PRICE 10 CENTS

IN THIS ISSUE { Electric Service in a Great City / Wireless in a New Sphere

POPULAR ELECTRICITY

Trade Mark

IN PLAIN ENGLISH

Vol. 1. FEBRUARY 1909 No. 10.

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THE INDUSTRIAL LAW LEAGUE, Inc.
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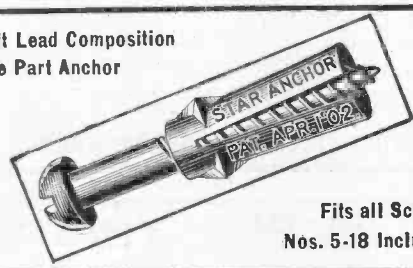
BOLTS THAT HOLD

In Brick, Stone, Concrete,
In Marble, Tile and Slate

AS LONG AS THE WALL STANDS

Soft Lead Composition
One Part Anchor



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The Star Screw Anchor above shown is designed especially for electricians, so are a number of our other specialties, such as Toggle Bolts, Bridle Rings and Star Drill Holders and special drills to fit.
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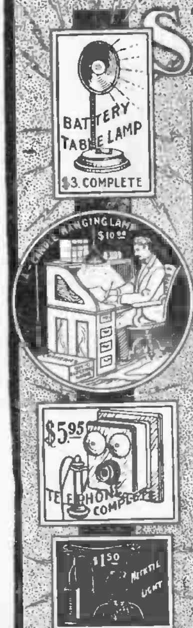

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Telephone, complete,	5.95
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Battery Fan Motor,	5.95
Electric Hand Lanterns,	2.00
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Electric Railway,	2.95
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All Electrical Books at	low prices.

We undersell all on Everything Electrical.

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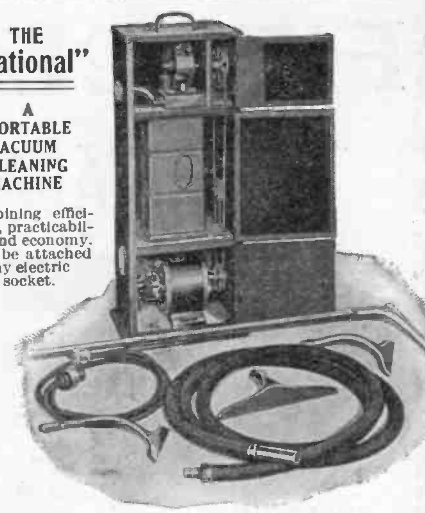
Headquarters for Electric Novelties and Supplies.
Agents wanted. Send for New Catalogue just out.

THE
"National"

A PORTABLE VACUUM CLEANING MACHINE

combining efficiency, practicability and economy. Can be attached to any electric light socket.



EFFICIENT Because it thoroughly accomplishes its purpose.
PRACTICAL Because of its simplicity and compactness.
ECONOMICAL Because of its minimum cost of maintenance and operation.

Growing concerns and responsible parties wanted for agents. Exclusive territory given. Price Complete $100.00. Send for Catalogue and Particulars

NATIONAL VACUUM COMPANY
20 Broad Street, :: :: NEW YORK

THORDARSON'S TRANSFORMERS

Toy Transformer a practical substitute for all batteries. Applicable only to alternating current circuits.

Designed to operate any class of electrical toys, such as small fans, motors, electric railway trains, ring bells, buzzers, light small lamps, etc., etc. Will last a life time. A most suitable Christmas present for any boy.

Send for circulars and prices on our Bell Ringing and Christmas Tree Lighting Transformers.

Thordarson Electric Mfg. Co.

151-157 S. Jefferson Street,
CHICAGO, ILL.

Are You Deaf?

If your hearing is affected in any way or to any degree you are sure to find great relief with the aid of the lately perfected scientific hearing device

THE AUROPHONE

You cannot judge the value of the Aurophone by what you have seen of any other hearing device and many of the present owners of these instruments have found absolute relief after all others had failed.

The Aurophone is practically invisible. It is extremely Simple, being a powerful miniature telephone which magnifies sound waves distinctly and to such an extent

it will restore hearing in many instances

Read what these prominent business men say

Mears Ear Phone Co., N. Y.

Gentlemen: Knowing how many fake devices have been offered deaf people, I am moved to offer you this testimonial, unsolicited, hoping it may convince some other deaf person that there is something real in the Aurophone. If at any time anyone in this section would like to hear from me personally regarding your instrument I would be pleased to tell what it is to me.

Respectfully, F. I. HUBBARD, Alameda, Cal.

Mears Ear Phone Co., N. Y.

Gentlemen: If I could not get another Aurophone I would not part with mine for any amount of money. Yours truly,

JOHN D. BELL, 150 Nassau St., N. Y.

Mears Ear Phone Co., N. Y.

Gentlemen: I have been deaf for many years and have tried every kind of hearing device. I find the Aurophone the only effective aid to the deaf. Wishing you success, I am, very truly yours, J. B. GOSHORN, 169 Plymouth Place, Chicago.

A SPECIAL REQUEST TO YOU

Whether you are interested in the Aurophone or not, and whether you answer this advertisement or not, we beg of you not to confound this instrument with the much advertised worthless variety. We want you at any rate to believe us and our claims for the Aurophone. We wish to restore hearing to every deaf person that will give us the chance. If we cannot enable you to hear we do not want your money.

We would like to tell you more about it.
Write to-day for booklet and terms of trial.

MEARS EAR PHONE CO., Inc.

Main Office, Suite 890, 45 West 34th St., New York City
Branches in Chicago, Philadelphia, Baltimore, Minneapolis, etc.

Silver Solder For Brazing

COPPER, BRASS, IRON or STEEL.

Many of the largest manufacturers use it for brazing new parts and repairing broken parts.

If you have never used Silver Solder investigate the merits. It may help you.

Easy Flowing and Very Strong

Made in three qualities. Sheet any width from ¼ inch to three inches, and thickness .003 to .057. Wire solder from No. 14 to 22.

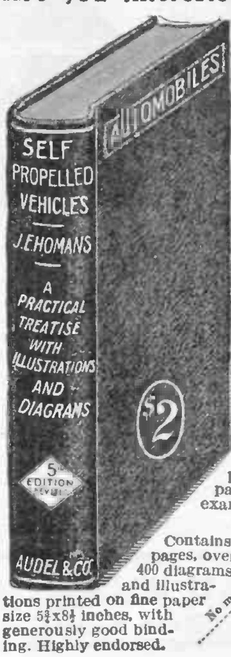
Write for information.

