out-of-date and Mrs. Artistic Newlyrich protest, I would say that Denver is a commercial center; it is the 'Queen City of the Plains'; its motto is 'Forward,' and we are going to live up to our motto. If Denver can be made the talk of the country by the development of display lighting, then me for light."

The sentiment expressed by Mr. Doherty was echoed by the Denver Post in the following editorial: "What was the deepest impression everybody brought from the World's Fair at St. Louis? The illumination! Let all answer, who visited the great exposition: 'What does your pleasantest memory recall, above everything else beautiful and impressive?' The lights!

"The lesson is invincible. Denver is already known as the 'City of Sunshine.' And it can be made world famous as the 'City of Lights,' by encouraging private electrical illumination. The electric sign represents a tremendous opportunity for Denver.

"Of course, the object of the electric light company is selfish, but it is the kind of selfishness we want more of. Civic pride and municipal progress are based upon reaping material advantage, just as the merchant, who invests in a beautiful electric sign, does so to advertise his business, but, while advertising his goods, helps to make the city attractive."

And then sounded the slogan, "Boost for the City of Light," and a wave of public opinion of resistless force swept aside all opposition to lavish illumination. Famed before as a city of sunshine, Denver now made a marked impression on account of its picturesque private and public lighting. It now feels that its claim to the title of the "City of Lights" is indisputable, and its citizens are convinced that all the title implies has been a wonderful force in the upbuilding of the new Denver.

All of this tells the story of a great idea worked out with marvelous success by electric light. Incidentally, the once despised light company is now lauded for the great work it performed in connection with Denver's richly productive booster movement.

## BUTTER MADE BY ELECTRICITY.

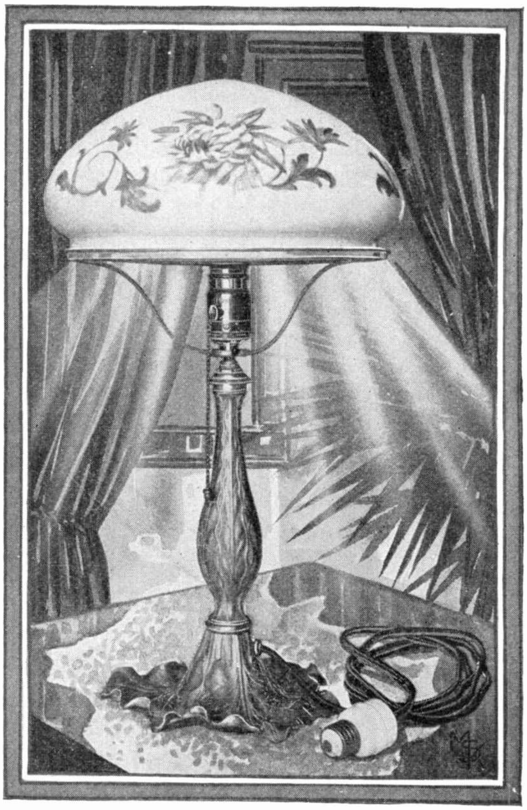
A process of butter making by means of electrolytic action on cream has recently been patented by George V. Frye and Frank B. Hinkson, of Lexington, Ohio.

Stated briefly, the process consists in the massing of butter globules on the positive electrode, which is suspended opposite the negative electrode in a receptacle containing cream, previously cooled to counteract the heating effect of the current. The electrical current not only collects the butter globules in suspension and in solution, but it also has a "ripening" action necessary to proper butter making.

After the electrolysed butter is collected it is worked mechanically to give it the usual marketable form. The process is claimed to produce butter of a superior quality and without waste.

## SOME NEW LAMP FIXTURES.

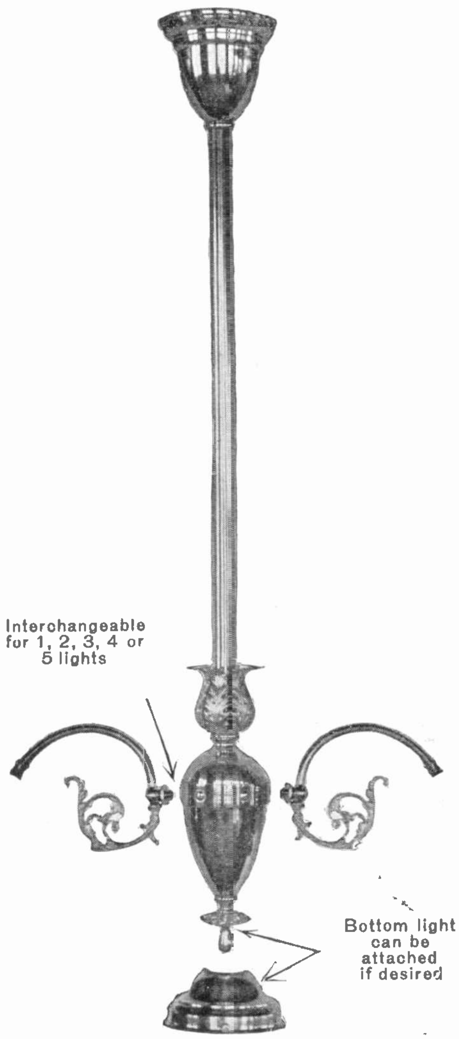
Artistically designed lamp fixtures are an important adjunct to the interior decorations of any room. From the multitude of designs of electric fixtures and portable lamps now on the market, embodying a great variety of sizes and materials, it is possible to select a type that will exactly fit in with the general scheme of decoration in almost any interior. Most large department stores now keep electric fixtures, and they are also obtainable from electrical supply dealers, contractors, or from electric light companies.



AN ARTISTIC TABLE LAMP.

Two very appropriate designs are illustrated one a portable lamp and the other a new type of electrolier. The portable lamp embodies in the design a base of cast brass in the form of a palm leaf, surmounted by an artistically designed post carrying a standard threeprong dome holder. The dome is of straw opalescent glass, roughed inside to give a sunlight effect. The metal work is finished a Pompeian green, and a green silk extension cord is provided, with plug and pull socket.

The electrolier is a new idea in the fixture line and is so arranged that any number of lamp arms from one to five




INTERCHANGEABLE ELECTROLIER.

may be used. The fixture body is provided with removable screws, properly spaced, for fastening the arms in place. The bottom finishing ornament, holding the lower half of the body, is so arranged that a cord may be passed through it for a pendent switch or it may be utilized with the use of a holder for an additional bottom light instead, carrying either dome or ball as required.

The result is that with this line the local dealer in the smaller towns may purchase a limited number of stems and arms and make up a multiplicity of designs according to cost or effect to suit the customer. This enables the contractor to complete his wiring job without delay as is usually made necessary by awaiting receipt of the fixtures from the factory. For instance, an assortment of stems, arms and holders will make an approximate ninety-nine possible combinations.

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**ADVANTAGE OF PRACTICAL TRAINING.**

Mr. H. H. Norris, professor of electrical engineering at Cornell University, thinks that the average man prefers to work with his hands rather than with his head; for example, a student will usually take more interest and pleasure in building and testing a motor than he will in calculating accurately what the torque in that motor will be when the machine has certain physical characteristics. Again, students lose interest in theory when they become very much absorbed in practical work; that is, they seem to like the practice better than they do the theory. Therefore, in technical training there should be included just enough practice to produce facts to think with, and no more; just enough facts to furnish the material for organization.

Dr. C. P. Steinmetz, professor of electrical engineering in Union University and one of the world's greatest electrical engineers, showed his broad-mindedness in a recent technical discussion on the training of electrical engineers, by the following statement:

"We must not forget, however, that the college is not the only educational institution. There are other important educational institutions for electrical engineers. There are trade schools and correspondence schools. They do work the importance of which many of you do not appreciate, work of the highest value, and I want to speak here for them and draw attention to them so that we may give them proper recognition."

# MEASUREMENT OF HIGH TEMPERATURES.

Standing before some raging furnace or retort we are told, perhaps, that the temperature of the fiery interior is 2,000 or 3,000 degrees Fahrenheit, or even more. The heat is terrific and almost blinds us even at a considerable distance.

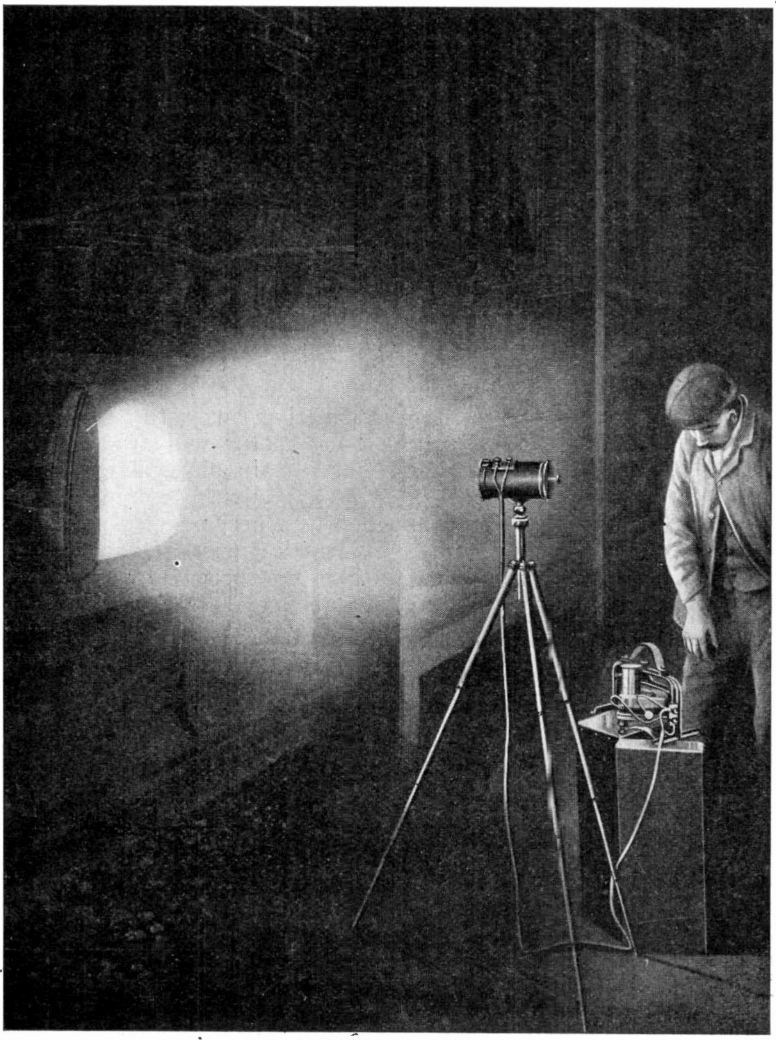


FIG. 1. RADIATION PYROMETER IN OPERATION.

So we are inclined to wonder how it is that these high temperatures are measured, when one breath from the white hot mass would melt an ordinary thermometer as if it were an icicle.

To know the temperature of such furnaces is essential in many industrial processes where great heat is employed, as in glass making, the manufacture of porcelain, etc. These temperature determinations are variously made, sometimes by thermo-couples, as they are called, placed in the hot body; that is junctions of two different metals which when heated cause electric current to flow in a circuit in which they are included, which current is then measured. Sometimes Segar cones of fusible clay are used by potters. These melt at a certain temperature, but they must be carefully watched and even then indicate indifferently only one given temperature.

Pyrometers are the best instruments for indicating high temperatures. Two such instruments are shown in the illustrations and their operation is very interesting.

Fig. 1 shows the Fery radiation pyrometer, which, when pointed toward a hot body, gives continuous automatic readings of temperature. It will even measure the temperature of steel billets passing through rolls in a steel mill, and that without stopping the rolls.

To understand the working of the instrument it is only necessary to remember the following facts:

All bodies radiate heat to their surroundings and the amount of heat radiated increases so rapidly with rise of temperature that it can be felt even before the body is hot enough to give out light. Heat rays can be reflected and brought together at a focus just as light rays can, so that where a concave mirror brings light to a focused image there is also a "heat image" at the same spot. The well-known burning glass which is used to set fire to a piece of paper by focusing heat rays from the sun is an example of this. The same thing that is done by a lens or burning glass can be done better by a concave mirror, and for that reason a mirror is used in the radiation pyrometer.

If two different metals are joined together and their junction is heated there will be an electrical pressure at the junction, and this pressure will cause a flow of current if an electrical circuit is provided. The more the junction is heated the bigger will be the current, the current always being in direct proportion to the temperature. This device is called a thermo-couple, and the place where the two metals are joined together and heated is called the "hot junction." The place where the two metals are joined to the rest of the circuit is called the "cold junction," and it is the difference in temperature between the hot and cold junctions that causes a current to flow.

The heat rays given out by a hot body fall on a concave mirror in the pyrometer telescope and are brought together to a focus. At this focus is the hot junction of a thermo-couple, and this junction is heated by the focused heat rays, the hotter the body the hotter the junction.

To guide the pointing of the telescope an eye-piece is provided, through which the reflected image of the hot body may be seen.

The indicating outfit that goes with the pyrometer contains an instrument like an ammeter for measuring electric current. This indicator is connected by wires to the circuit containing the hot junction. The scale on this instrument is, however, calibrated to read in degrees instead of amperes, therefore the needle on the scale at all times shows the temperature in degrees Fahrenheit of the hot body.

An interesting, self-checking pyrom-

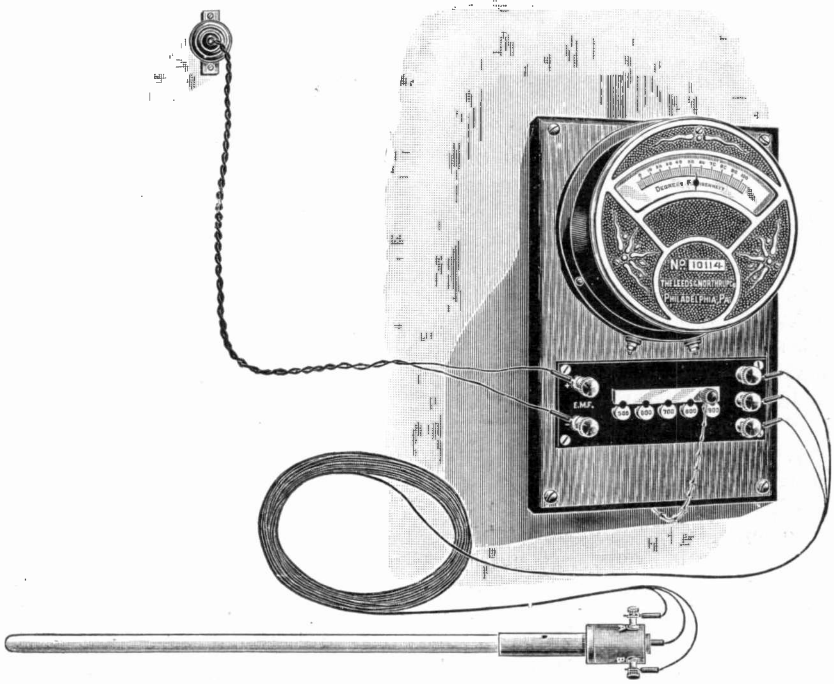



FIG. 2. A SELF-CHECKING PYROMETER.

eter, radically different from previous types, is shown in Fig. 2. It is especially intended for use where it is desired to hold the temperature of an oven, vat, etc., at a given value.

This pyrometer consists of two parts: the bulb or fire end and the indicator. The bulb consists of a porcelain or quartz tube, protected by a seamless nickel tube and containing a coil of platinum wire.

The indicator consists of a Wheatstone bridge mounted in the base of a

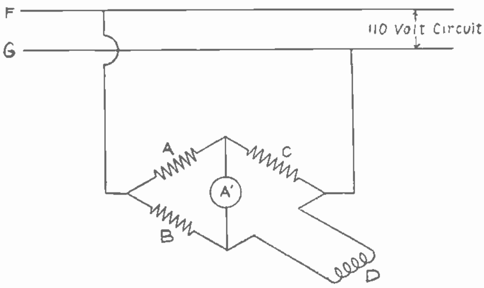



FIG. 3. SHOWING APPLICATION OF WHEATSTONE BRIDGE TO PYROMETER.

regular switchboard type ammeter. The ammeter may be connected to an ordinary 110-volt direct current system.

Fig. 3 shows the principle of the Wheatstone bridge as applied to the pyrometer. (F) and (G) are the 110-volt mains. In one of them is located the bridge (A), (C), (D), (B). (A) and (B) are known constant resistances, (C) is a known variable resistance and (D) is the unknown resistance, in this case the coil of platinum wire in the furnace.

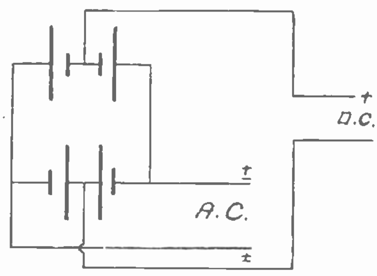
If (A), (B), (C) and (D) are all equal in resistance the current will divide equally in the branches (AC) and (BD) and none will flow through the ammeter (A') and it will not indicate. If the resistance of (D) increases some current will flow from (B) through the ammeter through (C) and out, causing a deflection of the needle. It will readily be seen, therefore, that the ammeter scale may be marked off in degrees of temperature so that the changes of resistance of (D) due to the temperature in the furnace may be indicated in degrees of temperature on the scale. The fundamental principle of the bridge precludes any errors through fluctuation of the voltage in the main circuit (G), (F).

The bridge is arranged so that the variable resistance (C) may be increased and balanced up against (D) at the middle point of every 200 degrees of its range. If, for instance, the instrument is off calibration three per cent, the error in the temperature reading will be three per cent of 100, or three degrees, anywhere on the scale. At 1,800 degrees, for example, it would still be three degrees, if properly balanced. Without the balancing feature the error in 1,800 degrees would be three per cent of 1,800 degrees, or 54 degrees.

## CHEMICAL RECTIFIER.

In the Question Box of the National Electric Light Association Bulletin the question was asked: Is there a chemical rectifier designed to operate on 110-volt alternating current and to change the same to direct current suitable for operating a one-sixth horsepower motor? G. W. Barlow of South Bend, Ind., offered the following solution of the problem:

Take four ordinary battery jars and fill them with a saturated solution of water and borax, or bicarbonate of soda. Then get four pieces of ordinary stovepipe or, better still, an equivalent of




Long Lines:- Iron or Lead
Short Lines:- Aluminum.

sheet lead one-quarter inch thick. Next, get four pieces of aluminum of about one-tenth the surface area of the stovepipe or lead, and arrange so that they can be raised or lowered; also removed entirely when not in use. Connect as shown in the diagram.

When using iron, if it does not start at first, soak the iron in a strong solution of common lye until the grease is cleared off. The ratio of transformation will be about 110 to 95, and the direct current can be readily reduced to proper voltage by the use of lamps or water resistance. Fuse up to 15 amperes on the alternating-current side before starting.

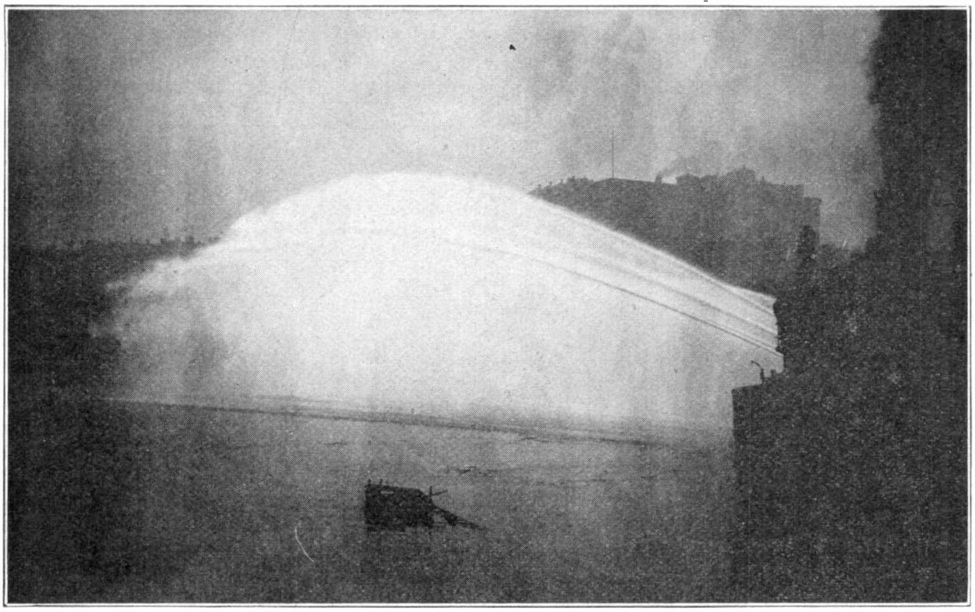
Such a rectifier will be found equal to a small mercury rectifier for ignition battery work and small batteries in offices of dentists and physicians, and in household service. It heats a trifle and needs a little attention, but is cheap and efficient.

# FIRST ELECTRIC FIRE BOATS IN THE WORLD.

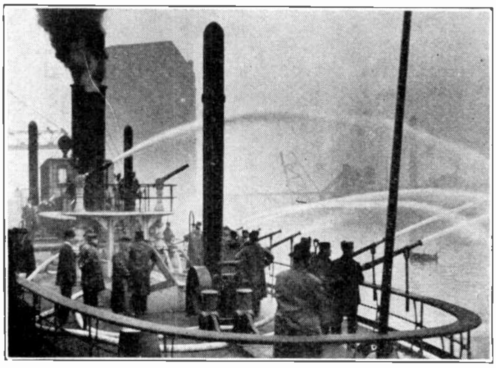
They are the first electrical fireboats in the world. They are the largest and most powerful fire boats in the world and the first centrifugal pump boats to be used on the great lakes. They are the first fire boats to be driven by electric propulsion. They are the first turbine driven boats in the world to be electrically controlled from the pilot house. The engineer answers no bells. The captain controls the screws from the pilot house, going ahead or back on either or both at any speed, entirely independent of the engineer. These are the interesting characteristics of the two new twin fireboats in Chicago, the Joseph Medill and the Graeme Stewart—"Dreadnaughts" among the fire fighters of the world.

In the design of these boats the power is applied in a unique manner. On one shaft is a powerful steam turbine, an electric dynamo and a centrifugal pump to throw the water. The dynamo in the middle generates electricity which is carried to electric motors to run the boat. The centrifugal pump at the left pumps the water for the fire streams. The steam turbine at the right operates them both.

A peculiar set of conditions made the above arrangement desirable. The Chicago River is crossed by bridges every block or two, which must be opened for the passage of the boats, so that high speed is out of the question. It was considered, further, that a combination of circumstances requiring full power on the fire pumps and full power on the propelling motors at the same time for any protracted period is practically impossible, and that if, while the boat is pumping water to her full capacity, the



ELECTRIC FIRE BOAT IN ACTION.