F. H. NOBLE & CO.

647-653 W. 59th Street
CHICAGO

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.

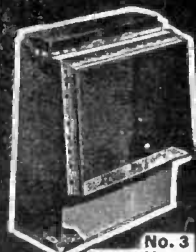
This good book will be sent to any address in the world, postpaid, upon receipt of two dollars, or if desired, will be sent on approval, to be paid for after examination.

Contains 608 pages, over 400 diagrams and illustrations printed on fine paper size 5¾x8¾ 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.

EVERYTHING for Furnace Work

AN ounce of performance is worth a pound of promise. This truism aptly applies to the problem of real saving and perfect satisfaction in heating the home. Here is our offer. It places all the responsibility on us. We have to make good. You take no risk.



No. 3 Stack Head for First Floor with Collar for Extension to Second Floor

On Free Trial at Our Expense

We will send you a complete furnace heating outfit, including pipes, registers, and everything needed for $25.00 to $100.00 less than you can buy from dealers, and deliver it at your station, Freight Prepaid. You may place the purchase price in the hands of your local banker, who will hold it while you test the heater.

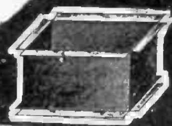
Our No. 45 "Leader" Steel Furnace Heats 7 or 8 Rooms

Price of this Furnace $49.00 (Pipes & Registers extra) **Delivered to any Station East of Omaha and North of the Ohio River.**

If the test is not satisfactory you may return the goods at our expense and have your money back, we to pay cost of removal and freight charges both ways. Ask us more about it. There's money in it for you. Our great co-operative plan makes you a partner in our success. We explain this with every estimate. This offer applies also to heating equipments for churches, schools, stores or other buildings. WRITE TO-DAY.

Round Tin Pipe

Air Supply Stub No. 2 for Metal Pipe



Box for Ceiling Register

Four-Piece 90° Elbow

Ask For Our Free Heating Plans

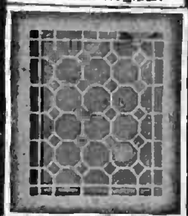
Send us a rough sketch of any building you wish to heat and without any charge or obligation on your part we will have our experts prepare a simple, clear plan which you can easily understand, showing every detail of the furnace, pipes, registers, etc., in their proper places, with the exact cost to you of the equipment delivered at your station, freight paid.

Our Free Booklets

Our booklet "Modern Furnace Heating" clearly explains the principles that cannot be ignored if the heating of any building is to be accomplished perfectly and at the same time economically. This booklet is written so that anyone can easily understand the diagram illustrations and principles involved. It covers the entire heating proposition thoroughly and contains much heating information of great value.

The booklet "These Bear Witness" gives the names and addresses of hundreds of people in every state and territory (many of them perhaps, your neighbors) who have and are using the Hess Steel Furnace and outfit and to whom we refer, as having found our furnace the best in heating capacity, and most inexpensive in first cost and fuel consumption. **Write today**

Moorish Design Wafer Side Wall Register



Hess Warming and Ventilating Co.
912 Tacoma Building, CHICAGO

POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. 1. FEBRUARY 1909. No. 10.

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.

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

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.

Send for our beautiful prospectus—it's free.

SCHOOL OF ILLUSTRATION

Founded by F. Holme

Dept. 278, 88 Wabash Avenue, Chicago

LEARN TO WRITE ADVERTISEMENTS

Are You Earning a Salary of $25.00 to $100.00 a Week?

Are you satisfied with your salary? It's a question of your advancement. Any man can positively qualify to increase his income 25 per cent to 100 per cent. We will guarantee to teach you by mail the most fascinating and profitable profession in the world to-day.

Learn the advertising business from the original school—the biggest and most substantial institution of its kind in the world. The institution that is the one school endorsed by all leading business men in the country.

If you are ambitious and energetic and have a common school education, we can teach you the business by correspondence and increase your income from 20% to 100%.

Send for our beautiful prospectus, it's free

PAGE-DAVIS SCHOOL

Address either office:

Dept. 278, 90 Wabash Ave., CHICAGO

Dept. 278, 150 Nassau St., NEW YORK

Be a Card Sign Writer

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.

If you are a clerk, window trimmer or advertising man in any wholesale or retail firm can quickly increase your salary and make your position more secure by learning to write card signs.

Send for free and full information from the most successful Card Writing School in the world. Address:

THE SIGN WRITING SCHOOL,

Dept. 278, 90 Wabash Avenue, Chicago, Ill.

75c. **THESE FIVE BOOKS** 50c.

Tell How $2 Grew Into $250,000.00; Yours for $3.50

FOR THE BUSINESS MAN: It will open his eyes to the possibilities of more business.

FOR THE ADVERTISING MAN: It will increase the percentage of orders from the inquiries his advertising has brought.

FOR THE PROFESSIONAL CORRESPONDENT: This work will be a constant reference.

Send us a money order, P. O. order, or check for $3.50, with your name and address plainly written. We will send the five books immediately, prepaid. If you don't find them worth their weight in gold, send them back.

The Publicity Publishing Co., Office 278 90 Library Court, Chicago, Ill.

ONLY $1.

A Perfect Time-Keeper, Calling the Hour and the Half-Hour. Naerly Two Feet High, 14 Inches Wide, in Solid Walnut Case.

The Inlaid Woods of Ash, Ebony and Mahogany Ornaments are put together with minute care.

You never had such an opportunity to get so beautiful and useful an ornament for your den or your home—on such easy terms—mail us $1.00 for one year's subscription to COMMON-SENSE, afterwards you may pay $1.00 a month for 8 months, which completes the payments on both the clock and the magazine.

Common-Sense Publishing Co.

Dept. 278 91 Library Court, Chicago.

LEARN JEWELERS ENGRAVING

"THE ENGRAVING SCHOOL THAT GRADUATES EXPERTS"

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.

Page-Davis School Dept. 278 90 Wabash Ave., Chicago; Dept. 278 15 Toronto St., Toronto, Can.

LEARN CORRECT ENGLISH

Our course of instruction deals with the vital points of the English Language. We will teach you thoroughly by mail **How to Speak and Write Correctly.** Send for full particulars.

SCHOOL OF CORRECT ENGLISH, Dept. 278 87 Wabash Ave., Chicago, Ill.

Beyond a doubt the greatest labor-saving device ever produced to lighten the never ending labors of the home is the Electric Flat Iron. Hundreds of thousands of these irons have been sold during the past few years and still comparatively few people comprehend the secret of this modern electric time-saver. They cannot understand how it remains "sissing" hot without coal or flame.

The Electric Flat Iron of today is the result of much study on the part of the General Electric Company's experts, with a result that no heat is wasted in the electric irons, which uses all the heat it receives. This iron is the only one of which this is true.

The General Electric Flat Iron is shaped a great deal like the ordinary sad-iron, except it has better lines and is constructed on a more scientific plan in regard to heat distribution. Inside each iron is a "Cartridge Resistance Unit," which produces the heat. The cartridge is a brass cylinder about 5 inches long, inside of which is a coil of flat German silver ribbon wound on edge and interspersed with heat-proof cement. In the rear of the iron is a porcelain plug with the wire terminals.

When the iron is connected to the electric lighting circuit and the current turned on electricity passes through the wires hidden in the flexible cord to the coils in the cartridge in the iron. Turning the switch completes a path for the flow of electricity which the pressure of the electric generator in the Power House forces through the resistance and thus generates heat. German silver wire resists the flow of electricity; the current doesn't flow through it easily; in fact, work must be done to force the current through the wire. This work produces heat and the heat generated in this simple manner keeps the iron hot.

This cartridge-heating unit is indestructible because made of cement and metal and entirely enclosed within the iron. The shape of the cartridge unit iron is such that all parts of the bottom are maintained at a uniform heat. Edges, center, toe and heel are all hot all the time while in use.

The gun-metal finish makes this iron very attractive in appearance. This finish is the most durable—it will not tarnish like nickel or other bright finishes when subjected to intense heat. It never discolors when the heat becomes intense and it will not rust.

The fact that all the heat produced by the electricity is used and none wasted in the air proves of great value when the iron is in steady use, either in household work or laundry service.

When one considers that there are one-third of a million satisfied users testifying to the unequalled convenience of the General Electric Iron it stands to reason that there must be very good cause for its universal use.

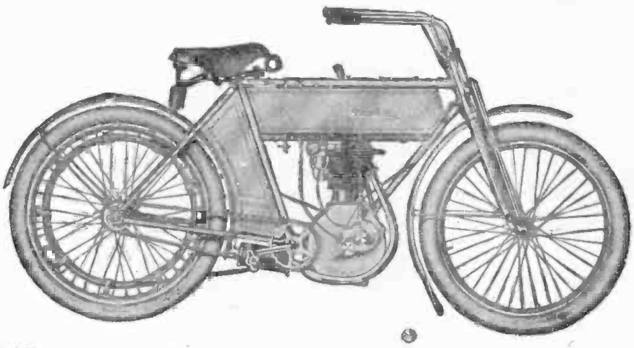
"Next Tuesday Will Be Ironing Day," issued by the General Electric Company, Schenectady, N. Y., gives a very good idea of the convenience of this electric iron. This little folder contains many interesting facts regarding this iron and its uses. Many users of this iron tell their friends that it would be the last thing they would give up if they were limited to one electrical convenience. They tell how it stands the wear and does the work of a half-dozen stove-heated irons, how it replaces a big hot coal stove on ironing day—how it can be used anywhere in reach of an electric light socket.

Another interesting booklet issued by the same manufacturer is "Electrically Heated Appliances," which describes in a general way many heating and cooking devices manufactured by this company which are in constant use in electrical homes.

Excelsior Auto-Cycle

The machine that makes good **EVERY TIME.**

Read the record of every big test that tries the quality of stock motorcycles and you will find the ***EXCELSIOR*** at the head of the list.



Not a new and untried experiment, but a machine that has been rigidly tested and found good.

It has more features of real practical merit than any other on the market.

Our catalog M.C. 12 is the finest motorcycle book ever issued. Let us send it to you. A postal with your address is all that is required.

We will do the rest.

Excelsior Supply Company

Established 1876 **233-237 Randolph Street, CHICAGO, ILL.**

Round Curls

Plain Curls

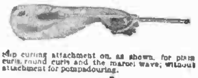
"A woman's hair is her crowning glory"

Dressing the Hair

is a new art with the DEL Electric Curling Iron in your hands. Affords new conveniences, results and styles in curling, marcel waving and pompadouring.

Heated for a minute or two in your electric light socket, it is detached and holds even, ample temperature long enough to dress a head carefully without reheating.

The terminal in the right hand connects with your electric light socket. When the Del is heated, the cord is detached and iron is ready for use.



Slip curling attachment on, as shown, for plain curls, round curls and the marcel wave; without attachment for pompadouring.

The life and luster, the cleanliness that go with electricity! Even heat makes even curls—fluffy, natural curls that last from two to seven days. NO BURNT ENDS!

Hairdressing is DEL-lightful with the DEL. Irons finely made, strong, guaranteed. Put up in gift boxes at $3.75 each.

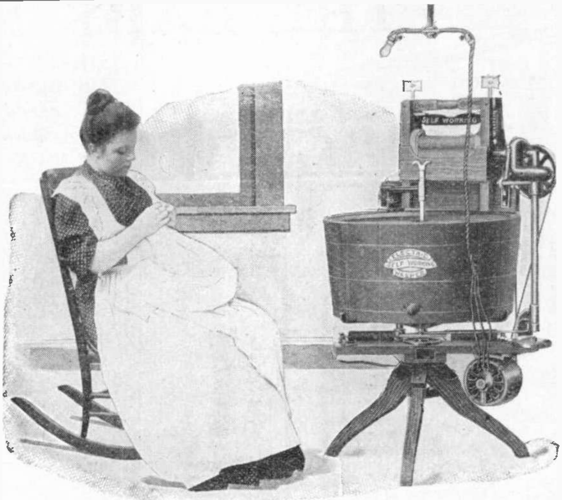
Marcel Wave

Pompadour

DEL SALES COMPANY,

98 Jackson Boulevard CHICAGO

Can be purchased at department stores, drug stores, electric light companies, electrical supply houses, hair dressers, sporting goods and hardware stores; or send us your dealer's name and you can order direct from us at $3.75, express prepaid.



PUBLISHER'S PAGE

THE DEVELOPMENT OF A NEW ART.