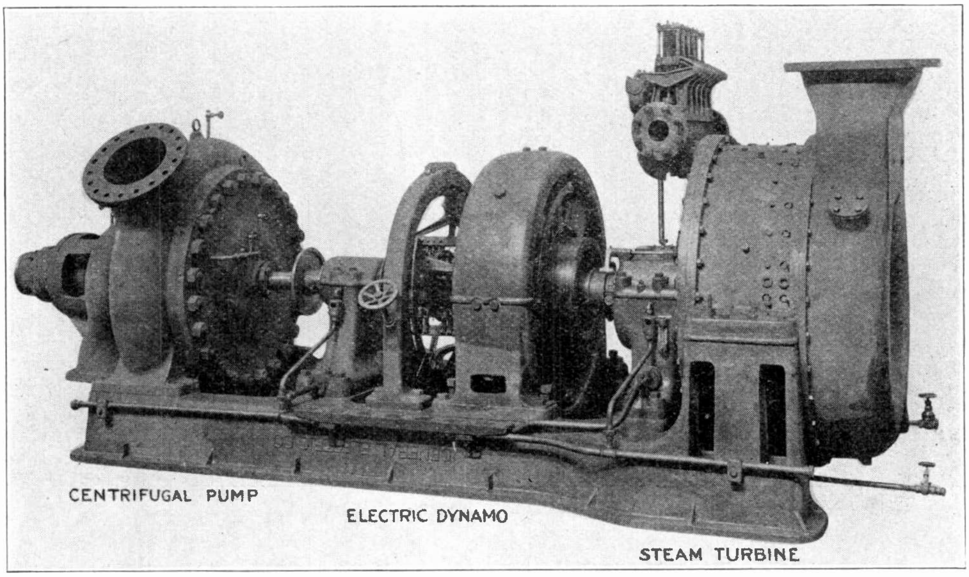
ON DECK OF A FIRE BOAT.

motors are called into service to change her position slightly, the turbines will easily stand the temporary overload.

It was for this reason that the electric propulsion was decided upon. The turbines were there, anyway, for the fire-pumps. If ordinary steam engines were used for propelling the boat, it meant two more engines, with four cylinders, valves, shafts, rods and all the complicated working parts to take care of and keep in repair. Adding the generators and motors, which practically require no attention at all, the engineer is even relieved of the necessity of answering bells and operating engines as usual.

When the boat is lying at her station, under banked fires, waiting for an alarm, the sea cocks are closed and the pumps drained of water. When an alarm comes in the engineer has only to start his turbines, circulating and air pumps. The captain starts the propelling motors, and on the run to the fire, the power of the turbines is used for running the boat only, the impellers of the fire pumps turning freely in the casings and doing no work. On arrival at the fire, all the engineer has to do is, without stopping the turbines, to open the sea cocks and turn water into the pumps.

If the boat ever has to go into rough water, there can be no racing of the screws, the speed of the motors being constant for whatever voltage is being used; this being governed by the controller. Another advantage is that, if a sudden strain is put upon the shaft by the propeller striking heavy ice, or running against dock piles or other obstructions which are frequently encountered in the confined spaces in which the boats must work, the circuit breaker is automatically thrown out, instantly taking off the power.




COMBINATION STEAM TURBINE, DYNAMO AND PUMP ON FIRE BOAT.

Each steam turbine is of 660 horsepower and there are two on each boat. The pump connected to each will deliver 9,000 gallons of water at 150 pounds to the square inch. By branch pipes, properly fitted, the discharge of one going into the suction of the other, the pumps may be operated in tandem, throwing 5,000 gallons of water a minute at 500 pounds pressure.

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### APPLICATIONS OF SMALL STORAGE BATTERIES.

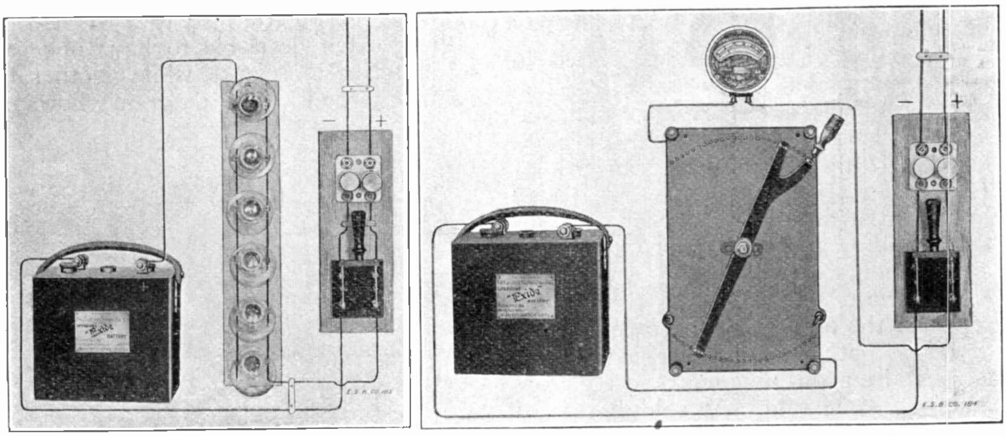
Storage batteries or accumulators or secondary batteries, as they are variously known, are extremely useful in electrical work, for they afford the only means of apparently "storing" electricity; that is, putting current into the device in time of plenty and taking it out again in time of need, or putting it in in one locality and carrying it to another for application.

When the accumulator was still in the experimental stage in 1881, enthusiasm was aroused by the fact that Sir William Thomson, afterward Lord Kelvin, received in Scotland a "box of electric energy" charged by Faure in France. This, seemingly made electricity portable; it was put into the battery cell in Paris, as one would put clothing into a traveling bag, and taken out for use in Glasgow.

Really the electricity is not actually stored when the current is applied to the cell (a battery, strictly speaking, consists of two or more cells or units). certain chemical changes are set up. This is "charging" the battery. When charged, if the proper electrical connections are made, current will flow or discharge from the battery as the result of chemical action. Not the same literal electricity is taken out as is put in. But, as Mr. Kipling would say, that is another story.

Large storage batteries are used in electric light, power and railway work. but there is also a wide field of application for small accumulators. The batteries make available many electrical appliances where other sources of current are not at hand. They operate electric fans, railway signals, motors for phonographs, sewing machines and other purposes, interior telephone and fire-alarm systems, telegraph circuits, bell circuits, portable electric lamps, carriage lights, small motor boats, Christmas tree decorations, sparkers for automobile or other gas engines, etc. For some purposes, as in laboratory work the steady storage-battery current is preferred even when other sources are available.

Of course some means of charging the cells must be available, and it is to be remembered that only direct current can be employed for this purpose. If the source of supply is alternating current, some means, as a "mercury rectifier," must be used to change it to direct current. If the cells must be taken to the charging source, the portable battery is, of course, necessary. In this type the "elements"—that is, the positive and negative plates, properly arranged—are sealed in rubber jars and placed in a wooden case with a handle. For small stationary batteries glass jars are generally used.



With Lamps in Circuit. With Rheostat in Circuit

METHODS OF CHARGING STORAGE BATTERIES.

The electromotive force of a storage cell is usually figured at two volts; it is about that at the beginning of discharge, but the voltage runs down to about 1.75 at the end of discharge at the normal rate. If the battery is discharged fas-

SMALL PORTABLE STORAGE BATTERY.

ter than the normal rate, the voltage will be somewhat lower.

Capacities of batteries are stated in ampere-hours at given rates of discharge. Thus, a cell of a certain size may discharge at ¾ ampere for eight hours. It therefore has a capacity of (¾ × 8) six amperes-hours; or it may discharge at the rate of 1½ amperes for three hours, giving a capacity of 4½ ampere-hours. One rating is at the 8-hour rate; the other at the 3-hour rate. If the battery has been completely discharged at the 8-hour rate, it will usually require about nine hours to recharge it at the same rate. At a high rate of discharge a battery is not completely exhausted, and it is necessary to restore only what has been taken out in ampere-hours, plus a small surplus for losses.

The simplest method of charging is from a direct-current incandescent lighting circuit, using lamps connected in parallel to reduce the voltage, the current being adjusted by varying the number of lamps. The lamps are in series with the battery. If the charging source is a 110-120-volt circuit, and the charging rate five amperes, 10 16-candlepower or six 32-candlepower lamps in parallel, with the group in series with the battery, will give the desired charging rate. The connections are shown in one of the cuts on the preceding page.

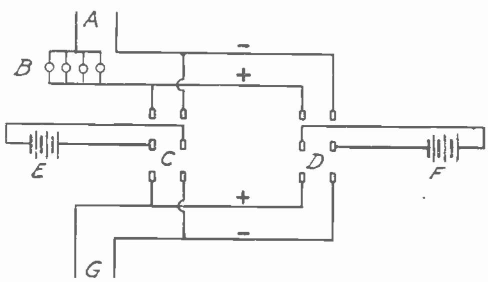
Instead of lamps, a rheostat is sometimes used, as shown in second cut. Its resistance should be such as to produce, when carrying the normal charging current, a drop in voltage equal to the difference between the pressure of the charging source and that of the battery to be charged. Thus, if a battery of three cells, requiring a maximum of about seven volts to charge, is to be charged from a 110-volt circuit at a 5-ampere rate, the resistance to be provided would be, according to Ohm's law, which is:

$$C = \frac{E}{R} \text{ or } R = \frac{E}{C},$$

$$\frac{110 - 7 \text{ volts}}{5 \text{ amperes}} = 20.6 \text{ ohms.}$$

The carrying capacity of the rheostat should be slightly in excess of the current required. The voltage required for charging varies from 2.4 to 2.7 volts.

It is often desirable to have one set of batteries in service while another is being charged. The diagram shows a




CONNECTIONS FOR TWO SETS OF BATTERIES.

convenient arrangement for accomplishing this. (A) represents the source of current and (B) the lamps or other resistance. (C) and (D) are knife switches connected as shown to batteries (E) and (F). (G) represents the connection to the apparatus supplied with current by the batteries. By throwing the switches in opposite directions one battery will be charging while the other is discharging.

Always connect the positive wire of the charging source to the positive terminal of the battery and the negative wire of the charging source to the negative terminal.

## GETTING A LIGHT.

Since the beginning, fire has been the most sacred possession of man. Fire came with the very beginning of civilization. It was worshipped by the men of the East and the half-savage Aztecs and Incas of the West. In this modern electrical age, when the simple turning of a switch gives immediate light or heat, it is interesting to follow the history of the primitive methods of "getting a light."

In ancient days it was very difficult to obtain fire and among the savages men were tolled off to tend the fires and to carry the live coals from place to place. Many of the American Indians could not make fire at all and either obtained their sparks from neighboring tribes or from trees struck and fired by lightning. Once the fire was obtained it was never allowed to go out. Other savage tribes produced fire by friction. The fire drill, used by American Indians of the North, which whirled a pointed stick of hard wood in a shallow crevice of a dry block of softer wood, was a good source of fire so long as it was kept dry. The drill revolving with great rapidity raised the temperature of the wood dust in the crevice until it burst into a flame.

Then came the flint and steel which proved the handiest way of getting a light for hundreds of years. Even in the memory of some of the older folk of today the flint and steel were in daily use. When it was found that a bit of jagged flint, struck with a piece of steel, would emit a shower of bright and intensely hot sparks, then fire building became easy. Sparks from the flint would set fire to tow, to charred rags, to gunpowder or to most any combustible material.

The first matches were made of thin strips of highly resinous or dry pinewood, about six inches long, the pointed ends of which were dipped in melted sulphur; thus prepared, the sulphur points easily ignited when applied to a spark obtained by striking fire into tinder from a flint and steel. Then someone invented the "instantaneous light box." This consisted of a small tin box containing a bottle, in which was placed some sulphuric acid, with enough fibrous asbestos to soak it up and prevent its spilling, and a supply of properly prepared matches. These primitive matches consisted of small splints of wood about two inches long one end of which was coated with a chemical mixture, prepared by mixing chlorate of potash, six parts; powdered loaf sugar, two parts; powdered gum arabic, one part; the whole colored with a little vermillion and mixed with water until it became a thin paste. The splints were first dipped into melted sulphur and then into the prepared paste. They were really made to burn by dipping the prepared ends into sulphuric acid.

In the year 1823 a peculiar match was introduced. Phosphorous and sulphur were carefully mixed in a glass tube tightly corked. A splinter of wood was slipped into the tube, a small portion of the mixture was drawn out, and when this was exposed to the air it ignited and set fire to the wood. John Walker, a druggist in England, invented the first really practical friction matches, giving to them the name of "Congreves." They were of thin strips of wood, or cardboard, coated and dipped with sulphur and tipped with a mixture of sulphide of antimony, chlorate of potash and mucilage. But they cost 25 cents for seven dozen of them.

It was not until about the year 1833 that the friction method of obtaining a light began to be developed, and friction matches came into use.

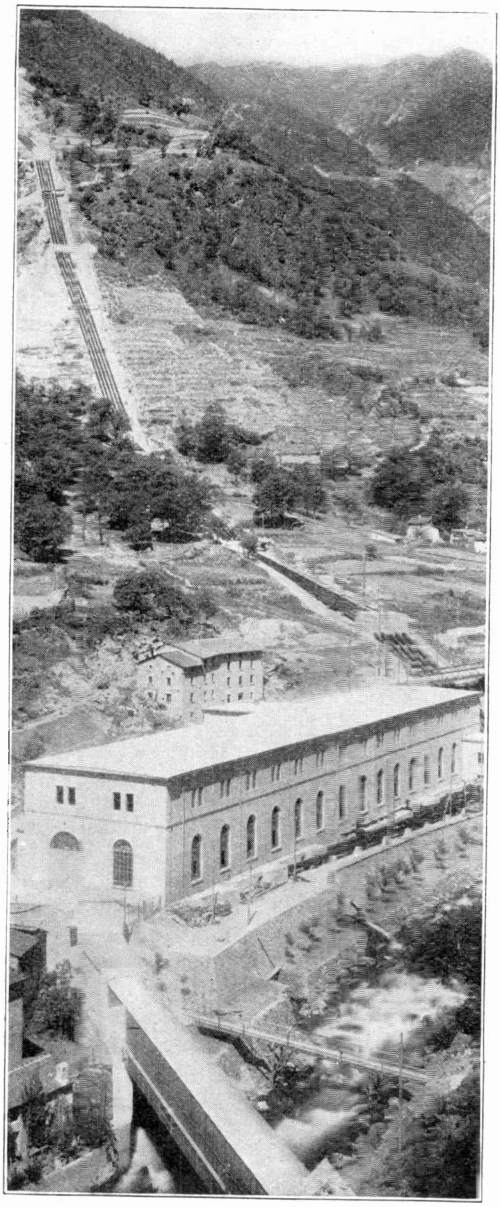
But even matches, so common today, are being superseded by electrical devices. Electric cigar lighters are provided at cigar stands as a substitute for matches which take too much time. The electric lights are rapidly superseding the old oil and gas lamps, which require matches, and even the faithful old cook stove is being replaced with an electric cooking outfit which produces plenty of heat without fire or flame and without matches or fuel. The electric cigar lighter, which is the very latest method of obtaining a light, consists primarily of a few turns of German silver wire stretched behind a non-conducting screen of mica or embedded in heat resisting cement. Electricity passing through this wire makes it red hot which in turn heats the screen or cement.

# THE "WHITE COAL" OF SWITZERLAND.

The people of Switzerland are noted for their thrift and ability to utilize to the last degree the available products of their country. But in the matter of fuel they have always been dependent upon outside sources, and to them "coal bills" have been a matter of serious concern. Fortunately, however, they had in their own beautiful Alps a substitute for coal which the developments in electricity in the last few years have placed at their disposal. This substitute is hydroelectric power—the "White Coal" of Switzerland.

Throughout the mountains of Switzerland are glacier-fed lakes which have been the admiration of sightseers for centuries. These lakes, situated as they are at great altitudes, are every one a source of potential energy, waiting only to be tapped by man to pour out their wealth of power. Electric power thus generated is now used very extensively in the operation of Swiss railroads and in the manufacturing industries.

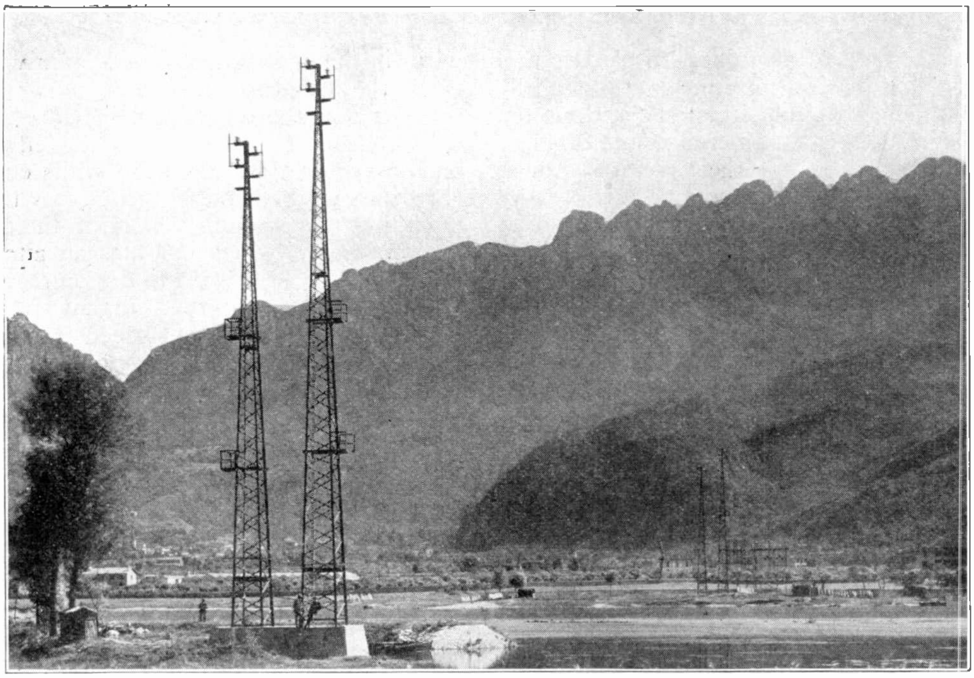
One of the notable power developments is the Brusio-Campoclogna plant, supplied by Lake Pochiavo over 3,000 feet above the level of the sea. There is a tunnel carried through the mountain leading from the Lake Pochiavo headrace to a collecting basin, and the water is carried through penstocks under a head of 980 feet to the power plant located at Campocologna. The headrace tunnel is 25 feet below the normal water level of the lake, a siphon being utilized for connecting the tunnel with the lake instead of directly with the lake bed.



ORIGIN OF THE "WHITE COAL."

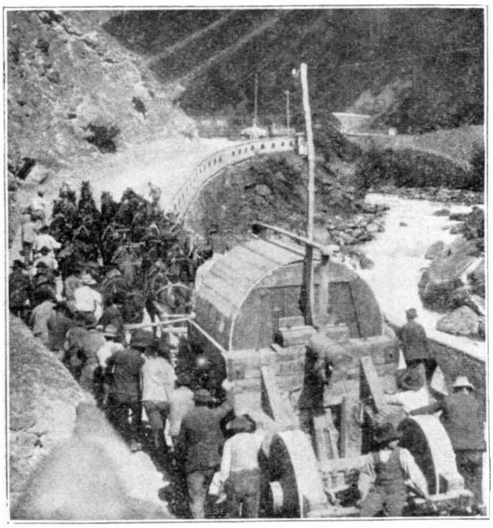
The five great penstocks, which bring the water down the mountain from the tunnel, terminate in the power plant at the foot of the incline, and the force of the water coming from such a height is sufficient to generate 48,000 horsepower.

The dynamos in the power house deliver electric current at a pressure of 7,000 volts. This pressure is, however, not sufficient to transmit the electricity over the long distance which it is to be carried before it is turned to useful work, so transformers are used which raise the pressure to 50,000 volts. Current at this pressure is carried by a transmission line through nearly 100 towns and across three provinces. The towers which carry the conducting wires are of steel lattice work. There are over 3,000 of them and they weigh from 1,500 to 2,800 pounds each.



ELECTRIC TRANSMISSION LINE IN SWITZERLAND.

Owing to the fact that the generating plant is not located on a railroad line the heavy machinery was hauled over the mountain roads by teams, part by part. One of the pictures shows a massive armature being drawn to its destination, 20 horses being required to accomplish the task.



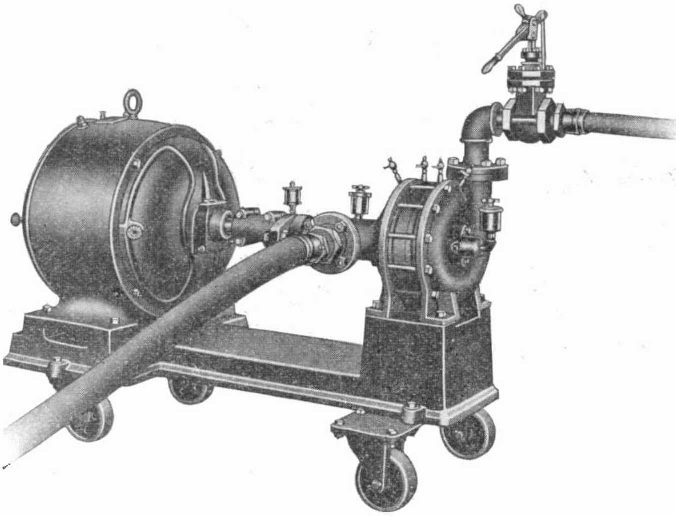
HAULING ELECTRIC MACHINERY THROUGH THE MOUNTAINS.

**PATENT OFFICE ODDITIES.**

Mr. William A. Darrah related some of his experiences as an examiner in the United States Patent Office at a recent meeting of the branch of the American Institute of Electrical Engineers at the Worcester (Mass.) Polytechnic Institute. He found the work very interesting. He observed that the examiner handles applications from all kinds of people in all parts of the world (for there are a large percentage of foreign applicants), and naturally comes across many curious errors and ideas. Thus a certain legal light from California, more versed in legal than technical details, recently presented several cases describing a "Paul and Rachel" wheel evidently considering "pawl and ratchet" a biblical quotation. Then there is the class of attorneys, who, having a marked antipathy to friction, call all pivots "anti-friction pivots," while another group of practitioners call all devices automatic. The applicants from abroad, notably German inventors who try to conduct their cases after the rules of their home office, are another group who make interesting errors.

# SOME UNIQUE MOTOR APPLICATIONS.

The field of usefulness of electric motors for driving machinery is practically limitless. In this electrical age motors are no longer considered complicated or impracticable by the average power user, and there is almost no line of work requiring power where they may not be employed with economy.

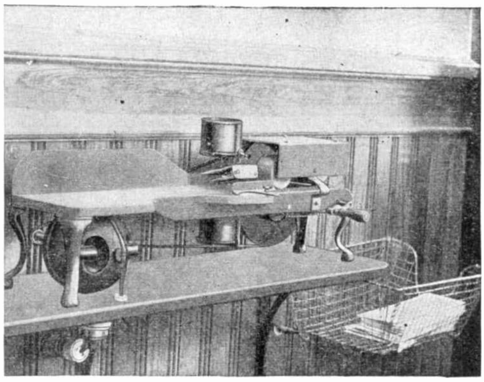


THREE STAGE PORTABLE PUMP.

The three illustrations show the application of motor drive to three widely different operations. One is a letter sealing machine, driven by a little spherical motor about as large as a good sized apple. It is a pretty small affair, not over one-thirtieth horsepower, but it makes the letter sealing machine hum. The only work necessary is to feed the letters into the machine, where they are moistened and come out neatly sealed, all in the twinkling of an eye.

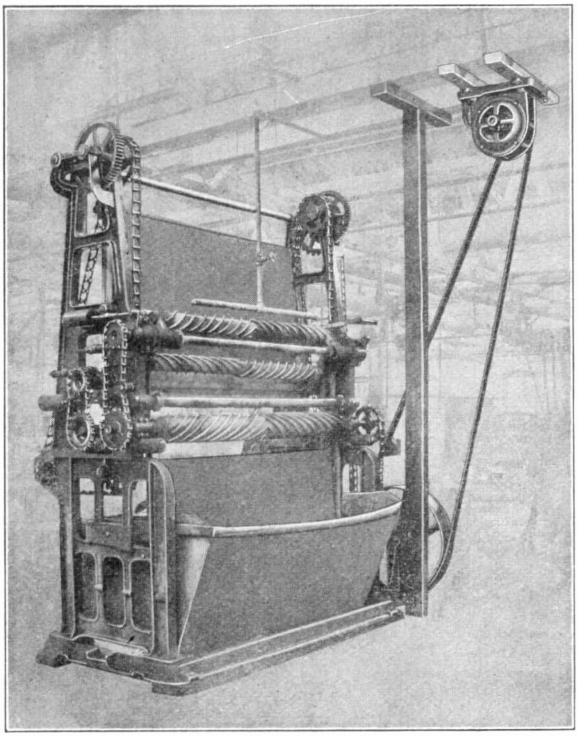
Another view shows an induction motor operating an unhairing machine in a modern tannery. The motor is fastened to the ceiling and drives a number of rolls which carry spiral shaped knives or scrapers. The hides are fed into the roller and come with all the hair neatly and expeditiously removed.