We cannot help but comment upon the fact that our advertising pages in this issue exploit in greater numbers and in larger space than in any previous issue electrical accessory appliances for the household. There seems to be an unusual amount of activity among the manufacturers at this time to exploit electrical household utensils and to educate the general public especially the women, in their use.

Time was when Mondays and Tuesdays of each week were looked upon with more or less dread by the women, and by the man and the rest of the family they were looked upon as a general upsetting of the home. Monday was usually set aside entirely for washing; Tuesday, the whole day, was set aside for ironing.

In the last year or two the drudgery of many household tasks has been entirely eliminated in many homes, due to the use of electricity. This is fast becoming realized by people in cities and towns where central stations exploit the consumption of current to a great degree and where they are constantly carrying on a campaign of education by demonstrations, electrical shows and the like.

The result has been that manufacturers have given this a careful study and have put upon the market at a small cost electric flat irons and electric driven washing machines, to say nothing of the other electric appliances such as curling irons, toasters, hot water heaters, and scores of other household appliances.

The electric iron is undoubtedly a great labor-saving device and it is only necessary to look back upon the days when coal stoves were used to appreciate this. Then it was often necessary to wait fifteen or twenty minutes and sometimes a half hour for irons to be heated, and then often times they were not heated enough to accomplish their work satisfactorily.

With the electric iron it is just simply a question of plugging in at the nearest socket in a room, after which the iron becomes heated and remains constantly hot. And last but not least, the operator need not leave the ironing board.

The devices above enumerated have become fairly well established, but there are other new ones coming onto the market by the scores. Hardly a week passes in which some one does not launch a new idea in the application of electricity in the home. It is always interesting and profitable to study the advertising pages of a magazine, but in this new field especially we are witnessing the development of an art, the possibilities of which are almost unlimited.

A SMOKELESS, FIRELESS CITY.

Will it ever come, the smokeless, fireless city of the future? A city in which electricity is the source of all power, of all light and of all heat—electricity generated by a great central power plant, where combustion is complete and smokeless, and from which radiate the wires and cables transmitting the energy for every industry and every home. Such would be the ideal condition, and it is toward this ideal that the largest cities of the country are working.

At the present time it is rather difficult to imagine Chicago playing the role of a smokeless city. Nevertheless a great work is going on in this direction, which means much for the future of the western metropolis. This is the system of the Commonwealth Edison Company, the extent of which is little realized by the majority of the Company's patrons.

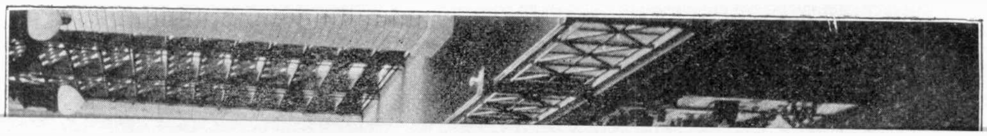
The leading article in this issue entitled, "Electric Service in a Great City," will open the eyes of many to the extent of this great undertaking. It emphasizes the idea of centralized production of current as exemplified by the Fisk Street and Quarry Street turbine stations. It explains how the current is transmitted and utilized over an area reaching as far north as Milwaukee, Wis., and south to Kankakee, Ill., an extreme range of 150 miles. It tells how the 170,000 horsepower of electrical energy are generated and of the plans for future extensions.

It is said to be the ambition of the Commonwealth Edison Company to turn every wheel in Cook County and abolish every smokestack, except its own. The ambition is laudable and its realization would mean greater economy and better living conditions for the city's millions.

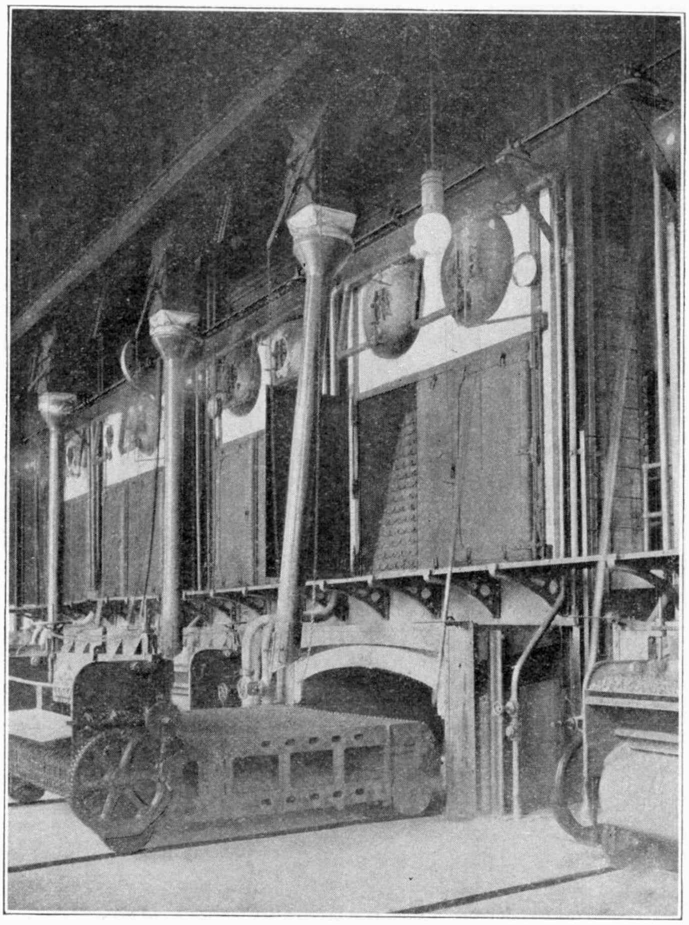
is fired, or when we stand in some immense powerhouse and watch the machinery by which some form of energy is converted into power to do useful work.

Such a feeling of admiration comes over the spectator in a marked degree than that known as the Fisk Street Station of the Commonwealth Edison Company of Chicago, which, with the system of which it is a part, forms the subject of this brief article.

This is so for several reasons. The station is very large, having a capacity



of 100,000 kilowatts or 134,000 horsepower; it was the first electric power house in which steam turbines were installed on a large scale, and here has been demonstrated during the last five years the great advantages of the steam turbine in the generation of electricity, so that great railway companies using current in very large quantities have found it to their interest to buy "juice" produced in this plant. And so "Fisk Street" occupies a unique place in the industrial life of Chicago, for it not only supplies the ordinary commercial electric light and power of a large city, but it supplies power to many of the factories and to nearly all the surface and elevated railways as well.



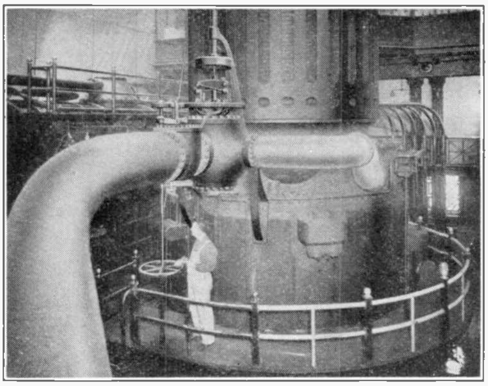
GLIMPSE IN THE BOILER ROOM OF THE FISK STREET PLANT.

But so important is the matter of uninterrupted electric power service to Chicago that sole reliance is not placed on Fisk Street, remote as is the chance of its breaking down. Within a few months another great power house on Quarry Street, just across the South Branch of the Chicago River from Fisk Street, has been placed in service, and this has already added 28,500 kilowatts to the company's total generating capacity, with ultimate capacity of 84,000 kilowatts when the building is completed. Here, it may be ramarked, are 14,000-kilowatt (18,600 horsepower) turbo-generators, and these are not only the largest dynamo-electric machines in use, but the largest prime movers of any description.

Adding to the maximum output of these two principal stations the capacity of the old reliable Harrison Street station, with its reciprocating engines, and that of still other generating plants which may be used, the total maximum generator capacity of the systems will be found to be 158,000 kilowatts, or over 200,000 horsepower, of which 80 per cent is afforded by Fisk and Quarry Streets. Thus the former, developed to three-quarters of its ultimate capacity, and the latter, one-third developed, mean much to the city of Chicago.

These are big figures, but one has only to go back twenty years, or even less, to find the entire central station generating capacity of the company, consisting of about 4,000 horsepower in perhaps 20 small engines, and dynamos, housed in a low building at 139 Adams Street, since replaced by the present office building and substation on the same site. From 4,000 to 200,000 horsepower in less than 20 years!—a wonderful growth is it not? And through the railway systems which receive current from Fisk and Quarry streets power from these plants is available from Milwaukee, Wis., on the north to Kankakee, Ill., on the south, an extreme range of 150 miles.

Chicago is sometimes called the "Electric City," and with the foregoing facts in mind one can see why the name is appropriate. From the Fisk Street



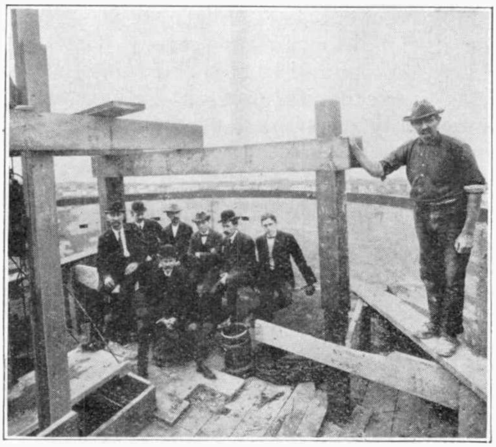
CONTROLLING 18,000 HORSE POWER BY THE HAND.

power center current is transmitted to 33 sub-stations, principally as 9,000-volt alternating current. In the sub-stations the current is changed to direct current, or perhaps to alternating current, of lower voltage, suitable to the needs of the customer. There are railways, manufacturing establishments (many of large size), public and office buildings, stores, residences and other users. On October 1, 1908, the date of the last annual report, the company's commercial business amounted to the equivalent of 4,137,650 16-candlepower lamps connected. In addition, it was supplying current amounting approximately to 75,000 horsepower to street railways and other public-service corporations. Since then these totals have been materially increased.

There are many facts of interest in connection with the system as a whole. For instance, the company occupies 49 buildings wholly or partially. It has in reserve 15 storage batteries, having a capacity of supplying 38,000 horsepower for half an hour, to be called upon in emergency or in case of quick, unexpected load. Exclusive of railways, there is 114,000 horsepower in motors connected. There are 280 miles of transmission lines, 325 miles of underground mains and feeders, 1,700 miles of ducts in underground conduits and 3,950 miles of overhead line wire. Millions of dollars are represented by the copper placed in the streets.

Ground for the Fisk Street Station was first broken for this imposing structure in 1902, and the first steam-turbine generating unit was placed in service October 2, 1903. It was the first great power house in the world to be equipped exclusively with steam-turbine generating units, and it has become famous. There is a row of ten units with a total maximum capacity of 100,000 kilowatts, and they represent a wonderful advance in the art, for the later units are fully twice as efficient as the ones that were first installed.

The main building is 475 feet long and 240 feet wide. It contains the boiler room and the turbine room. The switch house is a separate building 340 feet long and 50 feet wide. The idea of a separate switch house was another innovation for Fisk Street. With its oil switches, it is in great contrast to the old power-plant



ON THE TOP OF A 268-FOOT SMOKE STACK.

switchboard. The turbo-generators are 35 feet high and have (the later ones) a maximum capacity of 12,000 kilowatts each. The weight of revolving parts in each machine is 70 tons, and the peripheral speed is 3.8 miles a minute. Fifteen gallons of oil is provided per minute for each turbine.

The unit system of construction and operation is everywhere provided, with a view to isolating possible trouble and minimizing its effects. The boiler house contains a battery of eight boilers for each turbine, or 80 in all. Each boiler has 5,000 square feet of heating surface and is equipped with a superheater which takes the steam, at the boiler pressure of 180 pounds, and heats it from 150 to 200 degrees above the boiler temperature. The steam then becomes a "dry" gas of much higher pressure and of a power second only to that of some powerful explosive..

There are five steel chimneys and they are 18 feet in diameter, rising 268 feet above the ground. The daily coal consumption during the busiest season is about 1,700 tons, and the coal reserve is 50,000 tons on the ground and 10,000 tons in the bunkers in the boiler house.

Everything about the plant is on a large scale, but carefully planned, and carried out with the most minute attention to detail.

A big concern is the Commonwealth Edison Company. Its stock and bonds are valued at about $50,000,000 and it employs about 3,000 men. It is said to be its ambition to turn every wheel in Cook County and to abolish every smokestack, except its own, and these give practically no smoke, so excellent is the boiler combustion.