It might here be mentioned that an induction motor is different from the direct current motor, or the ordinary alternating current motor. These operate on the principle that a current flowing from the wires of the line through the wires in the armature and out again will cause the armature to revolve owing to the fact that the magnetism which is in the pole pieces exerts a repelling effect on the wires in the armature while current is flowing through them from the main line. On the other hand, in the induction motor, which operates an alternating current, the current from the feed wires does not pass through the armature, but goes around the coils of the fields. The armature contains wires which cut the lines of magnetic force of the fields, but these wires are short circuited at the ends, and are in no way connected with the source of current. The two or three phase alternating current flowing in the field coils makes the poles alternately positive and negative, and where there are several poles gives a rotating effect to the field as the poles one after another become positive. This rotating field drags the armature around with it through virtue of the induced currents which are caused to flow in the short circuited coils mentioned above.



LETTER SEALING MACHINE.

The third application of motor drive illustrated is that of a three stage portable centrifugal pump operated by a direct current motor. The advantages of this outfit for general utility purposes are evident. It is easily moved about from place to place and can be employed to drain excavations and for other purposes.



UNHAIRING MACHINE IN TANNERY.

### FROM TRAINS TO STOCKINGS.

From the gigantic task of hauling freight and passenger trains over the electrified branch of the Canadian Pacific the Aroostook Falls, in Maine, performs such little chores as knitting stockings. The falls has recently been harnessed to drive electric generators which supply current to the railroad and to the knitting mills of the vicinity. An electrically operated machine will knit a stocking in less than two minutes.

Competent engineers estimate that there is 2,000,000 horse-power which could be easily developed from water-power in this country. This would save annually 225,000,000 tons of coal.

### MARVELS OF ELECTRICAL COMMUNICATION.

Both telegraphy and telephony were "born and raised" in the United States, and it is in this country that their most remarkable development, particularly in the art of telephoning, has taken place. In the city of New York, for example, there are 250,000 telephones, while Chicago boasts 180,000. It is an interesting comparison to note that within a circle having a radius of 30 miles and its center in New York City there are more telephones than in all the British Isles.

Chicago telephone exchanges are the busiest in the country with an average of conversations of 22 per line per day. Every day there are about 1,100,000 telephone conversations in the city, and as each conversation averages two minutes, or about 200 words, there is a total of 220,000,000 words of telephone talk daily in this one city. This number of words is equal to the number contained in a library of 1,500 books each of the size of an ordinary popular novel.

If all the wires used in the Chicago telephone system both in the exchanges and in the lines were put end to end, they would be sufficient to girdle the earth at the equator 50 times.

Mr. Kempster B. Miller gave some of the foregoing facts in a recent address in Chicago. He added that in his opinion the automatic telephone system is a success and he also described briefly the semi-automatic systems, which retain a greatly reduced number of operators, but place at their disposal automatic apparatus in the exchange for making and disconnecting calls. The speaker thought it probable that in large cities, in the course of time the manual apparatus will be superseded by automatic or semi-automatic appliances, but probably the telephone operator will not become altogether extinct, for she is needed in private branch exchanges and in making toll connections.

Telegraphy has been backward compared with telephony, but Mr. Miller thinks that high speed telegraphy is surely coming, and he is confident that a transmission of a thousand words a minute is practicable.

By wireless telephony a transmission of 300 miles has been achieved, and it is said that the clearness of talking equals, if it does not surpass the result in telephoning over an equal length of wire, but for a number of reasons it is not thought likely that "wireless" will ever supersede communication by wire either by telegraph or telephone.

# A SUN POWER PLANT.

Heat of the sun's rays falling upon the earth represents an amount of energy that is almost inconceivable. This energy is for the most part wasted as far as its mechanical possibilities are concerned, but as coal becomes more scarce and higher in price the rays of the sun will undoubtedly be turned to account. Some courageous inventors are even now working in this direction and various types of sun power plants have been built with more or less success.

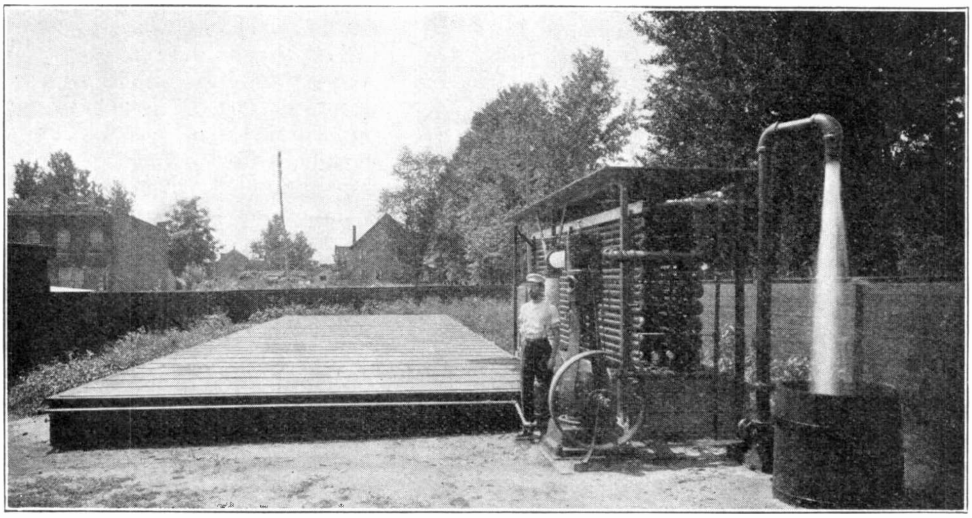


FIG. 1. WATER HEATING RESERVOIR OF SUN POWER PLANT.

A unique experimental plant of this kind has been constructed near Philadelphia which is said to be capable of developing considerable power. The plan employed consists in exposing to the direct and unconcentrated rays of the sun, under glass, a body of heat absorbing liquid, such as water, then storing up this liquid and subsequently using its energy in an engine or turbine of proper design to drive an electric generator.

Fig. 2 is a diagram showing the scheme upon which the system operates and Fig. 1 is a view of the 160,000 square foot water heating reservoir. Water in the reservoir is three inches deep and there is a dead air space between it and the glass cover. It has been found that the water will attain a temperature of 202 degrees F., not far below the boiling point.

Looking at Fig. 2 it will be seen that the hot water is brought from the reservoir, marked A, through a pipe (M) to the turbine (B), which carries on its shaft an electric generator. A partial vacuum is obtained in a chamber in the turbine by vacuum pumps shown in the lower part of the diagram. This partial vacuum brings the pressure low enough so that the incoming hot water at 202 degrees F. will boil and go into steam in the same manner that water will boil at comparatively low temperatures in high

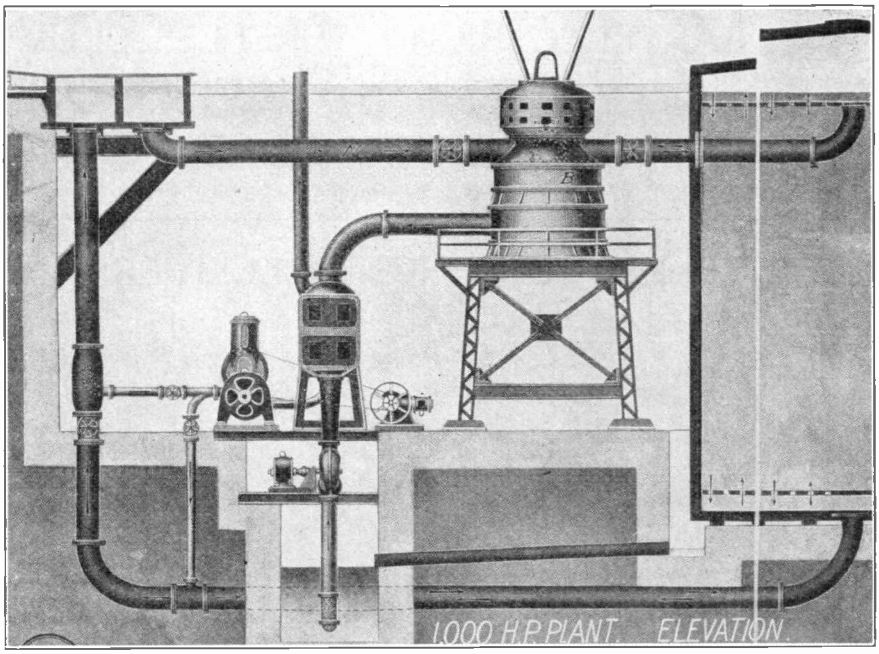



FIG. 2. SHOWING THE PRINCIPLE OF THE SUN POWER PLANT.

altitudes where the air pressure is low. The steam so formed is used to turn the low pressure steam turbine and so turn the dynamo.

The large tank at the right stores the cold water, which is returned to the reservoir during the night.

## ELECTRIC RAILROADING ON A LARGE SCALE.

It is not generally known that over the 800 miles of mountain stretches of the new Pacific Coast extension of the Chicago, Milwaukee and St. Paul Railroad, electricity is to be used as the motive power, and the engines will be 200-ton electric locomotives. Down the sides of the Bitter Root mountains are pouring a sufficient number of streams to furnish abundant power for all of the electric locomotives which the St. Paul will need to handle its trains over the mountain division. These streams are to be harnessed at the cost of millions. The boldness of conception and the unobtrusive way in which the work is being executed challenge admiration. Through the fastnesses of the Bitter Root range a tunnel 8,750 feet long is being constructed by electrical power and through it will be operated electrically propelled trains. One end of this tunnel will open in the state of Montana and the other will land the traveler in Idaho.

## FULGURITES.

Fulgurites, as they are called, are found in sand and consist of tubes, both simple and branched, which are lined with vitrified silica. There was once some doubt as to their origin, but it is now known that they are formed by lightning striking in the sand and melting the latter so as to make the strange formations. Artificial fulgurites have been formed by discharging electric condensers of high capacity through the sand.

## BAKING BY ELECTRICITY.

The largest electrical cooking device in actual use is an electric bake-oven at Marseilles, France. This furnace stands over six feet high and has two compartments, one above the other, each of which is heated by electric currents passing through resistance coils. The cost of baking 50 pounds of bread is less than 50 cents. Among its advantages are rapidity of action, even temperature, absence from fire dangers, and precise control.

# POPULAR ELECTRICITY WIRELESS CLUB.

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine is devoted to the interests of the Club and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

# WIRELESS TELEPHONE RECEIVERS.

BY ALFRED P. MORGAN.

Probably the telephone receiver is the most sensitive electrical instrument in existence. A pair of high resistance telephones which are in nice adjustment will detect a smaller current than the most sensitive galvanometer.

In choosing a telephone receiver for wireless the best one is that type having what are known as consequent poles. That is, the permanent magnet is in the form of a ring as in Fig. 1. The advantage of this is that the lines of force cannot pass across the pole pieces of the electromagnets before passing through the diaphragm, as they are liable to do in the horseshoe type shown in Fig. 2.

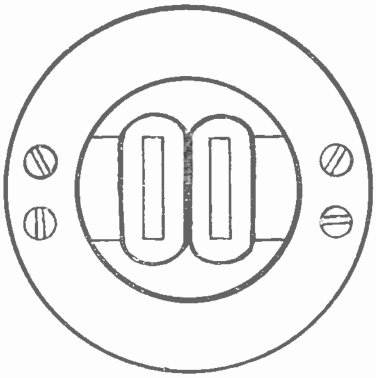


FIG. 1.

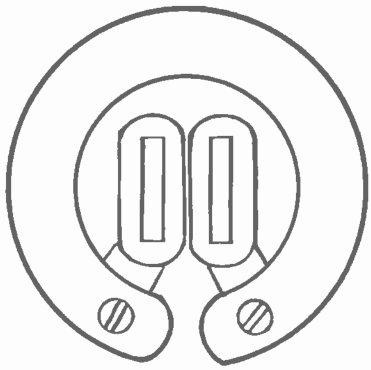


FIG. 2.

The ordinary low priced and low resistance telephone receiver is all right for the telephone work for which it was made and adjusted. Although it will work on a wireless system as it stands, it may be improved by carefully following the directions given below.

The first and principal objection to the ordinary 75-ohm receiver is that it does not contain enough turns of wire on its bobbins. This is easily remedied by carefully rewinding them with a very fine silk covered, pure copper magnet wire, no larger than No. 40 B. and S. This will increase the number of turns and likewise the resistance. But it must not be inferred that high resistance is a thing to be desired. This is a common error of amateurs who do not understand the underlying principle of electricity; that the strength of an electromagnet varies directly as the product of the number of turns of wire multiplied by the amperes flowing through the magnet. When we wind a telephone with finer wire we increase the resistance which cuts down the current and therefore the strength of the magnet. But this is counteracted and an increase in magnet strength results when copper wire is used, for the number of turns then increases faster than the resistance until the circumference of the outside layer becomes twice as great as the circumference of the first layer. The winding should not be carried beyond this point.

The Navy Department specifies that its wireless receivers shall be wound with silk covered copper wire of not less than 0.0015 inch. The diaphragm to have a diameter of one and three-quarter inches and a thickness of 0.004 inch. The resistance of the coils is given at from 1,000 to 1,100 ohms. This has been found to be the best winding for use with most detectors, except the Marconi magnetic type, in connection with which a low resistance receiver gives the best results.

The second objection to the ordinary telephone is that the diaphragms are very often too thick. A receiver having a thin diaphragm is preferable to that having a thick one because when a weak current is sent through the coils the change in strength of the permanent magnet is greater. But this may be carried to excess and the diaphragm made so thin that it cannot absorb sufficient line of force to properly play its part. The best thickness for a diaphragm can only be determined experimentally, as it depends altogether on the diameter and thickness.

The distance from the poles and strength of the magnets also have a bearing on the thickness to be used. The ordinary telephone will give good tones and be very sensitive with diaphragms from 0.01 to 0.005 inch in thickness.

The relation between thickness and diameter is shown by the following: If the diaphragm of a receiver is increased in diameter the tones will become more distinct but if the increase is carried too far they become indistinct and the remedy is to thicken the diaphragm. Likewise if after clearness is secured, the diaphragm is thickened so that the tones again become indistinct, the diameter must be increased. Telephones which are small in diameter and therefore have small diaphragms are liable to give indistinct tones.

The third objection is that such receivers are not adjusted properly. The adjustment is also a matter of experiment and is generally done by comparison of the receiver in question with one which is known to be in a sensitive condition. The adjusting is done by means of a special tool as shown in Fig. 3. This tool is easily made from an ordinary file by grinding off the teeth on one side save for a distance of about three-quarters of an inch in the middle. The grinding may be done on an emery wheel. The part (a) is used for filing the pole pieces and thus making the distance between them and the diaphragm greater. The idea of the tool is to permit the poles to be filed easily without removal from the receiver case and without grooving the diaphragm bed, or the edge of the receiver case.

To lessen the distance between the poles and the diaphragm, lay the receiver, bed downward, on a piece of fine

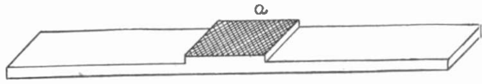



FIG. 3.

emery paper, and rub with a circular scouring motion. If the emery paper is placed on a perfectly flat surface no trouble will be experienced in grinding the bed down evenly. In filing the pole pieces rub with a firm circular motion so as to grind off all points evenly. Test from time to time by passing a straight-edge over the bed in all directions, while holding to the light and looking between the straight edge and the poles. They should be made perfectly even and of the same height.

In case you have a pair of telephones which were in good condition but do not give their former results, the last thing to do is to tamper with the adjustment. The cause is often very easily remedied. The most common fault when the tones of the receiver are impaired is caused by filings and dirt or dust accumulating on the poles and damping the vibrations of the diaphragm. The cap should be carefully unscrewed and the diaphragm examined to see if it is bent. If bent replace it with a new one of the same size. Remove any dust or filings, and if the diaphragm is rusty clean it by laying it on a flat surface and rubbing with a piece of fine emery paper. Then give it a thin coat of varnish or lacquer. The magnets and poles should be examined to see if they have not become loose and allow the poles to touch the diaphragm.

The trouble may be that the permanent magnets have lost part of their magnetism, and almost every receiver which has been used any length of time will bear having its magnets strengthened.

If the magnets are found to be weak they should be removed and magnetized. This is done by winding a coil of wire around them and sending a heavy direct current through the coil for a minute.

In carrying out any of the suggestions let me advise working with one receiver at a time and keeping one for comparison, so that by repeated tests you may tell whether or not an improvement is being made, and when well enough is reached let it alone.

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## HOW TO MAKE A TUNING COIL.

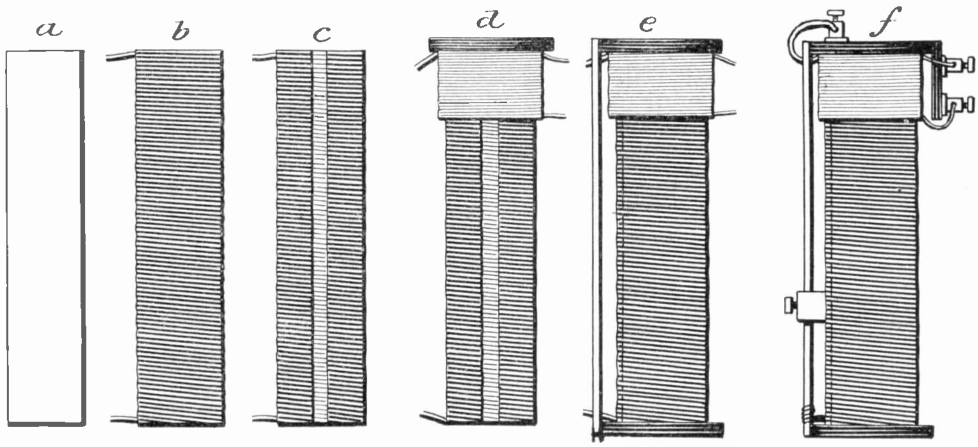
BY LOUIS DIETERICH.

This tuning coil comprises a secondary coil wound over a primary coil. The primary coil being of the usual type. This will be made clear by reference to the diagram, from which it will be seen that on a suitably insulated core (a), a primary coil (b) is wound. The coil (b) is wound with ordinary bell wire of a size about No. 18. After the primary coil has been wound it is scraped bare of insulation as at (c) to form a bare strip running parallel with the length of the coil.

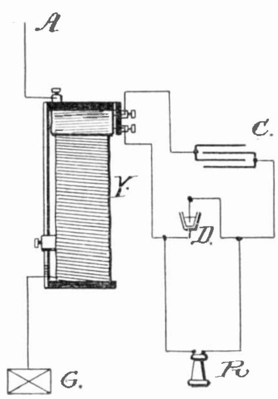
The secondary coil is next slid into place as shown at (d), the secondary coil being wound in the form of a bobbin, with fine wire about the size No. 30. A metallic bar is then secured to the insulated heads of the coil and held parallel to the scraped part of the coil as shown at (e). The primary is wound with a great number of turns, while the secondary contains but comparatively few turns.

A sliding contact makes engagement between the rod and the scraped part of the primary in the usual manner and one end of the primary coil connects to the aerial at (A), while the rod connects with the ground at (G), as shown in the lower part of the diagram.

The ends of the secondary coil are connected one to a condenser (C) and the other to the detector (D). The de-




VARIOUS STEPS IN MAKING A TUNING COIL.




tector and condenser are also connected. The receiver (R) is connected with the detector as shown.

To make a working coil the core (a) should be about 14 inches long and 2½ inches in diameter and wound with one layer of No. 18 insulated wire. Over one end of the primary (b) is fitted a sleeve of heavy paper, on which the secondary is wound with one layer of No. 30 insulated wire and about 30 or 40 turns.

### EFFECT OF WIND ON WIRELESS WAVES.

The effect of atmospheric changes on transmission in wireless telegraphy is a subject still unsettled and being studied. Mr. Marconi found that during the day on water, 700 miles equaled 1,500 miles at night. He believed that daylight weakened the medium of transmission. Aside from this we know that with good insulation electric transmission is at its best. Reason thus, when air becomes a poor conductor, energy is dissipated. At 15 pounds pressure air is almost a perfect dielectric. At 35 miles above the earth it becomes as good a conductor as a mixture of three parts of sulphuric acid and one part water. Indirectly air movements or wind may assist in making these conditions.

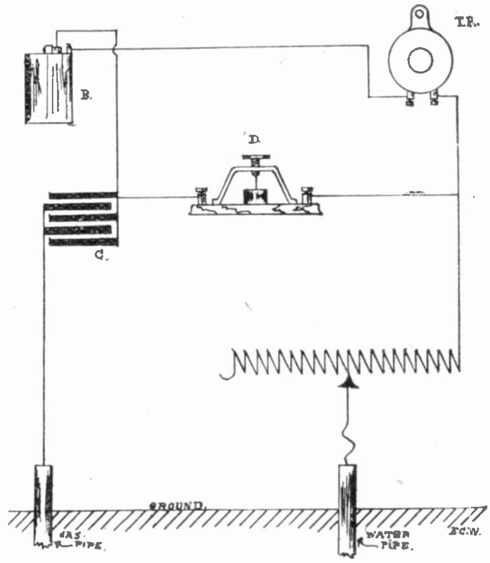
Capt. Jackson, of the U. S. Army, studied the effect of atmospheric conditions on wireless and found that in fine weather, when the barometer showed a lessening air pressure and a storm coming, the signalling distance was reduced to one-third that of normal conditions. He noted that damp, dusty winds reduced the distance. He concluded that in both cases the atmosphere became a better conductor and so dissipated the energy of the waves.

Capt. Wildman in Alaska, found damp, stormy weather a difficult time to send signals. One conclusion which he makes in his notes is "that there is some connection between the wind velocity and the traveling, or about to travel, electromagnetic wave."

### WIRELESS SYSTEM WITHOUT AERIAL.

Members of Popular Electricity Wireless Club will no doubt be interested in knowing how to receive messages without the use of an aerial. The diagram shows one method that may be employed. The parts of the system are as follows: (D) is the detector, (B) the battery, (TR) the telephone receiver, (C) the condenser. A tuning coil is connected between detector and ground.

Connect a wire from one binding post of the detector to the battery and from there to the telephone receiver. From the telephone receiver connect to the other binding post of the detector. Now connect another wire from the condenser to the gas pipe in your cellar. It does not




WIRELESS SYSTEM WITHOUT AERIAL.

make any difference what kind of a detector you use. With this outfit you should be able to receive messages for a considerable distance.