One marked feature of the company's policy has been the steady reduction of rates, not only to the large, wholesale consumers, which are of course very low, but also to the small shopkeeper and householder. Thus the rates—commercial and residence rates—of this year are but 40 per cent of what they were ten years ago. These low rates are made possible by the very remarkable economies that have been effected in operation, and most conspicuous among these economies has been the reduction in the cost of producing electric current by means of the great, modern, scientifically designed Fisk Street Station.

Thus the courage and foresight of the men who boldly planned a great power house in 1902 without reciprocating engines have met a deserved reward.

LAMP POSTS AS HISTORICAL MEMORIALS.

Very wisely, those who planned the recent celebration in Philadelphia, to commemorate the two hundred and twenty-fifth anniversary of its founding, sought some means which would not only add to the festive appearance of the city at the time but could also be retained as a permanent memorial. A particularly happy

Courtesy of the Illuminating Engineer

A ARTISTIC MEMORIAL LAMP POST.

thought resulted in the erection of suitably designed and executed lamp posts around the municipal center of the city in which is located the city hall. As this edifice occupies four entire blocks, and is one of the most imposing structures of its kind in this country, the opportunity for the display of such embellishments was ideal.

In order that this plan might express as much symbolism as possible, the committee having it in charge decided that the number of posts should be 28, corresponding to the number of original districts, boroughs and townships which were consolidated in 1854 to make up the present city. The posts in themselves are simple and dignified in design, as befits their purpose, each supporting a shower cluster of electric lamps in frosted globes. The material is bronze, and the execution is an example of the most finished and skillful workmanship.

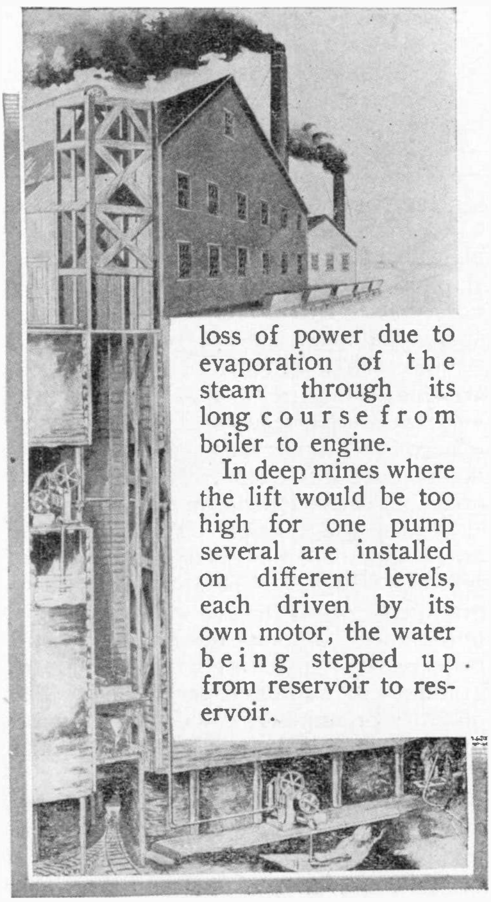
SINGLE-PHASE RAILROADING AND TELEPHONES.

Some apprehension has been felt by telephone men, who have feared that the spread of the single-phase electric railway would interfere with the safety of telephone service by induced currents. It is a fact that single-phase electrification affects telegraph and telephone systems whose wires run parallel with the railroad and close to it. On an eastern railroad system it is said that a correction has been found for this disturbance which has proved to be simple and not too expensive. Briefly described, it consists of what are called compensating transformers, whose secondaries are a part of the telephone wires and wnose primaries receive their voltage from pilot wires strung on the same cross-arms as those bearing the telephone wires and thus having by induction the same voltage as the telephone wires. The transformer secondary voltage is nearly equal and opposite to the induced voltage on the telephone wires and thus constantly compensates for it throughout all ranges of induction due to the single-phase wires. If no "bugs" are found in this plan, it will be valuable in removing what at first was considered a great drawback to the use of the single-phase railway.

PUMPING OUT A MINE.

Down deep in most mines water is constantly seeping in and tending to fill up the lower levels. A continual warfare must be waged between man and the elements in order that the miners may work at their task. Like prisoners in ancient times who were made to pump water out of their cells to keep from drowning so the miners in the depths of the earth must be protected by constant pumping, only in the latter case electricity does the work.

The electric motor-driven mine pump is an ideal machine for the work. It requires little or no attendance as would a steam-driven pump. A couple of wires carry the current to the motor with practically no loss and very little cost for installation. To bring steam down from the surface to operate an engine requires an expensive piping system with



loss of power due to evaporation of the steam through its long course from boiler to engine.

In deep mines where the lift would be too high for one pump several are installed on different levels, each driven by its own motor, the water being stepped up from reservoir to reservoir.

ELEMENTARY ELECTRICITY.

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

CHAPTER X—CHEMICAL EFFECTS OF ELECTRIC DISCHARGES (CONTINUED).

It was by means of electrolysis that Davy made his great discovery of the compound nature of the alkalies, potash and soda. The means he employed for this discovery are shown in Fig. 71. The battery consisted of four voltaic cells connected together in series. The positive pole of the battery was connected to an anode consisting of a disk of platinum, while the negative pole of the battery was dipped in a globule of mercury forming the cathode and supported at the center of a piece of caustic potash.

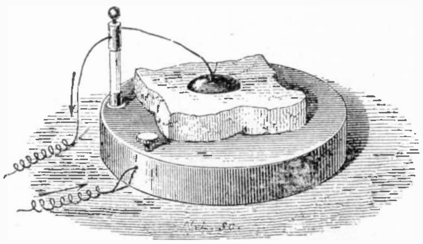


FIG. 71. DAVY'S EXPERIMENTAL APPARATUS.

On the passage of the current the molecule of caustic potash is broken up, oxygen liberated at the anode, and potassium, a metal, at the cathode, where it immediately enters into combination or is amalgamated with the mercury.

Since all electrolytic decompositions are due to electricity, it is evident, from what we have already said about the doctrine of the conservation of energy, that the amount of chemical decomposition produced must depend on the quantity of electricity that passes. The passage of one coulomb of electricity is capable of setting free or liberating 0.0000105 grammes of hydrogen. Consequently, one ampere, or one-coulomb-per-second, is capable of setting free 0.0000105 grammes of hydrogen per second. This quantity or number, 0.0000105 grammes of hydrogen, is known as the electro-chemical equivalent of hydrogen.