E. C. WAGNER.

### A NEW TRIUMPH FOR WIRELESS.

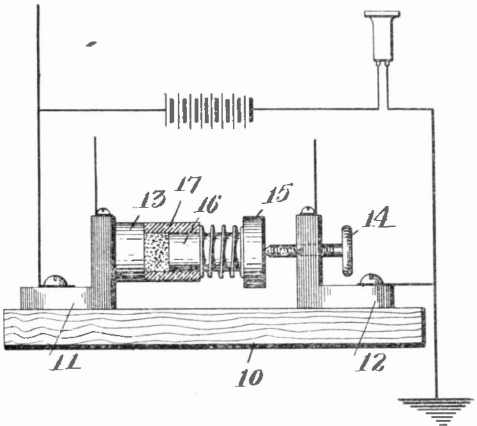
Wireless was given a real test and one which will fortify its position almost more than any accomplishment up to the present time, when it saved the lives of almost a thousand people on the fated steamer Republic which collided with the Florida on January 23d. The story of wireless operator Binns on board the Republic, his coolness and devotion to duty, the concentration of helping ships from miles around at the scene of the disaster, made possible by the steady stream of messages which he flung to the winds—all this is an interesting story which has been published by every newspaper in the country.

The mystic letters of the code, C. Q. D. (ship in great danger) which flew from ship to ship, and were relayed from station to station, causing all the wireless operators for hundreds of miles around to "sit up and take notice," and to listen for more definite information, did a great deal on that fateful occasion to prove the worth of wireless. What ship, be she modern liner or tramp, can afford to be without wireless equipment, in view of its wonderful life saving possibilities?

### AN ELASTIC COHERER.

Frederick G. Sargent of Westford, Mass., has patented a coherer which does not require a tapper, decoherence being obtained through the agency of an elastic substance mixed with the cohering material.

As shown in the diagram, a non-conducting base (10) is provided, upon which are mounted two metal brackets (11) and (12). On the bracket (11) is a disk (13), of carbon. On the other bracket is mounted an adjusting screw (14) which engages the end of the other electrode (15), made of metal. The electrode (15) is provided with a



ELASTIC COHERER.

plug (16) on which is mounted a glass tube (17). A spring forces the plug and tube apart against the adjusting screw (14) and holds the end of the glass tube against the face of the carbon disk.

The cohering material preferably consists of a mixture of two or more kinds of fine particles, some of which are conducting and others non-conducting. The conducting particles may conveniently be made of metal such as zinc, and the other particles are preferably formed of rubber so that they will always tend to separate the conducting particles after the cohering action has ceased, so as to de-cohere them automatically. Any other elastic substance may be substituted for the rubber, especially if it is non-conducting, and in fact the other parts of the invention can be used with a cohering material comprising a conducting substance, such as carbon mixed with the metallic particles.

## WIRELESS QUERIES.

ANSWERED BY V. H. LAUGHTER.

### TWO INCH SPARK COIL FOR 110 VOLTS A. C.

*Question*—Would it be feasible to make a spark coil for use on a 110 A. C. circuit that would give a 2" spark?—T. M. S., Jr., Memphis, Tenn.

*Answer*—It would be next to impossible to wind a coil that would give a two-inch spark on the 110 volt alternating current. This is taking into consideration the limited means the amateur has for accomplishing the delicate work. For your purpose we would recommend a coil of the type described in the article "How to Construct a Two-Mile Wireless Outfit" in the November, 1908, issue. It will be necessary, however, to use this coil with direct current and a vibrator.

### WIRELESS DETECTOR, MOTOR OPERATION.

*Question*—(A) Will you kindly tell me how a simple wireless detector is made, besides the carborundum or silicon detector? (B) Where can I buy the July issue of Popular Electricity? (C) How many volts and amperes would I get out of a half horse power, 110 volt, shunt wound, direct current motor, running it backward at the rate of 1200 revolutions per minute?—C. M., Kingsbridge, N. Y.

*Answer*—(A) The filings coherer is as simple a detector as any, and consists of two 1-16 inch silver plated wires inserted in the ends of a short glass tube until their ends are 1-16 inch apart. The space between them is filled with metal filings, preferably silver and nickel. The filings must be decohered after each impulse by tapping the tube. This is usually done automatically by allowing the striker of the signal bell to strike the tube.

(B) The July number of Popular Electricity will be sent on receipt of ten cents.

(C) You do not give the rated or normal speed of your motor, and 1,200 revolutions per minute is rather low. It is doubtful if the machine will excite at this speed as a dynamo. A shunt wound machine should be run in the same direction as either dynamo or motor. If the machine excites you may get 50 volts and 1½ amperes. Better try a higher speed.

### CLOSED CORE TRANSFORMER.

*Question.*—I wish to construct a closed core type transformer, using 110 volts in the primary and obtaining 20,000 volts from the secondary.

*Answer.*—See answer to C. R. P., this issue.

### MOTORS; SPARK COILS.

*Questions*—(A) How is a battery motor reversed? (B) Will any kind of a spark coil do for wireless work? (C) What is a condenser used for, and is it necessary to use one in connection with a spark coil for wireless work?—J. F., San Francisco. Cal.

*Answers*—(A) This is usually accomplished by reversing the field connections.

(B) Almost any of the types that gives a spark above ¼-inch will answer.

(C) Condensers are put to such a variety of uses that it would be impossible to give the total list here. It is necessary to use the condenser with the spark coil, whether intended for wireless work or not. The condenser is connected across the vibrator and serves to take up the spark at the contacts in the form of a charge and discharges back through the primary winding.

### CONSTRUCTION OF WIRELESS EQUIPMENT.

*Questions.*—(A) Will you please tell me how to make a 250 watt transformer? (B) What is the best wire to use for the aerial of a wireless telegraph station? (C) With a 50 foot pole how far would I be able to receive with a 250 ohm receiver? (D) What is the most common way of measuring wave length? —C. R. P., Los Angeles, Cal.

*Answers.*—(A) The construction of a 250-watt transformer brings in quite a lot of detail matter and is too lengthy to be given here. We would refer you to the article "How to Make a High Frequency Apparatus" in the January. 1909, issue.

(B) Stranded phosphor-bronze wire is employed for commercial use. For experimental work No. 14 bare copper will answer. An experimental aerial arrangement is fully described in the article "Wireless Telegraphy Made Simple," August, 1908, issue of this magazine.

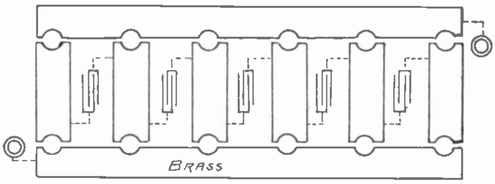
(C) This question cannot be answered with any degree of accuracy. As an estimate we would say that you could pick up messages from the commercial stations 50 miles away.

(D) The Donitz wave meter, the Fleming Cymometer, the Slaby measuring rods, are all used.

### MOVABLE PLATE CONDENSER.

*Question.*—Can I make a variable condenser out of ⅛ inch brass plate, 5¼ inches wide and 7 inches long, having four movable and four fixed plates?—W. S. McL., New Haven, Conn.

*Answer.*—Metals are more or less good conductors. A non-conductor or insulator must be used for plates. Paraffined paper or glass are common. Tinfoil tongues from alternate plates may run to wires at opposite ends respectively.



VARIABLE CONDENSER.

By using glass and having a sliding spring contact on these tinfoil tongues at each end, any plate may be withdrawn at the side. See answer to A Reader, Questions and Answers Department, September issue, 1908. The diagram shows another self-explanatory method of arranging and connecting plates so that the capacity of the condenser may be varied by putting in or removing brass plugs.

### CONDENSER; INDUCTION COIL.

*Questions.*—(A) How many sheets of tinfoil 5 inches by 10 inches mounted on glass plates will be required to make a suitable condenser for the induction coil described in the article "A Two Mile Wireless Set" in the November, '08. issue? (B) How many feet of wire should be wound in each section of the secondary of this coil and what size should the ends for the case be cut? (C) Would it help to fill the case with boiled linseed oil and place the coil in it?—F. S. W., Delta, Colo.

*Answers.*—(A) Is the condenser in question to be used across the vibrator contacts or in the oscillation circuit? Advise us on this point so that we can give you a satisfactory answer.

(B) There will be approximately 1,400 feet to the section. The end for the case should be cut 5 by 5 inches.

(C) By placing the coil in linseed oil you will have a guarantee against break downs. This method is recommended wherever possible.

## WIRELESS CODES.

*Question.*—I would like to know the telegraph code in use by wireless operators.—A. G. McL., St. Boniface, Man., Can.

Below are given the Morse and Continental codes.

| LETTERS | MORSE | CONTINENTAL |
|---|---|---|
| A | · — | · — |
| B | — · · · | — · · · |
| C | · ·  · | — · — · |
| D | — · · | — · · |
| E | · | · |
| F | · — · | · · — · |
| G | — — · | — — · |
| H | · · · · | · · · · |
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| J | — · — · | · — — — |
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| NUMERALS | | |
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| PUNCTUATIONS, ETC | | |
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| , Comma | · — · — | · — · — · — |
| ? Interrogation | — · · — · | · · — — · · |
| ! Exclamation | — — — · | — — · · — — |

MORSE AND CONTINENTAL CODES.

## AERIAL ELEVATION.

*Questions.*—(A) Does not the amount of air wire increase the sending efficiency of a wireless set? If so, how far would a 1½ inch spark coil send with a 150 foot aerial elevation? (B) When I connect the air and ground wire to my coil the spark is cut down to about ½ inch. Why is this?—E. L. S., Brooklyn, N. Y.

*Answers.*—(A) The sending efficiency under certain conditions is increased by increasing the height and amount of wire used in the aerial. However, when the small size coils are used an aerial about 40 feet in height gives the best results. It would be a guess on our part to say how far the 1½ coil would send with a 150 foot aerial. By using a 40-foot aerial you could probably send up to two or three miles.

(B) See answer to D. H. in the January, 1908, issue.

## TUNING COIL.

*Question*—I am constructing a tuning coil for wireless work of 1000 meters wave length. May No. 20 B. & S. gauge magnet wire be used, and should same be single or double cotton covered?—J. S. H., Shawnee, Okla.

*Answer*—The No. 20 gauge can be used. Either single or double cotton covered will answer.

## SPARK COIL.

*Questions.*—(A) How can I make a 1 inch coil for wireless use? (B) Is a vibrator necessary for this coil? (C) What other apparatus would be necessary?—A. E. G., White Plains, N. Y.

*Answers.*—(A) The dimensions of a one-inch spark coil are as follows: Core 7½ inches long, ⅞ inch diameter, wound with two layers No. 16 double cotton covered wire for primary; secondary 1½ pounds No. 34 single silk covered magnet wire; condenser 33 5 by 6-inch foil sheets built up with paraffine paper. For more detailed information concerning the construction of a coil we refer you to the article on "How to Construct a Two-Mile Wireless Outfit," November, 1908, issue.

(B) Yes.

(C) We would refer you to the article "Wireless Telegraphy Made Simple," May, 1908, issue, which fully explains the operation and all the parts used in an experimental set.

## PECULIARITIES IN SPARKING APPARATUS.

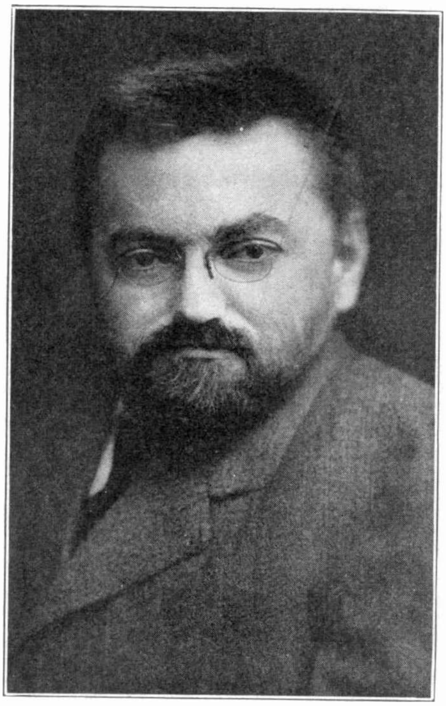
One of the members of Popular Electricity Wireless Club, Mr. William Weber, of Novinger, Mo., has noticed some peculiarities in the operation of his sparking apparatus. He tried making the spark gap between two bodies of mercury, but could obtain no results whatever. He then doubled the distance, making two openings in the circuit, whereupon two sparks would jump across the double gap. The spark worked better between two pieces of steel than between brass or copper, and seemed to give better results if the make and break were slow. He would like the experience of other members of the club in this line.

# ELECTRICAL MEN OF THE TIMES.

## CHARLES PROTEUS STEINMETZ.

In sheer intellectual brilliance, in grasp of the principles underlying all forms of electrical application, in versatility, Charles Proteus Steinmetz of Schenectady, N. Y., consulting engineer for the General Electric Company and professor of electrical engineering in Union University, stands in the very front rank in his profession not only in the United States but in all the world.

Steinmetz is gifted with a marvelous mind and is a most interesting personality. He can talk offhand on the most abstruse scientific subjects with a fluency, clearness and correctness which are simply amazing not merely to ordinary folks, but to specialists as well. Whether the subject be history, political economy, chemistry, astronomy, meteorology, the theory of alternating currents, electrification of railroads, high-efficiency electric lamps, telephone engineering, electrochemistry, or the latest slant in national or world politics, apparently it is all one to Steinmetz. Seemingly all knowledge is his province, as was said of Macaulay.



And yet this man's work is essentially practical. He is no mere spinner of theories. Like Edison, he wants to know if the thing will work. He is often called into conference with keen, practical men of affairs, and his sound, sensible advice is highly valued. He is one of the finest mathematicians in the country, but he is credited with having said: "Mathematics is valuable only to obtain results. Mathematics for mathematics' sake is foolishness." His inventions, principally electrical, run into the hundreds, but they are all directed to some useful purpose, never merely showy or fantastic. They embrace generators and motors, systems of electrical distribution, various forms of lamps, both arc and incandescent, steam turbines, lightning protection, motor control and devices of various kinds. One of the latest related to an arrangement of arcs for producing nitrous compounds from the atmosphere.

Dr. Steinmetz was born in Breslau, Germany, in 1865. He was a student in the university of his native city, but, embracing socialistic opinions, he displeased the authorities, and thought it wise to leave suddenly for Zurich, Switzerland, where he continued his studies in chemistry, physics and electricity in the university at that place. Forming a close friendship with an American, the whole course of his life was changed, and he came to the United States in 1889, practically penniless and unknown. He studied English in the steerage. He secured employment with Rudolph Eickemeyer, the electrical inventor, as a draftsman at $12 a week. When the Eickemeyer works were sold to the General Electric Company four years later Steinmetz was perhaps the most valuable acquisition secured by the latter company. Now the man who formerly cooked his own meals in modest lodgings in Brooklyn is perhaps the foremost electrical engineer in the country, with a finely appointed laboratory, a large staff of assistants and a salary so ample that he is reported to have refused an increase offered him.

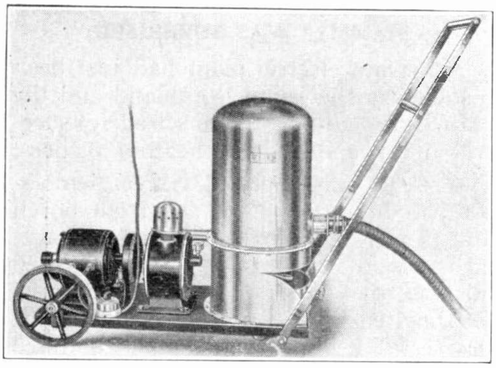
# ELECTRICITY IN THE HOUSEHOLD

## A MODERN AEOLUS.

Aeolus lived in the Aeolian Islands and gathered the winds in an ox hide sack to be liberated at will to do his bidding. If this mystic progenitor of the great Aeolic race were to visit the earth again he would be apt to say that the people of the Electric Age had stolen his ideas, so remarkable has been the development of electric vacuum cleaning devices. Three thousand years ago the temples of Pharoah were swept with brooms and up to the last few years this humble implement solved the problem of keeping clean, or trying to. But with the widespread use of electricity in the home which presents a source of power, ready at all times, the electric vacuum cleaner has sprung into prominence.

Several types of these machines have already been described in this department, but here is a new one which not only performs the ordinary duties of the vacuum cleaner, but also has attachments for cleaning especially difficult places, for cleaning clothing and upholstery and also for massage purposes. It

APPLICATION OF THE MASSAGE ATTACHMENT.

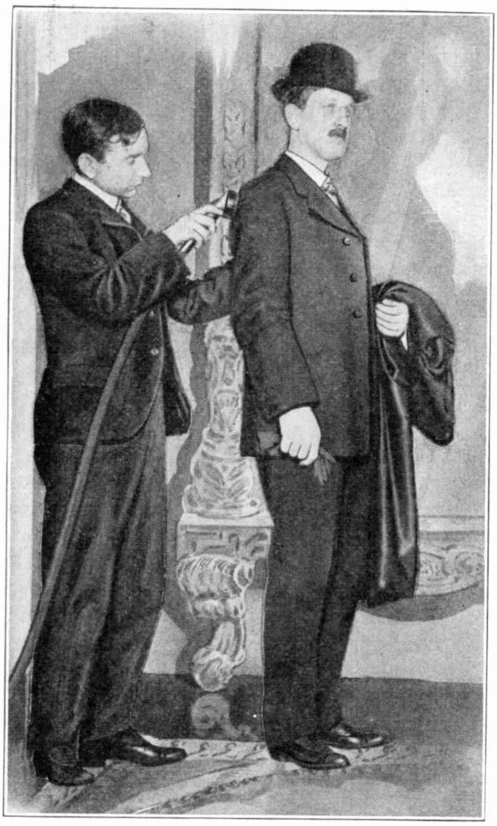


PORTABLE VACUUM MACHINE.

has ten tools or attachments for various purposes.

The device consists of a rubber-tired truck with a conveniently arranged handle-bar, and, weighing about 75 pounds, it can be easily wheeled to any portion of the house where cleaning is to be carried on. A ¼-horsepower motor is geared to a rotary pump. The motor is connected to an ordinary lamp socket by a flexible cord, and either direct or alternating current may be utilized.

It is operated at 1,800 revolutions per minute, and by suitable gearing this speed is reduced to 300 revolutions per minute in the case of the pump, which acts as a positive blower.



CLEANING CLOTHING WITH THE VACUUM OUTFIT.

CLEANING THE DIFFICULT CORNERS WITH A SPECIAL TOOL.

The air is forcibly drawn into a dust separating and collecting tank and again returned to the atmosphere of the room, through a muffler device, after all dust and foreign matter has been removed in the tank.

The housemaid rolls the cleaner into one corner of the room, attaches the cord to the lamp socket, unwinds a rubber hose, connected to the tank, and attaches to this hose one of the cleaning nozzles or tools. The electric current operates the little motor, and at once the vacuum pump begins to revolve, creating a strong suction at the tool at the end of the hose. The tool is passed over the floor or curtains or furniture, or whatever is to be cleaned, and the dust is screened out through a bag in the

REMOVING DUST FROM UPHOLSTERY.

tank and is collected in a receptacle beneath. Later it is taken away and preferably burned.

One of the tools, for instance, is a carpet and rug sweeper, another an upholstery and stair-carpet cleaner, while others are arranged to clean the edges of stair steps, tiles and floors, tuft buttons in furniture, drapery and curtains, wall paper and clothing. Still other arrangements to the same machine, as mentioned above, operate tools for facial or body massage. It is said that the whole machine operates at a cost of three cents an hour for electric current.

Of course the great advantage in electrical cleaning is that the dust and dirt are entirely removed from the room and taken away. In ordinary cleaning by hand the dirt is usually simply dislodged by the broom or duster to settle in a new place, with its countless germs and possibilities of diseases.

**"MAMMY" WAS SURPRISED.**

A private electric plant had just been installed in the sunny southland and the plantation buildings were wired for electric lights and electric heating devices.

A shiny nickel-plated coffee percolator was brought out on the front porch and placed on a small table and connected to one of the lighting fixtures. When all was ready the old negro "Mammy" was invited to come and inspect the new device. The old woman's pipe was filled and as she smoked she was shown the new device, but no explanations of its mysterious powers were added as the current was turned on. A few minutes later the aged negress began to look quickly under and around the table.

"Fo' de Lawd, honey, wh' dat steam comin' frum," she exclaimed when the percolator began to boil. "Dat dish am voodoo shur', to boil wid out no fiah."

It was several minutes before her alarms were quieted and she was convinced the boiling was not the work of spirits. When she was handed a cup of steaming, aromatic coffee she refused both sugar and milk saying: "Ah jus' want de pure 'lectric coffee."

And then they went to the laundry where "Mammy's" daughter Julie was looking doubtfully at the electric iron.

"Go ahead, Julie," said the mistress.

"But muh iron ain' hot," she answered.

"Yes it is, Julie. Try it and see."

Julie tried the iron and was astonished to find that it was "sissing" hot. A few minutes later when the mistress called Julie she answered, "Law, Missus, ah hasn't time. Ah has ter run dis here iron; I'se afeared it might get col'."

For upwards of 30 years a small flour mill, of 35 barrels a day capacity, has been busy operating at Catawba Mills, an active little hamlet three miles west of Fincastle in Virginia. The mill is driven by a turbine water wheel of 20 horse-power. A year and a half ago a member of the family chanced to visit the plant of one of the great electrical manufacturing companies at Schnectady, N. Y., where he was told the possibilities of the utilization of small water power for private electrical plants, and it was not long before he was figuring on securing an electric generator.

# ADVANTAGES OF FLAMELESS COOKING.

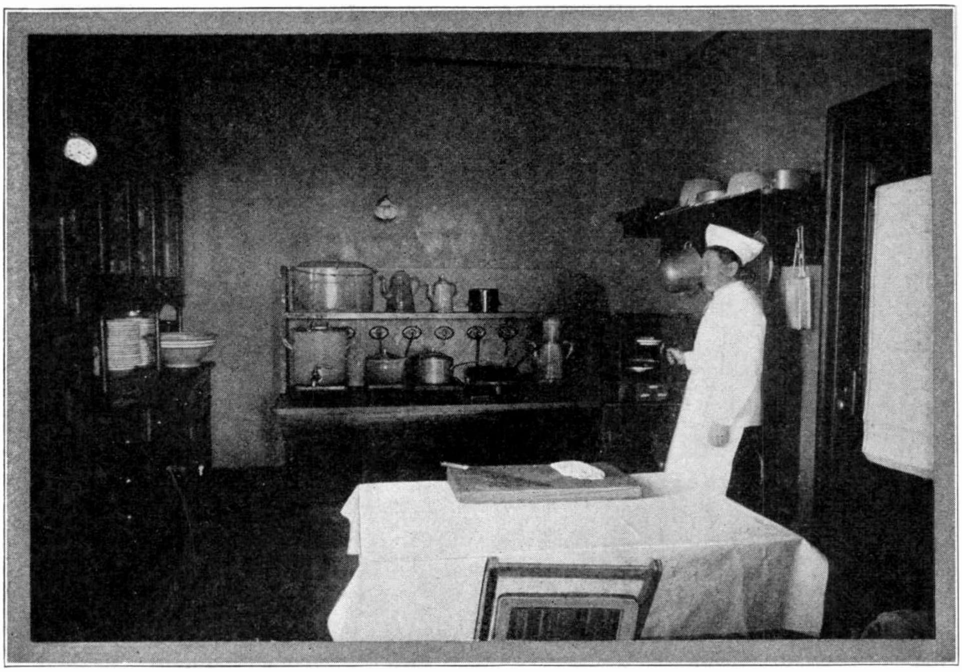
BY JANE STANNARD JOHNSON.

With the approach of the spring and summer seasons, the woman who must do much of her own cooking turns to electricity for relief. In the great variety of electrical utensils now made for household use, every culinary need is supplied. It is surprising the number of ways in which electricity is adapted to the household tasks.

The most complete method of installing electricity for cooking is, of course, the electrical range. Its top, which looks like an ordinary kitchen table, is of slate or marble. The electric wires pass through the wall at the back, and are placed under the bed of the range so as to supply current to each vessel in use. By merely turning a button, the current is on and the heat ready.

In this kitchen, the Japanese cook has pastry and biscuits baking in the oven, while meat and vegetables are cooking on the body of the range. The economy of electricity lies in the fact that the current may be applied to the vessel in use, and be turned off when no longer wanted. With the oven, the current may be turned off 10 or 15 minutes before the baking is completed. The oven is regulated for three different degrees of heat. For baking bread, 120° are required, while for meat 350° to 400° are necessary. A controller allows the heat to be gauged with absolute accuracy.

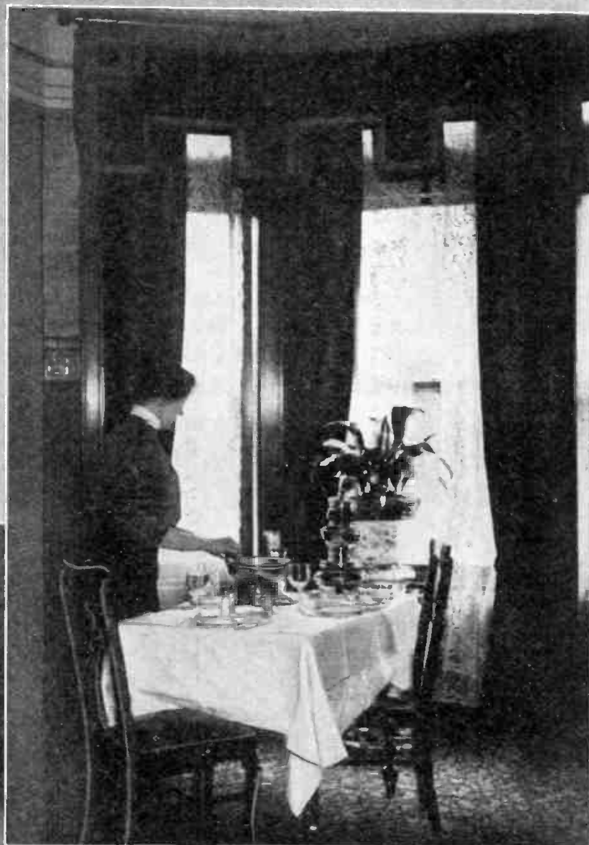
For a less elaborate installation there is a less expensive and very simple method. The wires may be brought through the kitchen wall, providing one attachment for each vessel to be used. The cooking utensils are then placed on an ordinary kitchen table, and the electrical cord attached to each. Very odd indeed it looks to see these pans and kettles steaming and boiling, with no sign of heat or fire near, the only thing to identify them as anything but handsome nickel cooking utensils being the cord attached at the bottom, and leading to the baseboard where the wires are connected.

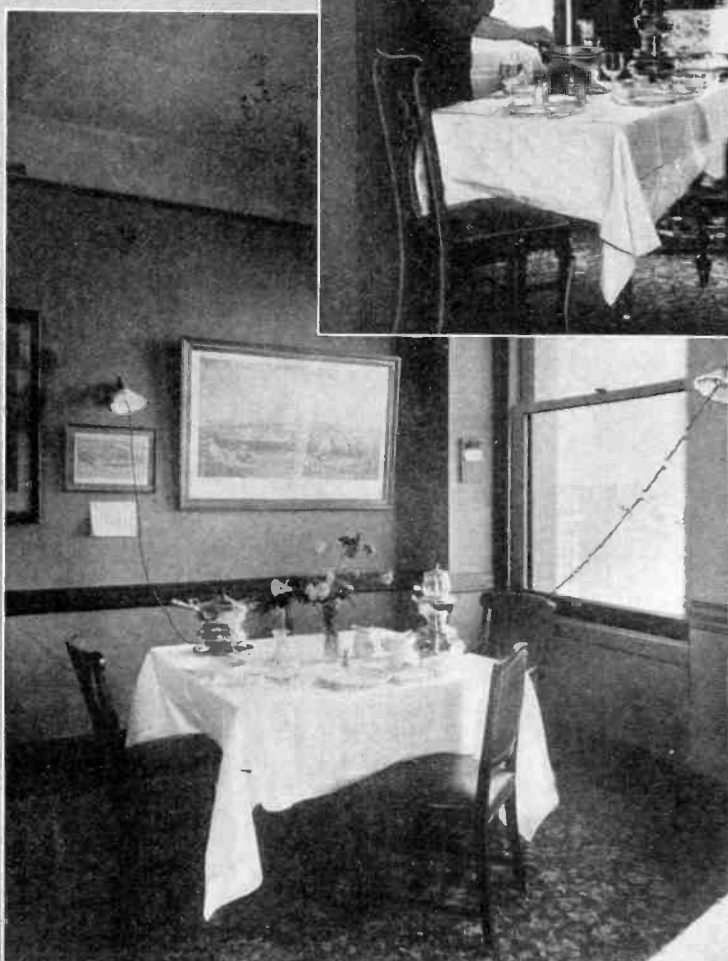


THE JAPANESE COOK IN HIS ELECTRICAL DOMAIN.

The time varies for heating the individual dishes. A griddle will heat in five minutes or a trifle less, while a broiler will require about 10 minutes; and it will take 15 or 20 minutes to boil a quart of water. In preparing breakfast, the cooking may be so estimated as to have every dish ready on minute schedule, each one hot when wanted to serve; for electricity is always on tap, and can be instantly utilized by turning the button.

A portable "stove" is a great conve-





**A dainty breakfast prepared on the dining room table**

nience in using the style of installation just mentioned. This stove consists of a piece of steel about half an inch thick, round, square or oblong, with a lever underneath for regulating the heat. It comes in several sizes, from 3¼ to 15 inches in diameter, and the oblong ones ranging accordingly. The larger stove will hold several vessels, and any ordinary kitchen ware may be used; but it is important that each piece have a flat bottom, to utilize the heat to the fullest advantage.

Where a house is equipped with electricity for lighting purposes only, electrical cooking may still be indulged in, for the current from the lighting system is sufficient to heat most of the individual pieces, including the 4½-inch stove. Quite extensive housekeeping may be carried on with only two or three electrically attached utensils. These are specially desirable if a coal range is used instead of gas.

For using the lighting current, electrical utensils are specially designed. For instance, the double boiler is an ideal arrangement for cooking breakfast. While the cereal is cooking in the top boiler, the eggs will boil in the lower one. If a slow cooking cereal is being prepared, water for coffee may be boiled in the lower boiler and the eggs cooked afterward, and both will be ready by the time the cereal is ready to serve.

Another pot made on the same principle, but differently constructed, is the one with a partition across the middle, cutting the space into half. This is convenient in preparing a dinner. Two vegetables may be cooked at the same time, and a pudding or custard will steam on the top meanwhile.

There are still other electrical cooking devices which may be used on the dining table, and the dishes be prepared actually while you wait. The chafing dish we have with us always, but it is more or less of a nuisance with alcohol as a fuel. With the electric chafing dish there is no alcohol to spill over or burn out at the wrong time, nor is there any danger of setting something afire, and a uniform heat may be maintained as long as it is wanted. For a supper at home or when entertaining friends, it is not necessary to go into the kitchen to prepare oysters, rarebit or any of the delicious dishes suitable for the occasion. These may all be prepared on the dining table, the hostess or some obliging man presiding over the cooking.

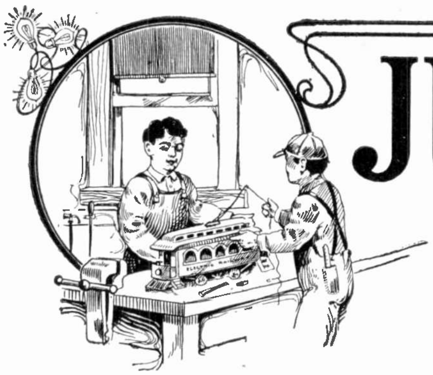
If coffee is to be served, the electric percolator will automatically make the coffee without the intervention of anyone. The ground coffee and water are first accurately measured and put into the percolator. The heat is then turned on, and as the temperature rises, the water is forced up and automatically drips over the coffee grounds until the strength is fully extracted. The coffee may then be kept hot until the last cup is called for, by turning the heat regulator to the point where the minimum current will be supplied. Coffee is served from the percolator by a faucet.

Another improvement of the kitchen is the electrical refrigerator. The ice man is a creature of the past in the electric household. The refrigerator is kept cold by artificial means, and operated by electrical appliance, at the same time freezing enough ice for daily table use.

The cost of electricity for cooking is a very important item to those contemplating its use. The impression is abroad generally that electricity is very expensive, and the first question always is, What will it cost? The cost is dependent to some extent upon conditions. The operator, too, must be taken into consideration in estimating the cost, for one may use the maximum and another the minimum of heat to secure the same results.

It is stated by persons of authority upon the subject that if electricity be used with the same care as gas, and with proper attention to the controlling gauge, that it will cost no more than gas as a fuel.

One other erroneous belief is that a person using electricity is liable to receive a shock in handling the utensils. There is no danger of this, as thorough insulation has been provided to prevent possible injury by contact with the current. The current is turned on and off by switches, and the heat is controlled by regulators. Any person of average intelligence may be instructed in its manipulation and the attachment of the various utensils.

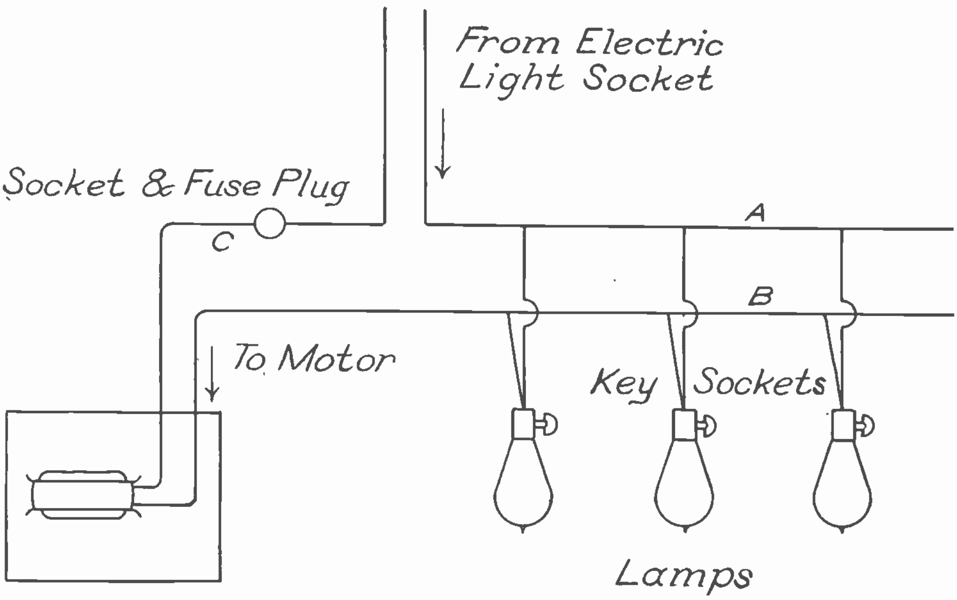


# JUNIOR SECTION

**OPERATING BATTERY MOTOR FROM LIGHTING CIRCUIT.**

A simple and practical method of running battery motors by the ordinary electric light current is as follows: Remove one of the electric lights from a convenient socket and in its place put a plug with two long wires running out, (A) and (C) in the diagram. Procure another wire, as (B), and attach three or four 16 candlepower lamps in multiple to wires (A) and (B). The sockets for these lamps should be key sockets so as to enable the operator to cut out the different lamps conveniently. A fuse plug and socket can be located on wire (C) to protect the motor in case the current becomes too strong.

When first commencing to operate the motor, one 16 candlepower lamp should be lighted. If the motor does not run fast enough then another lamp should be thrown in the circuit. The more lamps connected in the circuit the faster the motor will run. This plan will work either with direct or alternating current, although with the latter the motor heats considerably. In that case it should be allowed to cool off for a short time, when again it may be run. If the motor sparks when alternating current is used then a slight film of oil put on the commutator will allay the trouble. In case one or more motors are to be used then they can be connected up in series on wire (C).




OPERATING BATTERY MOTOR FROM LIGHTING CIRCUIT.

EDW. E. HARBERT.

# SOME ELECTRICAL TERMS SIMPLIFIED.

BY PAUL T. KENNY.

VOLT.

The volt is the unit of electrical pressure.

In order to explain its meaning, we will take a water tank—the one that you

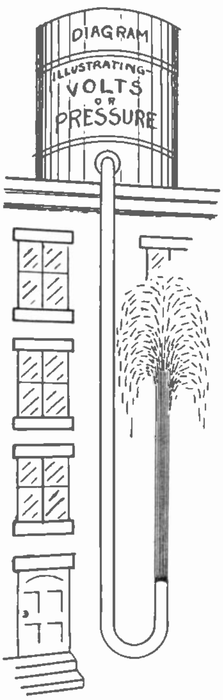



FIG. 1.

have ridden on will do—and plant it on a house roof, say 120 feet high. Tap it

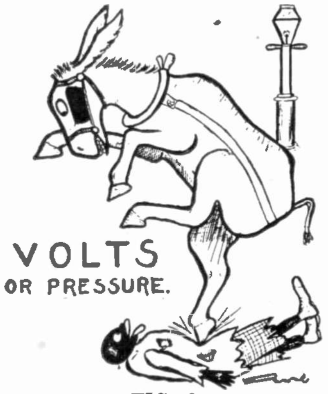



FIG. 2.

with a pipe leading to the ground, turning the lower end upward.

Look at the illustration (Fig. 1). The water spurts upward. Why? Simply on account of the pressure exerted.

It's exactly the same in electricity; it will "flow" only when pressure is applied.

In a dynamo, this pressure is exerted between two elements, positive and negative, or from one "brush" to the other.

Is this clear? No! Well then, imagine a machine in operation with its positive part on a roof 120 feet high, the negative part on the ground, a metallic circuit or wire connecting the two, and you have the everyday generator or dynamo causing a "current" to flow at 120-volts pressure.

AMPERE.

The ampere is the unit of current or "flow" and is found by simply dividing

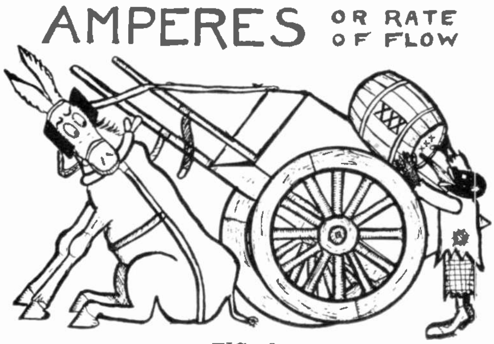



FIG. 3.

the pressure by the resistance, or the volts by the ohms.

Back to the water tank again.

You may remember we stated that a volume of water, 120 feet high, exerts a certain pressure, and in passing through a one-inch pipe, encounters a given resistance which permits a "rate of flow" of about 40 gallons per minute. Ponder carefully now!

Raise the tank higher in the air, thereby increasing the pressure, and a greater flow will take place. Or, leave the tank where it stands, and enlarge the pipe, again the flow will also be increased.

Precisely the same in electricity.

Impressing 120 volts pressure on a wire or lamp having 40 ohms resistance, permits a rate of flow of three amperes.

Double the pressure to 240 volts, and

retain the same resistance and you have six amperes. Enlarge your wire so as to halve your resistance, or 20 ohms, and you get with the original pressure of 120 volts, six amperes.

After all, isn't this simple ?

Now for the terms that are liable to send you flying in the direction of the water cart, the "watt" and "kilowatt."

WATT.

The watt is the unit of power, and is obtained by multiplying the pressure by the rate of flow, or the volts by the amperes.

A kilowatt is 1,000 watts, and represents about one and one-third horsepower; 746 watts being equal to one horsepower.

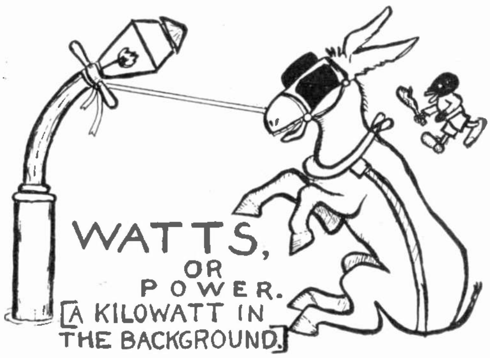



FIG. 4.

Can we explain it? Certainly.

We have before stated that 120 volts impressed on 40 ohms resistance, gave a current of three amperes.

Multiplying the last by the 120 volts we obtain 360 watts.

Impressing pressure of 120 volts on a larger wire, having only two ohms resistance, enabling a current of 60 amperes to flow, will produce 7,200 watts or 7.2 K. W. of energy.

A kilowatt hour is the use of 1,000 watts for one hour or 500 watts for two hours or 100 watts for 10 hours. This is the unit that the electric lighting companies use in charging for current and is analogous to "cubic feet" of gas. An ordinary incandescent lamp consumes about 50 watts, so if it were burned constantly for 20 hours it would use a kilowatt hour. Burning 20 lamps for one hour means the consumption of identically the same amount of energy or one kilowatt hour.

DYNAMO AND MOTOR.

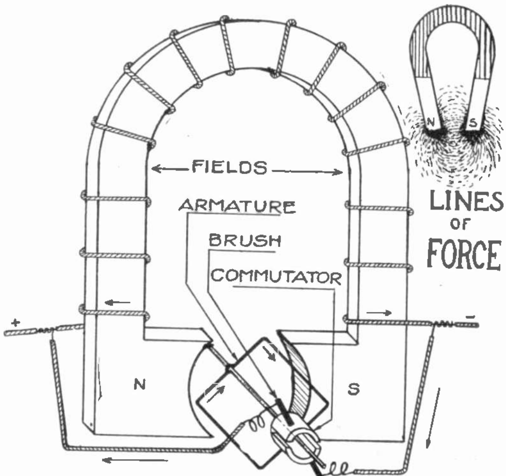
Having mastered the foregoing definitions you are now ready to investigate the principles of the dynamo and electric motor, a simple bi-polar form of which is illustrated (Fig. 5) with its "Fields," "Armature," "Commutator," and "Brushes."

The first step is to note the properties of the electromagnet.

We mentioned heretofore that when an ordinary dynamo is in operation, and a wire run from the positive to the negative pole or brush, a current would "flow" over the wire.

How is an electromagnet made?

Take an ordinary iron or steel rod, bent over as shown, wrap an insulated wire around it and permit the current to flow—Presto! the iron becomes a magnet, perhaps powerful enough to lift several tons.




A BI-POLAR DYNAMO OR MOTOR.

FIG. 5.

Interrupt the current, and the iron loses its magnetism, with the exception of a small particle known as residual magnetism, which is, so to speak, the dormant little spring emitting "Lines of Force." (see upper corner, Fig. 5) that can be developed into enormous proportions.

Every magnet has two poles, north and south, and between the two, these invisible mysterious lines of force are constantly traveling, varying in number with the magnetism developed.

When a dynamo is at rest, the minimum number are emitted, but when it is loaded with its maximum number of lights and motors out on the line, the maximum number are shot across the air gap. Why? Simply because the magnetic strength developed is proportionate to the amperes flowing around the fields.

THE ARMATURE.

If you take an ordinary piece of wire, bent as shown in Fig. 5 and place it between the poles (N) and (S) so as to cut

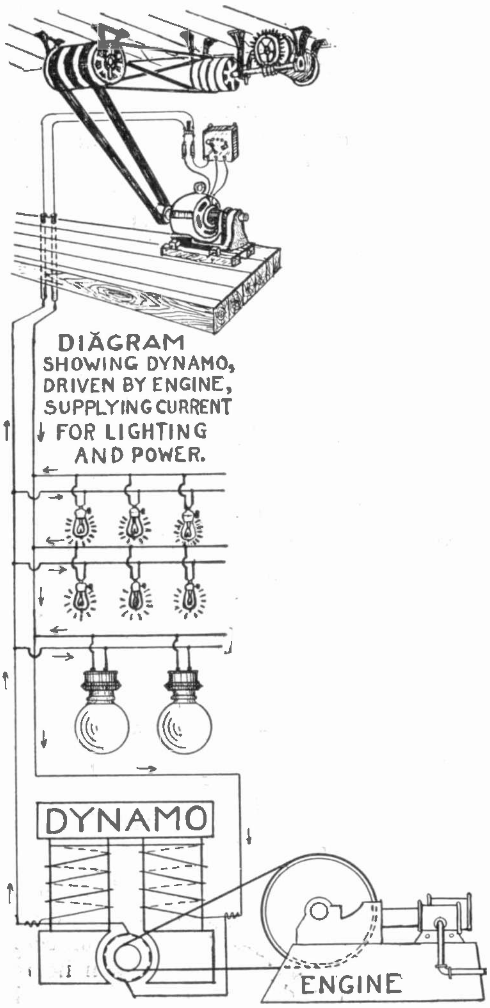



FIG. 6.

these lines of force, you are at the starting point of the armature.

Revolve this piece of wire, which we'll call an armature winding, in a given direction, and a current will flow from the upper side to the lower.

Connect each terminal of this winding to a convex piece of copper or segment, and we have the commutator.

Suspend two pieces of copper or carbon so as to rest on the upper and lower segments, and you have the brushes.

It is evident, therefore, that if we can construct a machine as above with several windings on the armature, and revolve the latter at a high speed, between the pole pieces of the field with an engine, or turbine, a current will start from one side of the commutator, thence to the positive brush around the fields out to the line, across each lamp, motor, etc. (see Fig. 6), back to the negative brush and other side of the armature winding.

That's all there is to the dynamo, which may be wound either "Series,"

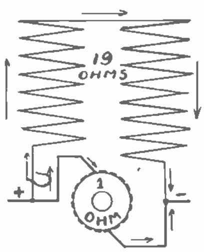



FIG. 7.

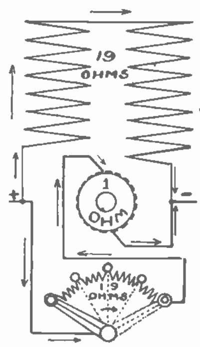



FIG. 8.

"Shunt," or "Compound," when required for direct current, as the conditions may require, or in "phases" or "frequency" for alternating current work.

Alternating current machinery should never be placed on the same line supplying direct current service, and direct current motors should always have the right voltage to meet the line conditions.

RHEOSTAT.

Of course, you've heard of the rheostat, and wondered what the clumsy looking box hung on the wall near a motor, was for, anyhow. Let us see.

Looking at the cut of a motor winding (Fig. 7) you will notice that the incoming current in passing into the machine is bifurcated, that is to say, one part travels from the positive around the field—over a winding perhaps a mile long—while the other part travels directly to the brush, thence across an armature winding to the other—the negative

—brush, a distance of perhaps 10 feet. In the former we might have a resistance of 19 ohms, in the latter only one ohm.

Now, electricity, like other things, will follow the path of least resistance, and, unless something like a dam were put in the path leading to the armature, nearly all the current would take the short cut home across the armature and blow the fuse.

We can reduce this flow with a rheostat (Fig. 8), which is practically nothing more than a lot of iron wire in compact form having, in this instance, a resistance of, say, 18 ohms; so that when it is placed in series with the armature, bringing up the latter's total resistance to 19 ohms, the current will flow as readily over the fields as it will across the armature, causing the motor to start up gradually, the speed being accelerated as the resistance is cut out. When the motor has attained full speed, the entire resistance should be cut out, unless the rheostat is designed for varying the speed. The reason for this is that the armature of the motor when it gets to revolving tends to become itself a dynamo and generate current of its own which flows in the opposite direction to that which is impressed upon it. This is called "back electromotive force." When the armature of the motor attains full speed this back electromotive force counteracts the impressed electromotive force to such an extent that the rheostat resistance is no longer needed. In an ordinary motor, the resistance is always placed in series with the armature, while in a dynamo, it is placed in series with the fields.