The electro-chemical equivalent of any other element can be obtained by multiplying the electro-chemical equivalent of hydrogen by what is called the chemical equivalent of the element; that is, by the atomic weight of the element divided by its combining capacity or valency. For example, the atomic weight of potassium is 39.1; its electro-chemical equivalent is therefore equal to $39.1 \times 0.0000105 = .0004105$. Consequently, by multiplying the current strength that passes in amperes, or coulombs-per-second, by the electro-chemical equivalent of any element, we obtain the weight of the element liberated in grammes in one second.

The laws of electrolysis as discovered by Faraday are as follows:

(1). In a series-connected circuit of a number of decomposition cells containing different electrolytes, the amount of decomposition that occurs in a given time is the same in all parts of the circuit; that is, in each decomposition cell.

(2). The number of ions that are liberated or set free by the passage of an electric current is proportional to the amount of electricity passing. A current of one ampere, or one coulomb-per-second, is capable of liberating a certain number of ions; a current twice as strong; i. e., two amperes, or two-coulombs-per-second, will liberate twice this number of ions.

Since, as already stated, electricity is conducted through an electrolyte by means of charges on the ions, and an ion is capable of carrying only a definite charge of positive or negative electricity, any increase in the number of ions liberated will necessitate a corresponding increase in the amount of electricity transmitted.

Therefore where several decomposition cells containing different electrolytes are connected in series, the weight of the different ions set free or liberated in different electrolytes by the passage of a given current strength will depend on their chemical equivalent, which, as we have seen, is equal to the atomic weight divided by the valency or atomicity. Since an atom of oxygen weighs 16 times as much as an atom of hydrogen, and is equivalent in combining power to two atoms of hydrogen, the weight of oxygen that is liberated will therefore be eight times that of the hydrogen. In other words, eight grammes of oxygen will be liberated to every gramme of hydrogen. Since, too, an atom of silver has 108 times the weight of an atom of hydrogen, and is equal in combining power, there will be 108 grammes of silver deposited in a silver decomposing cell for every gramme of hydrogen deposited in a water cell. Again, since an atom of gold is 197 times as heavy as an atom of hydrogen and is able to replace three hydrogen atoms in combination, 65⅞ grammes of gold will be deposited for every gramme of hydrogen.

As already stated, it is generally believed that when electrolysis takes place the electric current does not pass through the electrolyte by conduction as it does in a metallic conductor, but by charges on the ions or radicals. Consequently when electricity passes through a number of series-connected decomposition cells the same number of monad atoms, or atoms having a valency of one, will be set free no matter what their nature; that half the number of dyad atoms, or those having a combining capacity of two, will be set free; that one-third the number of triad atoms or those having the combining capacity of three, and so on. In other words, the atoms of every monad element carry the same electric charge or the same quantity of electricity, whether they are atoms of hydrogen or atoms of silver; that the atoms of every dyad element, or element having twice the combining capacity carry twice as great a charge; that the atoms of every triad element or elements having three times the combining capacity carry a charge three times as great.

When a metallic salt is electrolyzed by an electric current, it is broken up into its positive and negative ions. The metal, being electro-positive, appears at the cathode; the acid radical, being electro-negative, appears at the anode. This principle is employed practically in electro-metallurgy, in the art of electroplating, in electrotyping, as well as in the electric refining of metals.

For example, in the process of electroplating or covering the surface of any of the baser metals with gold, silver, or copper, the object to be plated is connected with the cathode or negative terminal of an electric source and placed in a solution of the metal with which it is to be plated opposite a plate of the same metal connected with the anode or positive terminal of the cell.

Suppose, for example, that an object is to be electroplated or covered with copper. This object connected with the negative terminal of the cell is placed in a solution of copper sulphate, or blue vitriol, immediately opposite a plate of copper connected with the positive terminal of the cell. As the current passes, the molecules of copper sulphate are decomposed, and copper, the electropositive radical, is liberated in the metallic state in a layer that firmly adheres to objects connected with the cathode. At the same time (SO_4) an electro-negative acid radical, is set free at the anode where it immediately enters into combination with the plate of copper, thus maintaining the strength of the copper sulphate in the plating bath.

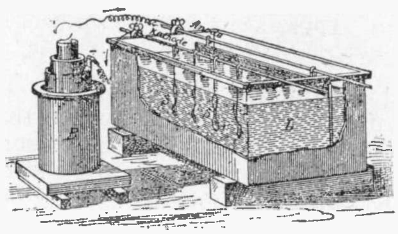


FIG. 72. SILVER PLATING BATH.

A silver plating bath is represented in Fig. 72, also connected with a single voltaic cell. As before, the articles to be plated, a number of spoons, are connected with the cathode of the voltaic cell and suspended in a silver plating bath, while a plate of pure silver, connected with the anode, is suspended opposite these articles, also suspended in the plating bath. As the current passes, metallic silver is deposited on the articles at the cathode, and the acid radicals liberated at the anode, enter into combination with the plate of metallic silver at the anode, thus maintaining the strength of the silver plating solution.

It is possible by the processes above described to decompose a metallic salt and deposit its metal on conducting surfaces suspended from the cathode so as readily to produce cold castings. This process is sometimes called galvanoplastics. The arrangement employed for obtaining these castings as in the case of a medal is represented in Fig. 73.

A mould or hollow casting of the medal is first obtained. This is readily done by the use of an alloy consisting of eight parts bismuth, three parts tin, and five parts lead. A sufficient quantity of the molten alloy is poured into a shallow box, and, when almost ready to solidify, the medal is placed in a horizontal position on the still plastic surface of the alloy, thus obtaining a sharp impression of its elevations and depressions. When the alloy sets, the medal is readily separated from the mould by a slight shock.

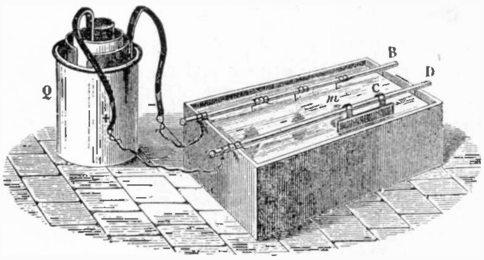


FIG. 73. APPARATUS FOR MAKING COLD CASTINGS.