A motor is constructed identically the same as a dynamo, but in operation it absorbs watts, instead of generating, proportionate to the work done.

Take two dynamos, connect with two wires, rotate one with a steam engine and the other, which may be miles away, will revolve as a motor.

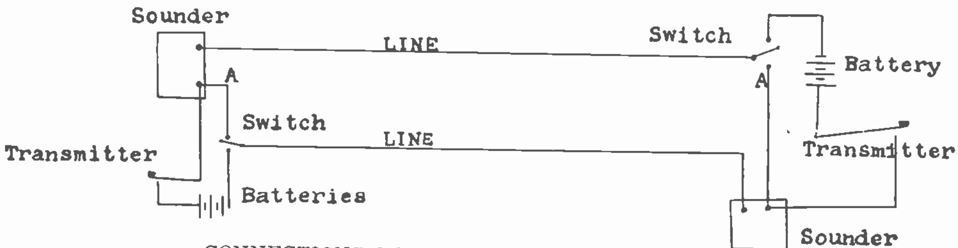
# AN OPEN CIRCUIT TELEGRAPH.

Being a young student of electricity myself I know the great desire which boys have to construct telegraphs between their homes, so I will describe for their benefit an open circuit equipment, because the closed circuit is entirely too expensive for this purpose.

All the instrument needed at each end of the line are a regular sounder, a regular transmitter, a two-point switch and a set of batteries.

It will be noticed that this plan is exactly the same as the ordinary telegraph except that a wire (A) (see diagram) has been added so that the current can be sent through the sounder at one end without going through the battery and key.

When not in use both switches are turned to connect through the (A) wires. When so connected there is no circuit through either set of batteries. The person who wishes to call simply moves his switch so that it connects through the battery and key, then he is ready to call and does so in the usual manner. To answer the call the other person also changes his switch. Then they may send messages in the usual manner. When through, both persons change their switches again and the circuit is open, but either person can call.



CONNECTIONS FOR OPEN CIRCUIT TELEGRAPH.

PERCY J. FRIDAY.

# QUESTIONS AND ANSWERS.

Readers of Popular Electricity are invited to make free use of this department. Knowledge on any subject is gained by asking questions, and nearly every one has some question he would like to ask concerning electricity. These questions and answers will be of interest and benefit to many besides the one directly concerned. No consideration will be given to communications that do not contain the full name and address of the writer.

### SMALL DYNAMO ARMATURE.

*Questions.*—I have a small dynamo which I would like to run on 110 volts direct current. It is of the bipolar type, single field coil, laminated armature, field magnets 5 inches high and 2 inches wide. Field core 1⅞ inches thick and 1¾ inches wide. The armature has 12 slots ¼ inch wide by ⅜ inch deep, and is 2 inches long and 1⅞ inches in diameter. Commutator segments, 12. Field coils wound with No. 22 B and S gauge, single cotton covered wire.

(A) What size wire should I wind on the armature?

(B) How many feet of wire will I need?—F. E. B., Mendota, Wis.

*Answers.*—(A) No. 24 B. and S. gauge, double cotton-covered wire.

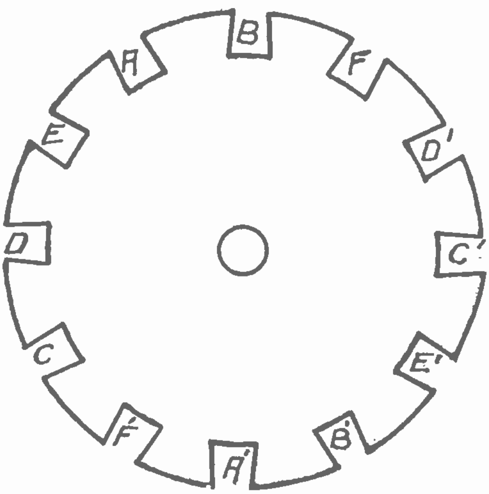



DIAGRAM REPRESENTING ARMATURE SLOTS.

(B) Winding as follows with slot dimensions given, you can wind each coil 4 or 5 layers deep and 7 layers wide, making 28 or 35 turns, or 22 feet per coil; coil No. 1 should go in slots (AA'); coil No. 2, (BB'); coil No. 3, (CC'); coil No. 4, (DD'); coil No. 5, (EE'); coil No. 6, (FF'). Now with slots half full, coil No. 7 goes in (A'A) on top of coil No. 1, beginning as lettered; coil No. 8 in slots (B'B) and so on. Bring finishing end of each coil where starting end enters and twist together. With all coils in place untwist the coil ends and twist the last end of each coil to starting end of the coil next to it at the right. These twisted ends go each to a commutator segment in regular order. We assumed the field winding to be in shunt to brushes and a starting resistance, such as a 110-volt lamp. We also assumed 5,000 or 6,000 turns of wire on field coil.

### WINDING A TWELVE-SLOT DRUM.

*Question.*—Please give diagram and information as to how a small twelve-slot drum armature should be wound.—H. J. R., Siloam Springs, Ark.

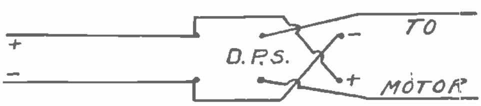
*Answer.*—See answer to F. E. B., Mendota, Wis.

### ELECTRO-MAGNECTIC ENGINE.

*Question.*—(A) How large an electro-magnetic engine similar to one described in the "Junior Section" of the June issue can be made for power purposes?

(B) How can a suitable reverse for this engine be made? H. R. C., Chicago, Ill.

*Answers.*—We have the assurance of manufacturers that they have thus far not designed such an engine for any considerable power purposes. One maker




DOUBLE POLE, DOUBLE THROW KNIFE SWITCH.

says: "We have made no calculations on a larger type than the toy form. At first glance we are inclined to think that for a larger type of engine, the rotary form might be preferable, but for a toy the reciprocating type answers every purpose and does it much more economically than the rotary form could possibly do. So far as we can say, the matter would involve much experimental design." We shall be glad to know results should you attempt a large engine.

(B) By using a double throw, double pole knife switch connected as shown in diagram.

## INDUCTION COILS AND HIGH FREQUENCY APPARATUS.

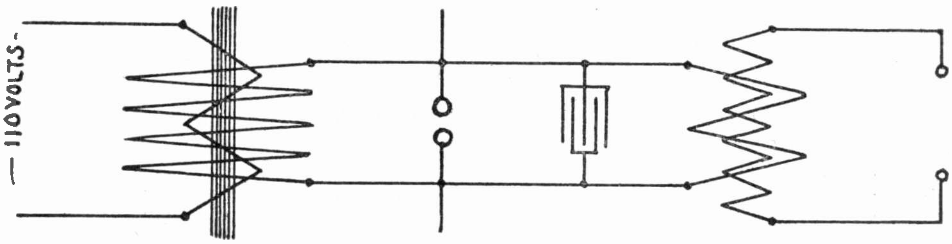
*Questions*—(A) How does an induction coil differ from a high frequency transformer? (B) How is a transformer made capable of sending 40 miles? (C) Did Tesla connect the secondary of an induction coil to the primary of a transformer? (D) Does the U. S. government make any charge or license for private wireless lines?—E. H. B., Jr., Brooklyn, N. Y.

*Answers*—(A) A high frequency transformer is, properly speaking, an induction coil; but it has no iron core, as no iron core would respond to the rapid changes of current. The primary is usually outside the secondary, and insulated from it by a considerable air space, or else the whole apparatus is immersed in oil.

(B) Soft iron wire core 16 inches long, two inches diameter. Primary, one layer No. 13 double cotton covered wire. Secondary, 10 sections each 1⅛ inches thick, 2 5-8 internal diameter, wound to six inches diameter with No. 31 wire and thoroughly insulated. Condenser, 30 sheets of tinfoil eight by 10 inches, with two plates of 10 by 12 inch window glass between each two sheets of foil. High frequency transformer, primary, 14 turns of four No. 8 wires in parallel wound on a paper cylinder 12 inches in diameter, 18 inches long. Secondary winding, placed inside the primary, No. 31 double cotton covered wire, one layer wound on paper cylinder seven inches diameter, 18 inches long. The diagram shows connections—110 volts at 125 cycles, or 50 volts at 60 cycles will be right. The transformer secondary will give a five to six inch spark, depending on condenser spark gap; but with oil insulated transformer will give a much longer spark.

(C) Yes.

(D) No. But transmission of government messages must not be interfered with.




CONNECTIONS OF HIGH FREQUENCY TRANSFORMER.

## 250 WATT TRANSFORMER.

*Question*—Please tell me how to make a 250 watt transformer that will give a six-inch spark on 110 volts 60 cycles.—C. S. K., Chicago, Ill.

*Answer*—See answer to E. H. B., Jr., in this issue. Use a rheostat in series with primary of coil.

## SPECIFICATIONS FOR THIRTY-INCH SPARK X-RAY COIL.

*Question.*—I would like some information as to how to build a 30-inch spark coil for X-ray work. I have a lot of No. 12 double cotton-covered magnet wire that I would like to use on the primary winding. I intend to use a motor generator set giving 110 or 220 volt direct current. Please give dimensions of this coil and the best way to wind the secondary.—R. A. F., Joplin, Mo.

*Answer.*—Core 2½ inches in diameter and 48 inches long should be made of annealed No. 22 B. & S. gauge Norway iron wire. Cover core with one layer of friction tape, or two or three layers of oiled paper. Wind four layers of No. 12 B. & S. gauge double-cotton-covered wire over oiled paper, placing cotton cord same diameter as wire between each turn of wire, bring out taps at ends of each layer for variable inductance (number of layers in circuit will depend entirely upon type of interrupter used; one layer for electrolytic interrupter and from two to four for mercurial or mechanical interrupter). Dip core with its winding in boiling hot beeswax. Place core and winding in mica or paper tube having ⅜-inch walls; if mica is used it must be free from metals, if paper is used, tube must be built up of paper soaked in boiling beeswax with no air spaces between layers. Twelve secondary coils should be wound in sections on mica or paper rings treated as specified for tube over primary; paper or mica rings to be two inches wide and to have an internal diameter at least one inch greater than external diameter of tube over primary. Wire may be from No. 31 to No. 36 B. & S. gauge single cotton-covered. Wind 250 layers on each ring, placing one strip of oiled paper two inches wide between each layer. Wire of each layer to be so wound that a clearance of 1/4 inch will be had to each edge of paper strips. Boil secondary sections in beeswax. Construct thoroughly seasoned birchwood box large enough to provide at least 3-inch clearance to secondary coils. Place core, tube and windings in position, spacing secondary sections so that a clearance of 1 1/2 inch will be provided between sections and 1/2 inch to tube over primary. Fill box completely with a boiling mixture of vaseline and paraffine, use just enough paraffine to slightly stiffen the vaseline.

## HOW TO MAKE AN INDUCTION COIL.

*Question*—Will you please tell me how to wind an induction coil? What is the size and length, and are the primary and secondary wires connected? Would soft wire make a good core?—R. Y., Rock Falls, Iowa.

*Answer*—Your question is very indefinite. Induction coils are made in all sizes, from the little pocket "medical" coil to the great wireless telegraph coil, throwing a spark 12 inches or more in length. For a small shock coil, wind two layers of No. 18 wire on a soft iron wire core three inches long and 3/8 of an inch in diameter. Over this lay three layers of paper, well shellaced. Then wind on two ounces of No. 36 silk covered copper wire, connecting the ends to handles. A vibrator in the primary circuit is needed to complete the coil; but a home made substitute may be used by connecting one pole of battery to one end of the primary winding and the other end of primary winding to a large, coarse file, then rubbing a wire connected to the other pole of battery on the file. The secondary winding is connected to nothing but the handles for delivering the shock.

## INDUCTION COIL.

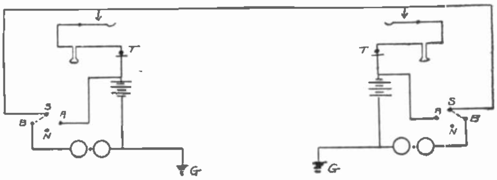
*Question*—I wish you would publish in your magazine how to make an induction coil.—S. M. C., Denver, Colo.

*Answer*—See answer to R. Y., in this issue.

## SIMPLE TELEPHONE CIRCUIT.

*Question.*—Will you please inform me how I may run two telephones on one wire with a bell on each, operated by a push button or switch?—K. Y., St. Paul, Minn.

*Answer.*—The diagram gives the circuit you wish with bells operated by




SIMPLE TELEPHONE CIRCUIT.

three-point switches. Normally the switches should be left as shown. Either party may call the other by swinging the switch arm across (SA) and preferably leaving it on (N) while talking. The batteries are arranged to work together when the receivers are off the hooks.

## REWINDING FAN MOTOR.

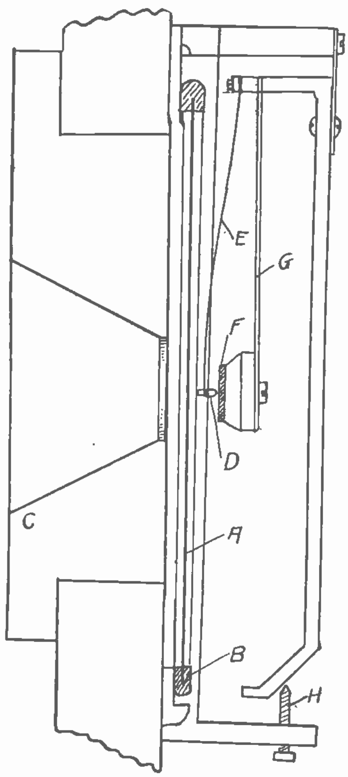
*Question*—I have a C. & C. 500-volt fan motor (1/4 horsepower) that I wish to wind as a dynamo. The armature is a laminated ring two inches wide, 1/2 inch thick by 4 1/2 inches diameter, with 30 segment commutator. Field spool is about 4 1/2 or 5 inches outside diameter. I wish to shunt wind the machine for 12 volts (or 10). What size wire, number of layers and turns to the section should I use? What size for fields? Speed of armature? I have the armature wound now with No. 20, four layers of 11 turns to the layer and calculated for 50 volts. What should I use on the field for a shunt and what current should I get, at what speed?—G. B. G., Bath, Me.

*Answer*—For 12 volts: Armature 30 sections, each two layers, six turns to the layer, No. 14 single cotton covered wire. Field, No. 20 wire, shunt connected. For 50 volts wind the field with No. 26 wire. You will have to experiment a little to determine the correct speed. Probably 2,800 or thereabouts. Machine should deliver 150 watts; but turning a small motor into a dynamo is often an uncertain performance.

## MAGNETIC NEEDLE; MOTOR OPERATION; TELEPHONE TRANSMITTER.

*Questions.*—(A) What is the effect of an alternating current on a magnetic needle placed parallel and under the wire? (B) Is there any effect of winds on oscillations in wireless apparatus? (C) Why should not an alternating current operate a series wound motor with a commutator, since the change of direction of direct current does not change the direction of the motor? (D) Please explain the parts and workings of a telephone transmitter.—E. R., Franklin, Ind.

*Answers.*—(A) The answer to your question is fully given in the article on "Elementary Electricity," pages 274-5, September number, 1908.




TELEPHONE TRANSMITTER.

(B) See article, "Effect of Wind on Wireless Waves," this issue.

(C) It will run. See answer to M. B., this issue.

(D) The diagram shows a Blake transmitter which operates on the principle of varying pressure and in this way the resistance of the circuit through the transmitter is increased or decreased. (A) is the diaphragm surrounded by a rubber ring (B), the whole being fastened back of the mouthpiece (C). A piece of platinum wire (D) is secured to a spring (E). The wire touches the diaphragm and also makes light contact with a carbon button (F) attached to a spring (G). The screw (H) adjusts this latter contact. When sound waves disturb the diaphragm (A), the resistance between the platinum wire and carbon button varies, and a fluctuating current passes through (E), (D), (F), and (G), and then to the receiver coil. This varying current reproduces the original variations and sounds in the receiver.

Some transmitters use carbon granules between two polished disks or electrodes, one of which is attached to the diaphragm. One type of this transmitter is called the solid-back or White transmitter and is used by the American Bell Telephone Company.

## DIRECT CURRENT MOTOR ON ALTERNATING CURRENT.

*Question.*—Can a direct current motor with laminated armature and field be run with alternating current?—M. B., Superior, Wis.

*Answer.*—Yes, if a series wound motor. The writer had occasion to do this with the above type motor and found it necessary to reduce the field turns about one-half for satisfactory results. See answer to questions (D) of V. E. H., July number, 1908; also any treatise on rotary converters.

## HIGH FREQUENCY APPARATUS.

*Questions.*—(A) In the article on "How to Make a High Frequency Apparatus," how many pounds of secondary wire would be required in the transformer? (B) What length of spark should transformer give and how far, with same, should transformer transmit wireless signals, both ends using tuned circuits and electrolytic detectors? (C) Of how many watts, amperes and volts capacity would above transformer be? (D) Would it be practical to use shasta water bottles for leyden jars by coating the outside with tin foil or some metallic paint and filling the jar about one-third full of dilute sulphuric acid, so as not to break or cut the neck of the bottle off? (E) Do you know of any better method of preparing jars, and how many would it take of same to condense the spark of the transformer?—R. L. McC., San Francisco, Cal.

*Answers.* — (A) Secondary: nine pounds No. 32 B. & S. gauge, single cotton covered wire. Primary: four pounds No. 12 B & S. gauge, double cotton covered wire.

(B) Primary in parallel on 110 volts

or in series on 220 volts will give a spark one inch long with pointed terminals; a little less than half as far with primary in series on 110 volts. The supposition is 60 cycle current. The spark will jump much farther if a condenser capacity is shunted across the gap. Dr. De Forest, who has seen this transformer in operation, said that it would transmit signals up to 200 miles.

(C) Maximum Watts 2,000; current, 25 amperes; secondary voltage, 10,000 and 20,000, depending on connections.

(D and E) With the apparatus described in the article it would be better to use plate condensers instead of Leyden jars. Leyden jars may, however, be made as described in answer to G. A. C., this issue, or as in the article on page 452, November issue.

### CONSTRUCTION OF A LEYDEN JAR.

*Questions.*—(A) How can I make a Leyden jar, referring to the December number, page 465, Fig. 63? (B) Of what material is the instrument there shown made? Can it be purchased? (C) How long does it take to pierce a hole through a glass one-eighth of an inch thick using an electric discharge? G. A. C., Pittsburg, Pa.

*Answers.*—(A) Paste tinfoil coatings on the inside and outside of a glass jar to about two-thirds of its height. Varnish the jar above the coatings to provide better insulation. Through a rubber or dry wood stopper pass a brass rod terminating in a knob at the top, and connecting with the inner coating by a loose chain at the lower end.

(B) Glass rods may be used for pillars; and brass fittings, rods and knobs for live parts. Glass serves as a good insulator, but collects moisture. Without proper tools it is hard to use in construction. Hard rubber, ebonite, or vulcanite is much more easily worked, is a good insulator and much used. Continually exposed to the light, however, the sulphur used in vulcanizing, oxidizes and the rubber slowly loses its insulating qualities to a certain extent. For mounting, quarter sawed oak, dull weathered oak, or any well seasoned solid wood may be used. Examine the apparatus of some physician who gives electro-therapeutical and X-ray treatments and you will be able to gather a great many helpful suggestions. Any company supplying experimental electrical apparatus to school and college laboratories will be glad to send you a catalogue.

(C) This depends upon the quality and brittleness of the glass, and the capacity of the Leyden jar. A one-quart jar will often if fully charged give desired results. A five or six-jar battery will act very positively on a single discharge.

### MAKING A STORAGE BATTERY.

*Questions.*—(A) How would be the best way to make a storage battery?

(B) What would be the dimensions?

(C) How many batteries would be required to light six sixteen candlepower lamps for twelve hours?

(D) How should connections be made?

(E) How can I tell when batteries are fully charged?—E. L. F., Fort Worth, Tex.

*Answers.*—(A) In addition to the method described in the answer to F. R. in the February issue, the following method is recommended: Get a quantity of torpedo lead about 1-64 inch thick by ⅜ inch wide; also ten pounds of sheet lead ¼ inch thick, cut into strips ⅜ inch wide. With these last make seven frames, 7 by 6 inches, using a block of

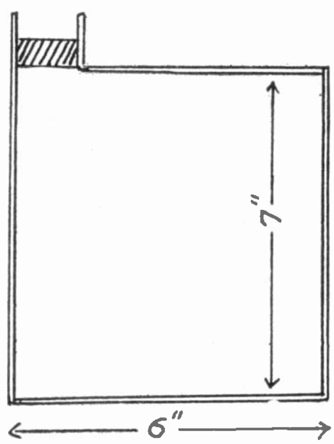



FIG. 1.

wood to shape the strip like Fig. 1. Solder a ⅜-inch strip between the ends. Now cut 6-inch torpedo lead strips, and as many 8-inch strips. Fit the 6-inch strips horizontally and corrugate the 8-inch strips as in Fig. 2, fusing the ends so they will stay in place. Using about four pounds of yellow lead, 10 parts of water and one part sulphuric acid, make a paste and fill four frames for negative plates. The remaining three frames fill with three pounds of red lead mixed with the same proportion of acid and water as for the negative plates. These are the positive plates. Prepare card-

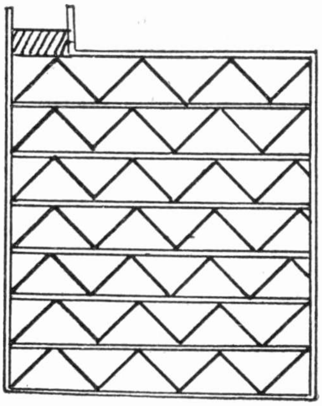


FIG. 2.

board 3-16 inch thick, soaked in silicate of soda and well dried. Place these between alternate positive and negative plates laid together and tied. Lugs of opposite plates should stand opposite each other. Now fuse a heavy strip of lead, Fig. 3, across the three positive

FIG. 3.

plates, and another across the four negative plates, Fig. 4. Place the whole in a glass jar and fill with dilute sulphuric acid and two ounces of sodium bicarbonate. Charge with a current of 12 amperes for 45 or 50 hours. This bat-

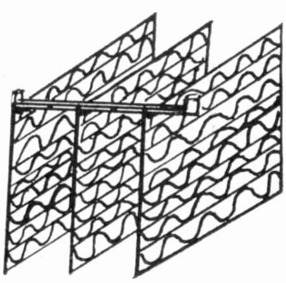


FIG. 4.

tery should give eight amperes for 12 hours at two volts.

(B) Since upon the size of the plates depends in part the current delivered, you can make a close estimate for your purpose from the above figures.

(C) This depends upon the voltage of your lamps. A battery should not be discharged below 1.75 volts per cell, so dividing the voltage of your lamps by 1.75 gives number of cells required.

(D) Cells connected in series give the voltage of one cell multiplied by the number of cells, and the current of one cell.

Cells connected in parallel give the voltage of one cell and the current of one cell multiplied by the number of cells.

(E) See answer to E. R. in February issue.

### COIL TO EXPLODE POWDER.

*Question.*—Please tell me what kind of a spark coil I would need to explode powder at any distance up to one mile.—C. D.

*Answer.*—Length of core, 6½ inches; diameter, 1 3-16 inches; diameter over primary winding, 1¼ inches; size of wire, No. 14 B. & S. gauge; weight of wire, 8 ounces; insulating tubes between primary and secondary, 3-32 inch; length of secondary winding, 4¾ inches; diameter, 2⅝ inches; size of wire, No. 36 B. & S. gauge, number of sections, 4; weight of wire, 1½ pounds. Condenser: Size of tinfoil, 6 by 3 inches; number of sheets, 40; voltage, 8; amperes, 4. See "Two-Mile Wireless Outfit" in November issue, 1908, for further construction details.

To make a fuse for exploding powder, provide a tube of paper, large enough to slip over two wires well insulated and twisted around each other, their ends for 1-16 of an inch being bare and within ⅛ inch of each other in the tube. Fill this tube with fine gunpowder, close up the end with wax and connect the two free ends to the ends of the secondary of your coil. Place this fuse in the powder to be exploded and close the primary circuit of the coil.

### THE NATIONAL ELECTRICAL CODE.

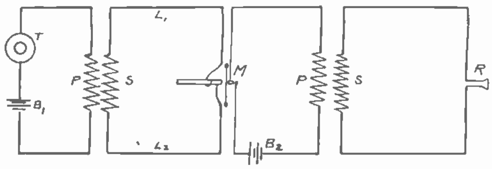
This department will be glad to answer and discuss questions pertaining to the installation of electric wiring and apparatus in accordance with the National Electrical Code, Rules and Requirements of the National Board of Fire Underwriters. These questions will be cared for by an electrical engineer and inspector actively engaged in field work.

### TELEPHONE REPEATERS.

*Questions.*—(A) Are there any telephone repeaters similar to the telegraph repeater in working principle in existence?

(B) Why do you not hear yourself talk in the telephone?—L. A. F., Lyons, Ia.

*Answers.*—(A) Yes. Under telephone relay or repeater in any standard work on telephony you will find a detailed account of one-way and two-way repeaters. The diagram shows the arrangement of the former. Transmitter (T), battery ($B_1$), induction coil (PS), line ($L_1L_2$), microphone contact on the principle of the Blake transmitter, operating with a receiver at (M), a second induction coil (PS), battery ($B_2$) at receiving end,




TELEPHONE REPEATER.

operate diaphragm at (M), which causes variation of resistance of contact at (M), allowing corresponding currents from battery ($B_2$) to act inductively on the receiver (R) with reinforced energy.

(B) Listen to your receiver while you blow into your transmitter. Let some one talk into the transmitter in a quiet room, while you stand off the full length of the receiver cord and listen in the receiver. The fact is you do hear yourself through the instrument but your voice is so much stronger that you do not notice it.

### GRAVITY BATTERY; SMALL INDUCTION COIL.

*Questions.*—(A) How many pounds of blue vitriol will it take for a gravity battery six by eight inches?

(B) I am to make an induction coil, core four inches long and ¼ inch in diameter. How much No. 18 single cotton covered wire will be required for four layers on the primary? How much No. 30 single silk covered wire will be required for twelve layers for the secondary?—A, E. H., Fenton, Mich.

*Answers.*—(A) The standard "Crowfoot" cell is a jar six inches in diameter by eight inches high, and for steady work about three pounds of blue vitriol is sufficient.

(B) About two pounds of No. 18 for primary, assuming that core is entirely covered, and ¼ of a pound of No. 30, B and S gauge, for secondary.

### SPARK PLUG COIL AND WIRING.

*Question.*—(A) Please give diagram for wiring a three binding post coil with vibrator to a make-and-break spark plug on gas engine. (B) Please give a diagram of a four binding post coil in circuit. (D) Could I make a coil by making a core and winding the primary on the core and boiling it in beeswax and insulating between each layer of wires, then wind on the secondary and boil each winding, insulating with paper and taking care not to wind close to ends of coil? (D) Would such a coil do for wireless telegraphy if made eight or nine inches long? (E) What size wire should I use?—W. W., Novinger, Mo.

*Answers.*—(A) See Fig. 1 in which are timer (T), plug (P), and vibrator (V).

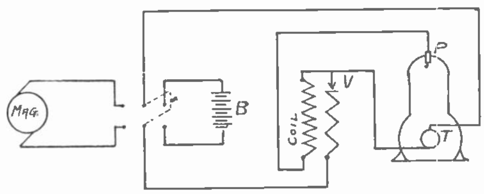



FIG. 1. WIRING OF A THREE BINDING POST COIL.

(B) See Fig. 2.

(C to F) You would need good insulation between the primary and secondary and also sectional winding of the secondary. See "Construction of a Two-Mile Wireless Outfit" and also answers to a Reader, C. R. B., G. S. and C. E., in the November issue, 1908.

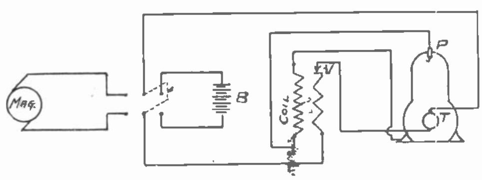



FIG. 2. WIRING OF A FOUR BINDING POST COIL.

### TELEPHONE MAGNETO.

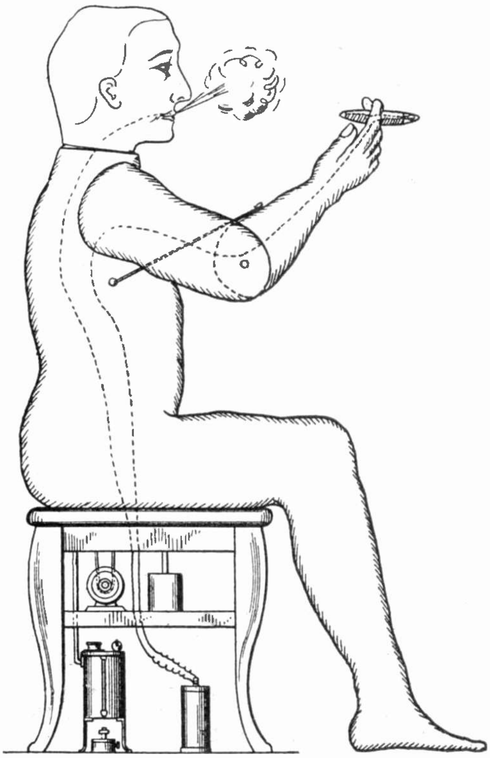
*Question.*—Can a telephone magneto be changed so it will give direct current without changing armatures?—A. M., Alhambra, Cal.

*Answer.*—Yes. See answers to questions (C) and (D) of V. E. H., this department, July issue, 1908.

# NEW ELECTRICAL INVENTIONS.

### ADVERTISING AUTOMATON.

A unique advertising "stunt" is illustrated in the accompanying cut. It consists of an electrically operated automaton used to advertise smokers' supplies. The figure is provided with a movable head and arm which are operated by a series of levers and cams, run by a small motor. The hand moves up to the face



ADVERTISING AUTOMATON.

and inserts a cigar in the mouth. The figure apparently takes a deep puff and the cigar is withdrawn. Then the head tilts back and a little volume of steam, from a small boiler beneath the figure, is blown from the lips, simulating smoke.

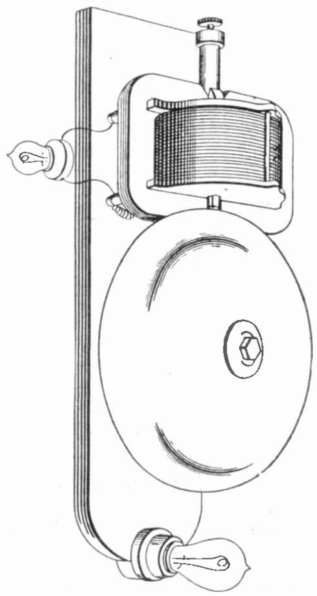
In the mouth there is a contact plate which is connected by a wire with one side of a battery. In the end of the cigar which is placed in the mouth is another contact plate, which is connected through a small incandescent lamp in the outer end of the cigar to the other side of the battery. Thus when the cigar is placed in the mouth the two contact plates are brought together and the lamp lights up. The end of the cigar containing the lamp is formed of frosted glass made to represent ashes, so that the effect produced is startlingly realistic.

The inventor of this ingenious apparatus is Daniel F. Brown of South Framingham, Mass.

### ELECTRIC BELL FOR LIGHT CIRCUITS.

There is a great demand for some means for operating an alarm bell from the electric lighting circuit instead of by dry batteries. The ordinary call bell cannot be operated in this way without a transformer or resistance of some sort to keep the coils of the bell from being burned out.

A special type of bell for connection



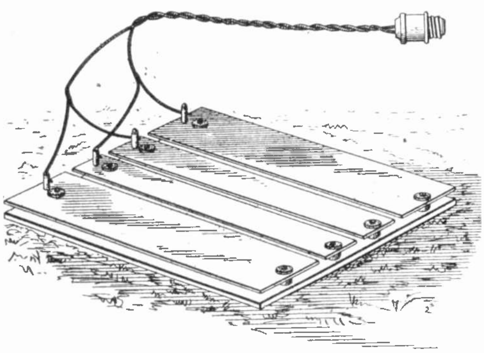
ELECTRIC BELL FOR LIGHTING CIRCUITS.

to the lighting circuit is shown in the cut herewith. It is the invention of E. P. Steen of Cripple Creek, Colo.

At the bottom of the bell is a tube containing an iron plunger. The tube is surrounded by a magnetizing coil which is in circuit with the lighting wires when the button is pushed. The current then flows around the coil and sucks up the plunger, on the solenoid principle, striking the bell or gong. The little lamp at the right cuts down the strength of the current in the coil and at the same time lights up and forms a visual signal.

## ELECTRIC RAT TRAP.

This unique device for killing rats consists of four metal plates insulated from each other. To the first and third plates are connected a wire from one side of the ordinary lighting circuit. To the second and fourth plates runs a wire from the other side of the circuit. Thus



ELECTRIC RAT TRAP.

adjoining plates are of opposite polarity and a rat stepping across from one to another is electrocuted. This ingenious trap is the invention of John T. Norris of Troy, S. C.

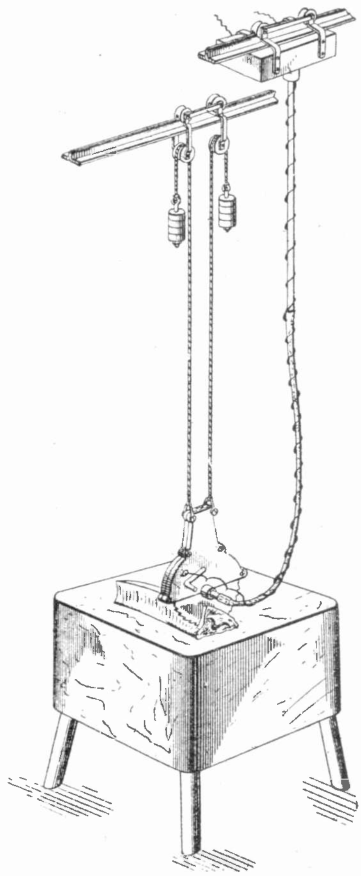
## ALUMINUM SOLDER.

One of the things inventors have been working on for a long time is to obtain an effective solder for joining aluminum to aluminum. Lack of such a solder has been one of the drawbacks in the more extensive use of aluminum in electrical work.

A new compound for this purpose has been patented by Harry B. Lambert of North Pelham, N. Y. It consists of 68 parts of tin, 29 parts of zinc, two parts of antimony and one part of phosphorous, by weight. These different component parts are first thoroughly heated separately to a liquid form, then thoroughly mixed and allowed to cool off and then used in the form of what is commonly known as bar solder.

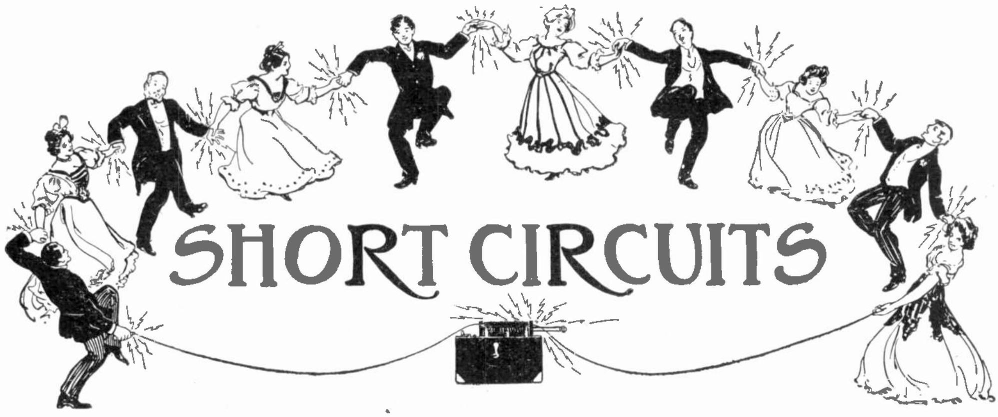
## BUTCHERS' ELECTRICALLY OPERATED SAW.

A meat saw which is operated by a motor and which is easily adjusted to the work in hand is shown in the cut. The saw, which is partially enclosed in a protective housing, is suspended by cords and weights from two wheels which run on an overhead track. Another parallel



BUTCHERS' ELECTRIC SAW.

track carries an electric motor from which depends a flexible shaft to turn the saw. The weights just about balance the saw and its housing so that the latter may be readily raised up out of the way when not in use. The inventor is T. A. Tubbs of Treadwell, District of Alaska.



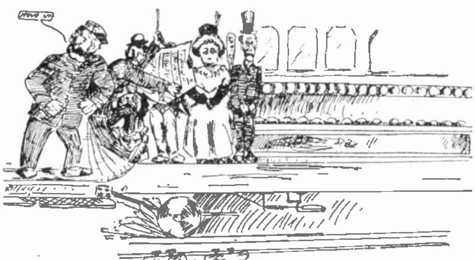
# SHORT CIRCUITS

"What's that curious-looking charm you are wearing on your watch-chain?"

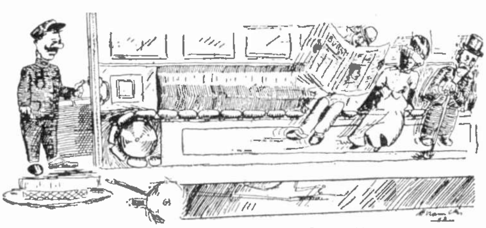
"That is our new coat-of-arms—chauffeur rampant, policeman couchant, justice of the peace expectant."

* * *

An Englishman said he liked babies best when they cried, and on being asked why, replied, "Because then they are taken out of the room."



THE OLD WAY.



THE NEW WAY.

*Courtesy The Electric Traction Weekly.*

"Now," said the teacher, proposing a problem, "suppose I had ten dollars and went into a store to spend it. Say I bought a hat for five dollars. Then I spent two dollars for gloves, and a dollar and fifty cents for some other things. How much did I have left?"

For a moment there was dead silence. Then a boy's hand went up.

"Well, Isaac, how much did I have left?"

"Vy didn't you count your change?" said Isaac, with a disgusted tone.

* * *

A widower who was married recently for the third time and whose bride had been married once before herself, wrote across the bottom of the wedding invitations: "Be sure and come; this is no amateur performance."

* * *

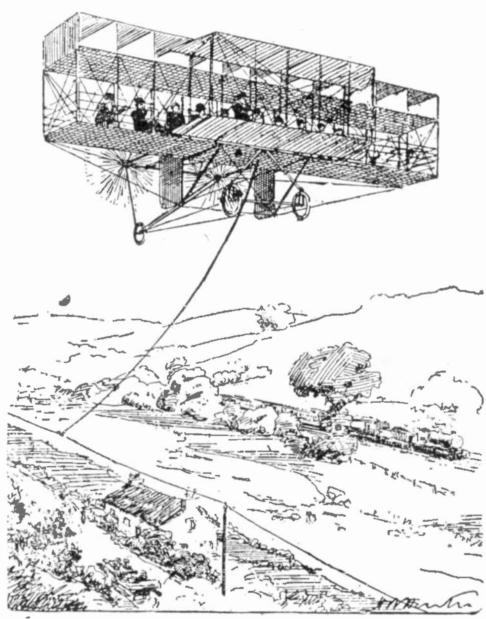
They were looking up at the latest skyscraper. "But what are those things sticking out from the sides?" asked the up-state friend.

"Those? Oh, those are mile posts!" answered the New Yorker.

An old darkey wanted to join a fashionable church on Fifth Avenue, New York, and the minister, knowing it was hardly the thing to do, and not wanting to hurt his feelings, told him to go home and pray over it. In a few days the darkey came back.

"Well, what do you think of it by this time?" asked the preacher.

"Well, sah," replied the colored man, "Ah prayed an' prayed, an' de good Lawd he says to me, 'Rastus, I wouldn't boddah my haid 'bout dat no mo'; Ah've been tryin' to git into that chuch mahself for de las' twenty years, and I hain't done had no luck!' "



AN AERIAL TROLLEY PARTY.

A burglar who had entered a minister's house at midnight was disturbed by the waking of the occupant of the room he was in. Drawing his pistol, he said: "If you stir you are a dead man. I am hunting for money."

"Let me get up and strike a light," said the minister, "and I will hunt with you."

* * *

A psychologist came upon a hard-working Irishman, toiling, bare-headed, in the street.

"Don't you know," asked the psychologist, "that to work in the sun without a hat is bad for your brain?"

"D'ye think," said the Irishman, "that Oi'd be on this job if Oi had any brains?"

Mistress—"Did the mustard plaster do you any good, Bridget?"

Maid—"Yes; but, begorry, mum, ut do bite the tongue!"

* * *

"That's a curious mule you're driving," remarked the man who was whittling a pine stick.

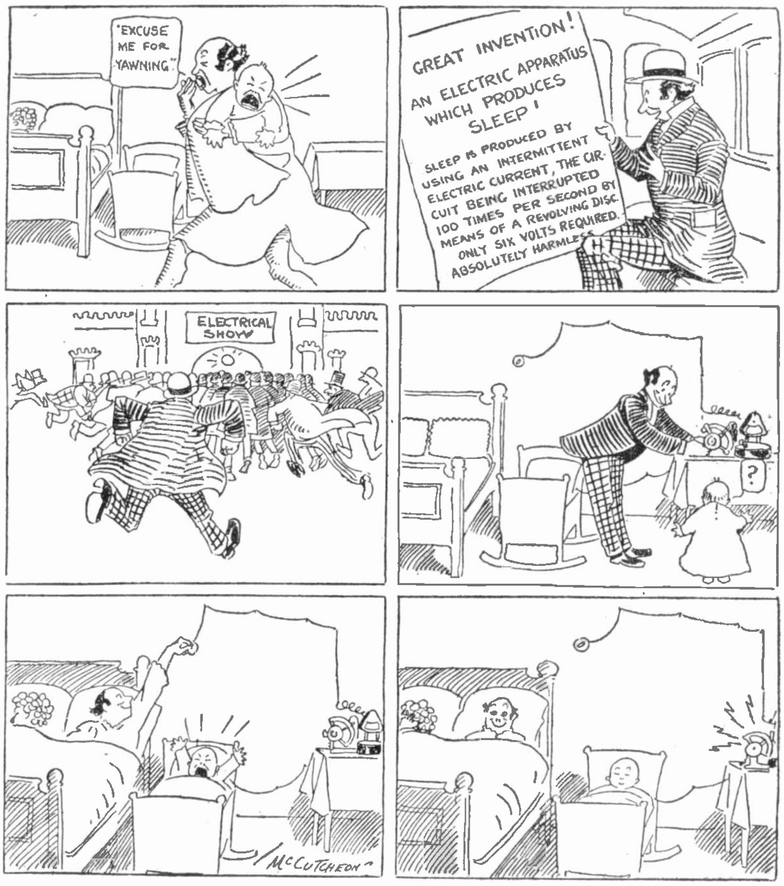
"Yassar," answered Erastus Pinkley. "He's kind of cur'us."

"What will you take for him?"

"What'll I take foh him? Say, boss, is you referrin' to dat mule as a piece o' property or an affliction?"

A diffident man who had been asked to respond to a toast at a banquet grew more and more nervous as the time approached when he should be called on. When at last the critical moment arrived, he gripped the edge of the table and rose uncertainly.

"Gentlemen," he said, "when I heard I was to be called upon this evening I made the effort of my life, and really the result was a fine speech. I made one telling point after another—but I kept my scintillations strictly to myself for a surprise. Only myself and God knew that speech; and now—God only knows it." And he sat down.




*Courtesy Chicago Tribune.*

"Now, children," said the teacher, "is the sentence, 'The horse and cow is in the pasture' correct?"

"No, ma'am," said Johnny.

"What is the matter, Johnny?" asked the teacher.

"Please, ma'am, the lady should be mentioned first."

* * *

Two London cabbies were glaring at each other.

"Aw, wot's the matter with you?" demanded one.

"Nothink's the matter with me, you bloomin' idiot."

"You gave me a narsty look," persisted the first.

"Me? Why, you certainly 'ave a narsty look, but I didn't give it to you, so 'elp me!"

A disheveled man, much the worse for liquor, staggered out of a Maine "speak-easy" and laboriously propped himself against the door. For a while he owlishly surveyed the passers-by. Suddenly his foot slipped and he collapsed in a heap on the sidewalk. A moment later he was snoring.

A hurrying pedestrian paused, reflectively surveyed the fallen man for a few seconds, and then poked his head in the door.

"Oh, Frank," he called. "Frank. Come out here a minute."

Presently the proprietor of the joint, smoking a fat cigar, emerged. He blinked in the bright sunlight.

"Hello, Hud," he said, pleasantly. "What's up?"

Hud jerked his thumb toward the slumberer on the sidewalk.

"Yer sign has fell down," he explained, and briskly resumed his walk uptown.

# ELECTRICAL DEFINITIONS.

**Accumulator.**—Storage battery.
**Alternating Current.**—That form of electric current the direction of flow of which reverses a given number of times per second.
**Ammeter.**—An instrument for measuring electric current.
**Ampere.**—Unit of current. It is the quantity of electricity which will flow through a resistance of one ohm under a potential of one volt.
**Ampere Hour.**—Quantity of electricity passed by a current of one ampere flowing for one hour.
**Anode.**—The positive terminal in a broken metallic circuit; the terminal connected to the carbon plate of a battery.
**Armature.**—That part of a dynamo or motor which carries the wires that are rotated in the magnetic field.
**Branch Conductor.**—A parallel or shunt conductor.
**Brush.**—The collector on a dynamo or motor which slides over the commutator or collector rings.
**Bus Bars.**—The heavy copper bars to which dynamo leads are connected and to which the out-going lines, measuring instruments, etc., are connected.
**Buzzer.**—An electric alarm similar to an electric bell, except that the vibrating member makes a buzzing sound instead of ringing a bell.
**Candle Power.**—Amount of light given off by a standard candle. The legal English and standard American candle is a sperm candle burning two grains a minute.
**Capacity, Electric.**—Relative ability of a conductor or system to retain an electric charge.
**Charge.**—The quantity of electricity present on the surface of a body or conductor.
**Choking Coil.**—Coil of high self-inductance.
**Circuit.**—Conducting path for electric current.
**Circuit-breaker.**—Apparatus for automatically opening a circuit.
**Collector Rings.**—The copper rings on an alternating current dynamo or motor which are connected to the armature wires and over which the brushes slide.
**Commutator.**—A device for changing the direction of electric currents.
**Condenser.**—Apparatus for storing up electrostatic charges.
**Cut-out.**—Appliance for removing any apparatus from a circuit.
**Cycle.**—Full period of alternation of an alternating current circuit.
**Diamagnetic.**—Having a magnetic permeability inferior to that of air.
**Dielectric.**—A non-conductor.
**Dimmer.**—Resistance device for regulating the intensity of illumination of electric incandescent lamps. Used largely in theaters.
**Direct Current.**—Current flowing continuously in one direction.
**Dry Battery.**—A form of open circuit battery in which the solutions are made practically solid by addition of glue jelly, gelatinous silica, etc.
**Electrode.**—Terminal of an open electric circuit.
**Electromotive Force.**—Potential difference causing current to flow.
**Electrolysis.**—Separation of a chemical compound into its elements by the action of the electric current.
**Electromagnet.**—A mass of iron which is magnetized by passage of current through a coil of wire wound around the mass but insulated therefrom.
**Electroscope.**—Instrument for detecting the presence of an electric charge.
**Farad.**—Unit of electric capacity.
**Feeder.**—A copper lead from a central station to some center of distribution.
**Field of Force.**—The space in the neighborhood of an attracting or repelling mass or system.
**Fuse.**—A short piece of conducting material of low melting point which is inserted in a circuit and which will melt and open the circuit when the current reaches a certain value.
**Galvanometer.**—Instrument for measuring current strength.
**Generator.**—A dynamo.
**Inductance.**—The property of an electric circuit by virtue of which lines of force are developed around it.
**Insulator.**—Any substance impervious to the passage of electricity.
**Kilowatt.**—1,000 watts. (See watt.)
**Kilowatt-hour.**—One thousand watt hours.
**Leyden Jar.**—Form of static condenser which will store up static electricity.
**Lightning Arrester.**—Device which will permit the high-voltage lightning current to pass to earth, but will not allow the low voltage current of the line to escape.
**Motor-dynamo.**—Motor and dynamo on the same shaft, for changing alternating current to direct and vice versa or changing current of high voltage and low current strength to current of low voltage and high current strength and vice versa.
**Multiple.**—Term expressing the connection of several pieces of electric apparatus in parallel with each other.
**Multiple Circuits.**—See parallel circuits.
**Neutral Wire.**—Central wire in a three-wire distribution system.
**Ohm.**—The unit of resistance. It is arbitrarily taken as the resistance of a column of mercury one square millimeter in cross sectional area and 106 centimeters in height.
**Parallel Circuits.**—Two or more conductors starting at a common point and ending at another common point.
**Polarization.**—The depriving of a voltaic cell of its proper electromotive force.
**Potential.**—Voltage.
**Resistance.**—The quality of an electrical conductor by virtue of which it opposes the passage of an electric current. The unit of resistance is the ohm.
**Rheostat.**—Resistance device for regulating the strength of current.
**Rotary Converter.** — Machine for changing high-potential current to low potential or vice versa.
**Secondary Battery.**—A battery whose positive and negative electrodes are deposited by current from a separate source of electricity.
**Self-inductance.**—Tendency of current flowing in a single wire wound in the form of a spiral to react upon itself and produce a retarding effect similar to inertia in matter.
**Series.**—Arranged in succession, as opposed to parallel or multiple arrangement.
**Series Motor.**—Motor whose field windings are in series with the armature.
**Shunt.**—A by-path in a circuit which is in parallel with the main circuit.
**Shunt Motor.**—Motor whose field windings are in parallel or shunt with the armature.
**Solenoid.**—An electrical conductor wound in a spiral and forming a tube.
**Spark-gap.**—Space between the two electrodes of an electric resonator.
**Storage Battery.**—See secondary battery.
**Thermostat.**—Instrument which, when heated, closes an electric circuit.
**Transformer.**—A device for stepping-up or stepping-down alternating current from low to high or high to low voltage, respectively.
**Volt.**—Unit of electromotive force or potential. It is the electromotive force which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere.
**Voltage.**—Potential difference or electromotive force.
**Volt Meter.**—Instrument for measuring voltage.
**Watt.**—Unit representing the rate of work of electrical energy. It is the rate of work of one ampere flowing under a potential of one volt. Seven hundred and forty-six watts represent one electrical horse power.
**Watt-hour.**—Electrical unit of work. Represents work done by one watt expended for one hour.

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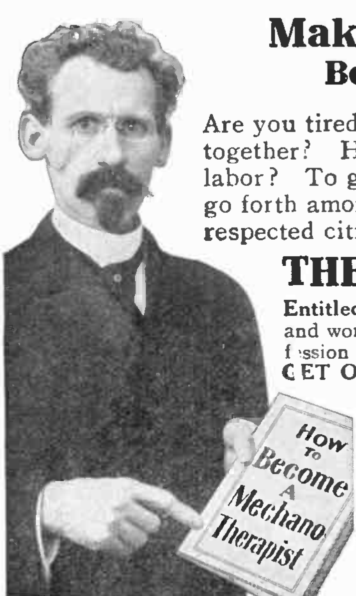


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Are you tired of working for wages which barely keep body and soul together? Have you the ambition to enjoy the profits of your own labor? To gain social prominence and financial independence? To go forth among your fellow men with your head up—an honored and respected citizen of your locality?

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### What is Mechano-Therapy?

Mechano-Therapy is the art, or science, of treating disease without drugs. It is similar to Osteopathy, but far superior, being the latest, up-to-date method of treating disease by the Natural Method. It heals as Nature heals—in accordance with Nature's laws.

The Mechano-Therapist is a drugless physician and a bloodless surgeon. His medicines are not drugs, but scientific combinations of food, circumstance, idea, water and motion.

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### CAN I LEARN IT?

Have you asked yourself this question? We answer, unhesitatingly, YES.

If you have so much as an ordinary, common school education, you can learn.

If you have the ambition to better your condition—to earn more money—to have more leisure—you can learn.

Nor does this require years of patient study to learn Mechano-Therapy—we can teach you in a very short time, so that you may enter this profession—and when you do, you begin to make money. No text books are required, beyond those furnished by us. We supply all lessons and necessary text books free of cost to you. No apparatus is used. You do not even need a place to work. All you require is your two hands.

### Read What Our Graduates Say

The statements of a few of our graduates below verify every claim we make. Read them carefully, and remember that what these men and women have done, you may do. The success they have made, you may make. We do not give the address of the people whose testimonials we print. Our graduates are meeting with remarkable financial success, and shrink from having their prosperity published broadcast. If you wish to communicate with any whose names are given below, write us and we will supply you with the address.

**Treating Physician for Diabetes**

**Dr. Ellsworth** says: I have all I can do, and at very good fees, and am at present treating an M. D. for Diabetes. It is impossible for me to speak in befitting terms of the wonderful success of Mechano-Therapy in the treatment of disease.

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**Dr. B. E. French** says: I consider Mechano-Therapy greatly superior to Osteopathy, and as it is a profession so very interesting and one so easily learned. I am suprised that more do not take it up, especially as the course in your college is so inexpensive.

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**From the President of the College.**

Have you ever thought of going into business for yourself?

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We *would* not (and could not if we would) thus address millions of the most cultivated and intelligent readers in the U. S., spend *thousands* in magazines publishing such a challenge, and *more thousands* in R. R. freights, if we were wrong in our statements or over-conceited about the tone quality of the Wing Piano.

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Gentlemen--You may ship me on trial one Wing Piano of the above style with stool and scarf, to this address: Town..........State........ with freight from New York prepaid in advance, and send me an order to get it from the railroad depot, ON TRIAL ONLY. THERE IS NO AGREEMENT BY ME TO PURCHASE THIS PIANO, but I will allow it to remain in my home on trial for twenty days, and if it proves satisfactory and I conclude to purchase it, I will make an agreement with you to pay you $........... in the following way:................. The piano to become my property upon completion of full payment as above.

If, however, the piano does not prove satisfactory, I will return it to the railroad depot. I am to be under no obligation to keep this piano. In all respects the conditions are to be the same as if I were examining it in your wareroom. It is distinctly understood that I am to be AT NO EXPENSE WHATEVER FOR FREIGHTS COMING OR GOING.

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¶ The Swedish Electric Vibrator comes in a handsome, portable case, including **six different applicators,** a long flexible, silk cord with plug and socket; attaches to any electric light fixture. Vibrator **will operate on either direct or alternating current**—110 or 120 volt. Vibrator weighs only 24 ounces—So safe and simple a child can use it.

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¶ Let us send you a copy of our unsolicited letter from an eminent Judge, now on the bench, a letter from a man who says **he is 86 years young** and will **live to be a hundred,** and that he blames it all to the Swedish Electric Vibrator. In short, the Swedish Electric Vibrator is the most extensively used, the highest endorsed and

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¶ If you are not posted as to what the Swedish Electric Vibrator can do to **save doctor and undertaker bills,** you owe it to **yourself** to get wise.

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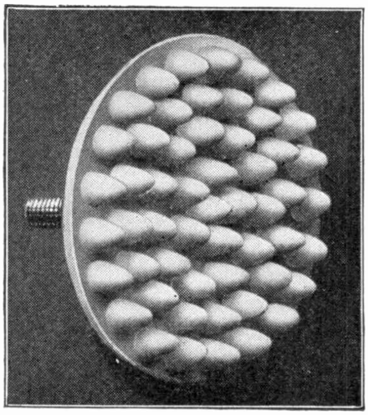

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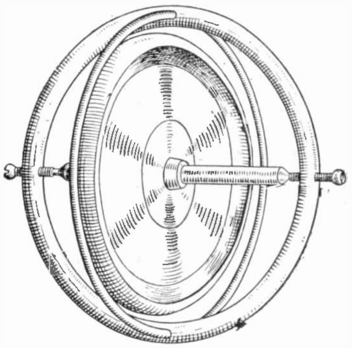
## THE NEW "DIAMOND" GYROSCOPE

**The Most Wonderful Novelty of the Age**



The GYROSCOPE is a most instructive instrument and with it many interesting experiments can be performed. It is used to demonstrate the principles of rotation, attraction and equilibrium of bodies when in motion, the centre of gravity and centrifugal.

The GYROSCOPE on the pedestal illustrates the rotation of the globe better than any other mechanical instrument in existence. The inner wheel shows the daily rotation of the globe on its axis. The whole body moving around shows the yearly rotation of the globe around the sun; the thin circle the equator, the thick one the meridian, and the two pivots the North and South Poles. M. Ganot's scientific treatise demonstrates the usefulness of this instrument in shooting galleries to measure the trajectory of projectiles and to ascertain their weight.

The GYROSCOPE is an instrument of high precision. A great variety of experiments are obtainable with the Gyroscope, thus providing a diverting, instructive and agreeable amusement in company.

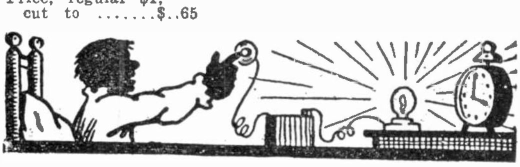
**Each 25 Cents, Prepaid,. $1.50 Per Dozen.**

## No. C POCKET FLASH LIGHT


This is an especially well made flash light; very strong and highly finished; length 3½ inches, width 2¾ inches, 1 inch thick; full metal case, with strong lense and bulb. All parts carefully fitted, nickeled and polished, with spring for holding battery in right position under all conditions, which is one of the many reasons why the battery lasts longer in this flash light than in other styles. Sold all complete. Good for 3,000 flashes.

Postage, extra, 11 cents.

**Price, regular $1, cut to .......$..65**



## E. B. ELECTRIC LIGHT OUTFIT

Consists of an extra strong and powerful battery; ten feet insulated wire; electric three and a half volt light bulb; socket for holding the bulb; switch and all necessary screws, etc., for installing. This outfit is useful in hundreds of ways. Can be placed so as to illuminate face of clock, having switch placed at bed. Fine for closet lights; nice to have in ice box (saves you from knocking things over); handy in the horses' stalls when you come home after dark, not bad to have in the cellar, etc. Often you have no match when you are down to fix the furnace. These lights are absolutely safe anywhere, in powder magazine or gas tank. Can be placed anywhere you need a light and the switch at the most convenient point.

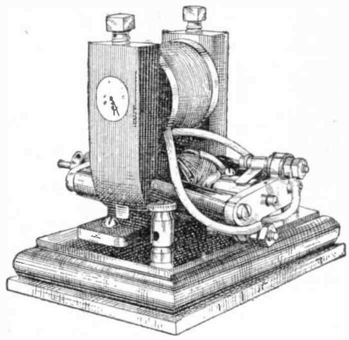
They are used extensively for experimenting, etc.; fine for the boys who are studying and experimenting with electricity. No 26 Bulbs are used. The "P." batteries used in this outfit give from 4 to 5 volts and 5 to 6 amperes. Choice of Green, Blue, Red or White Bulbs.

**The outfit all complete, reduced to................$ .65**

By express, prepaid, 20 cents extra.

## MOTOR No. 1

3 VOLTS. ¾ AMP.



This is the only true model of its size on the market. It is no magnetic engine with its pole armature, but a perfect, scientific machine.

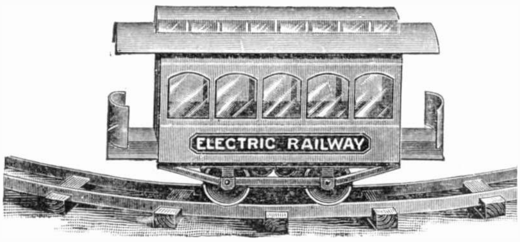
It has soft iron field pieces, a soft steel field core, a laminated drum armature having six slots, self-adjusting brushes, hard steel shaft, brass bearings, etc.

It is 3¼ inches high x 3½ inches wide x 3¾ inches long, and is finished in black enamel and nickel. It will run 2,500 R. P. M. on two good dry or wet cells, and is very powerful, being capable of revolving about its armature when its shaft is held stationary in a vertical position, or of turning an 8 inch fan at good speed. Fitted with a grooved pulley for running toy machinery, etc. Weight, 18 oz.

**Price .............................................$2.00**
**By express, extra .................................. .20**

## COMPLETE ELECTRIC RAILWAY

4 to 5 VOLTS. **Price, $3.50** ½ AMPERE




The above cut shows our small Electric Railway. This is a favorite size. The car is 7 inches long, 4½ inches high. It is made of polished brass and has iron wheels. The wheels are set with axles parallel, and are all of the same diameter. The car may be thus run on straight or curved track. The track furnished is a circle, 3 feet in diameter and 2 inch gauge, made of polished rolled steel.

Speed of car, about 150 feet per minute.

The electric current is conducted through the rails, and thence by the wheels of the car (which are insulated from one another) to the motor.

The battery consists of four dry batteries, which are connected in series and fastened in the box with two wires extending all connected ready for use.

**The complete equipment consists of car, 9 feet of track (circle 3 ft. dia.) and four dry batteries.**

Weight of the entire equipment, packed in wooden box, 12 pounds.

**Motor car only $2.25.**

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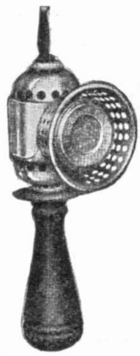

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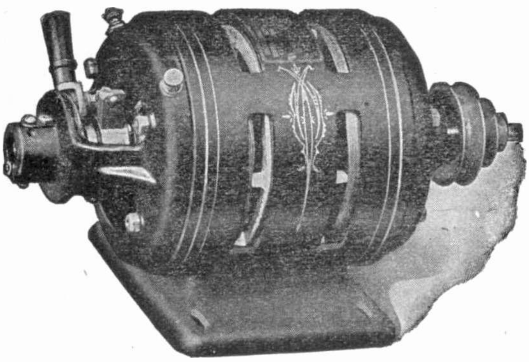

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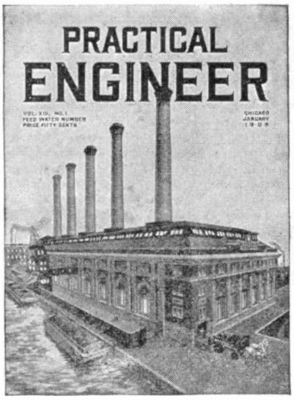


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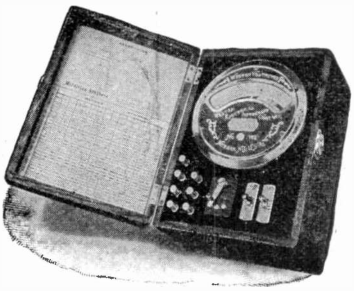

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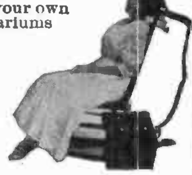

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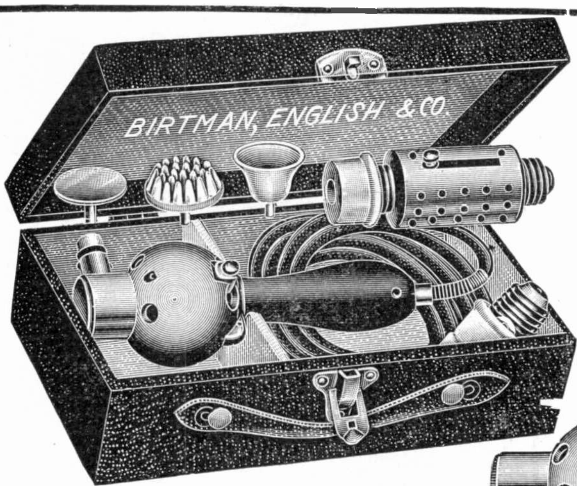


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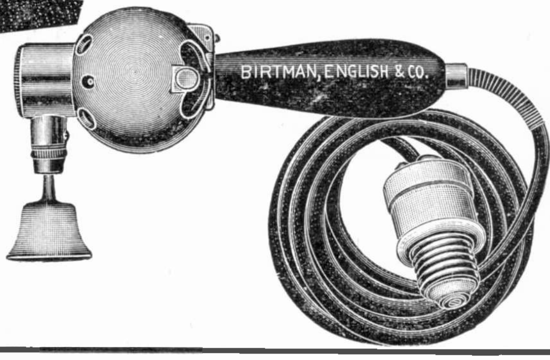


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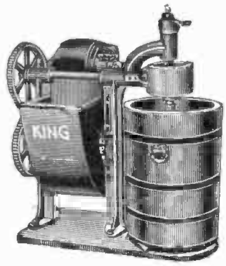


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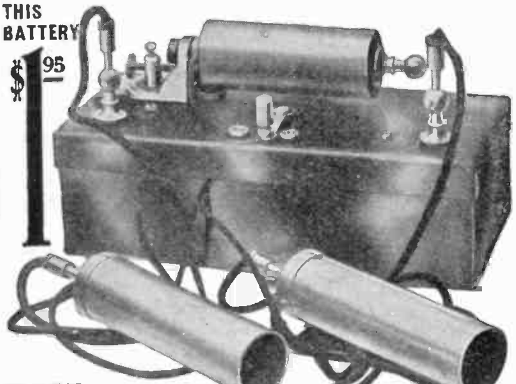

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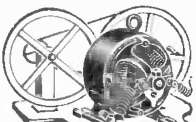

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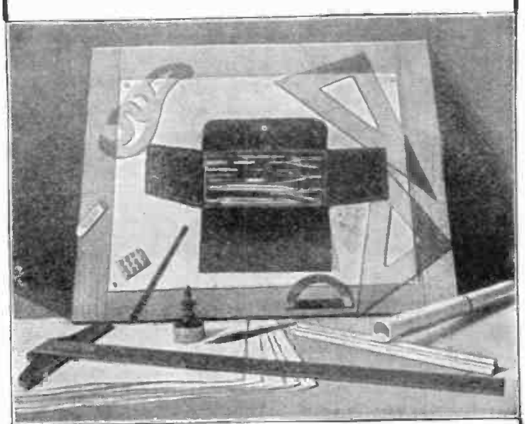

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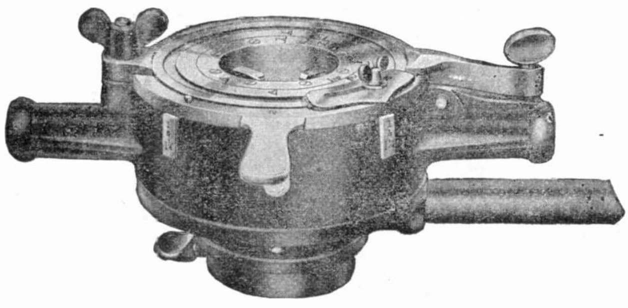

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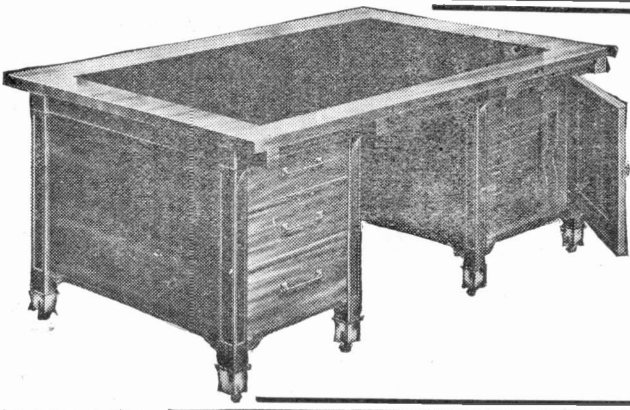

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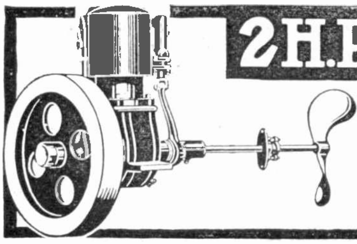

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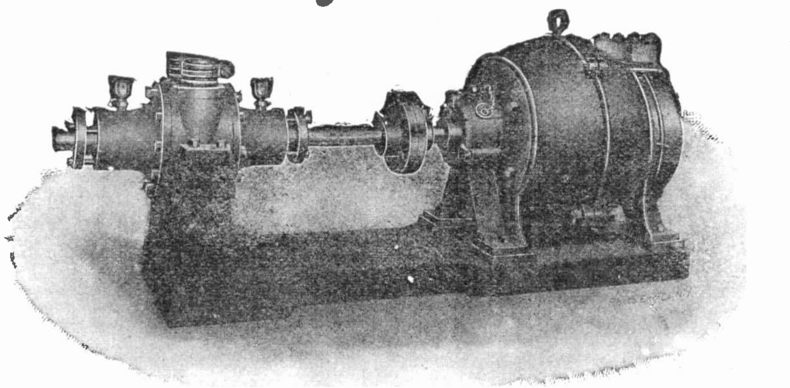

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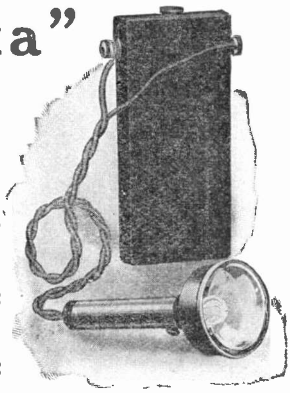

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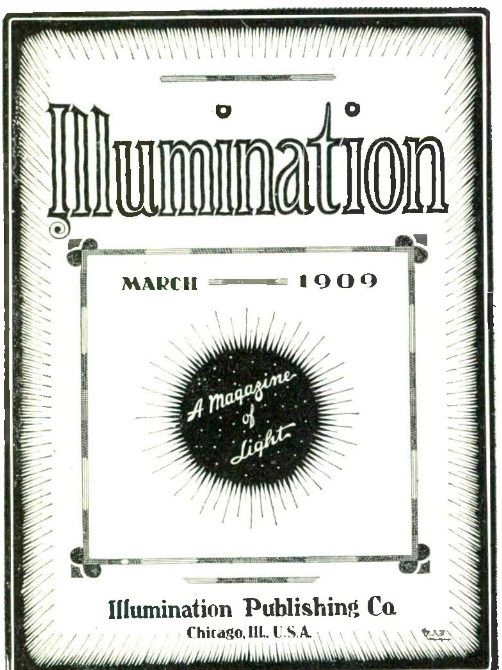


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