A metallic wire is then bent around the outside of the mould which is suspended from a metallic rod connected with the cathode and immersed in a solution of copper sulphate. A plate of copper is suspended at the anode in the copper sulphate solution immediately opposite the mould. On the passage of the current the molecules of copper sulphate in the plating bath are decomposed and metallic copper deposited in the mould, thus accurately producing a cold casting of the medal. In order to prevent the copper from being deposited on the back of the mould it is coated with a thin layer of non-conducting varnish.

Gutta-percha can also be employed for producing sharp moulds. In such cases, in order to prevent the object to be moulded from adhering to the gutta-percha it is previously coated with a thin layer of black lead or graphite. The gutta-percha is then softened by heat and pressed against the object whose mould is to be obtained. Since gutta-percha is non-conducting it is covered with graphite in order to permit it to conduct electricity.

In a similar manner, gold may be deposited on the surfaces of the baser metals. This process is known as electrogilding, and is a great improvement on the old method of fire-gilding, in which an amalgam of gold and mercury was applied to the surface of the metal to be gilded, and the objects so covered were heated in a furnace. This resulted in the volatilizing or driving off of the mercury and the depositing of the gold in a thin film on the object.

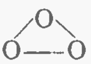
There are various processes for electrogilding. In all of them, as, indeed, in all cases of electroplating, it is necessary that the surfaces of the objects to be plated be thoroughly cleansed. The objects are connected with the cathode of three or four series-connected voltaic cells and immersed in a bath or plating solution of gold, opposite a plate of gold connected with the anode. Various gold baths are employed in electroplating.

The ease with which gold is dissolved from a plate connected with the anode and deposited on objects connected with the cathode, is sometimes employed by counterfeiters for electrogilding spurious coins. The counterfeit coin is suspended at the cathode in a gold-plating bath and a $20 goldpiece connected with the anode is placed opposite the counterfeit. In this way, on the passage of the current, a film of pure gold is deposited on the surface of the counterfeit. The same $20 goldpiece can be employed for covering a comparatively great number of counterfeit coins without undergoing any sensible decrease in weight.

The ease with which metals are deposited by electrolysis from their solutions is frequently employed in the refining of metals. For example, copper alloyed with the baser metals may be refined as follows: The impure copper is suspended from the anode of a decomposition cell in the shape of a plate in a solution of copper sulphate, and a plate of pure copper suspended in the same solution and connected with the cathode. On the passage of the current, metallic copper is deposited in a pure state on the sheet of pure copper connected with the cathode, while the sulphuric acid radical which is liberated at the anode enters into combination with the copper of the plate, forming a copper sulphate which is dissolved by the plating solution and thus maintains its strength. The impurities of the plate remain in the solution. Copper so refined is known as electrolytic copper.

Where the amount of electrolytic copper produced is great the electric current required for the refining is, of course, correspondingly great. This current is produced by means of huge dynamo-electric machines known as electrolytic generators. They are designed to produce powerful currents under comparatively small pressure or voltage.

The passage of an electric spark through moist air is generally attended by a peculiar smell, due to the production of a substance called ozone, a peculiar modification of molecular oxygen. As we have already seen, molecular oxygen consists of an atom of oxygen combined with another atom of oxygen and therefore having the formula O = O. Now, when a series of electric sparks are passed through moist air, it can be shown that the peculiar odor produced by the passage of electricity through the air is due to the breaking up of the molecule of oxygen O = O, and the formation of

 or tri-atomic molecular oxygen.

This peculiar modification of oxygen is known as ozone. It possesses strong oxidizing powers, and is capable of acting as a powerful bleaching agent. Its attraction for potassium is so strong that it is capable of setting iodine free from the molecule of iodine of potassium. When properly administered, ozone is able to afford relief in certain diseases of the body, such as rheumatism, pulmonary consumption, scrofula, etc. Ozone is also capable of acting as a powerful disinfectant by destroying disagreeable odors in the air. In addition to this, it acts as a powerful germicide, being able to destroy the micro-organisms or germs that produce many deadly diseases.

It is possibly because of the greater amount of ozone existing in the air of the seashore and the mountains that these places are so popular as summer resorts.

The ability of ozone to decompose potassium iodide makes it a comparatively easy matter to detect its presence in air, since a piece of paper moistened in a solution of starch in water containing iodide of potassium, when cut in strips and dried in a closed room, will become of a bluish color when exposed to air containing ozone. This blue color is due to the setting free of the iodine in the potassium iodide, thus permitting the iodine to act on the starch.

The passage of a lightning flash through air sometimes results in causing a combination of the nitrogen and oxygen, the two principal constituents of the air. In this way, traces of nitric acid are formed in the air by the direct combination of nitrogen and oxygen.

When a number of short disruptive discharges or electric sparks are caused properly to pass through moist air, the amount of nitric acid produced is sufficiently great to possess commercial values. Indeed, an actual commercial plant has been erected for the production of nitric acid in this manner. The plant consists of a nitrifying chamber, containing a vertical cylinder provided with means for the simultaneous formation of a number of short electric sparks. The electricity for these sparks is supplied by a steam-driven dynamo. The shaft of the nitrifier is caused to rotate so that the rubbing of metallic contacts over one another produces a succession of small disruptive discharges. At the same time a current of moist air is blown through the nitrifier. The air coming from the nitrifier and the chamber is charged with nitrogen. The nitric acid is absorbed by passing through an absorption tower, through which a solution of caustic soda is permitted to trickle. Professor Chandler, in a report made on this device, states that the apparatus was capable of producing nitric acid at a cost less than 1.6 cents to the pound, of 70 per cent acid. The market price of nitric acid at the time the report was made was 5 cents a pound. With an apparatus of the size of the one experimented on, the yield was about 8,766 pounds of 70 per cent nitric acid per annum.

Since, as is well known, nitrate of soda possesses marked fertilizing powers, it can be seen how important this effect produced by electric discharges must be on the ability of the world to grow wheat. The nitro supply of South America being almost exhausted, no little anxiety had been produced in the minds of many able men as to whether a serious calamity was not facing the world by reason of the lack of a proper fertilizer. Now, however, nitric acid can be produced directly from the atmosphere by the passage of electric sparks through it.

There are many other examples of chemical combinations being produced under the influence of electric discharges. Among these are the substances produced in electric furnaces; for, although in electric furnaces, most of the products produced are due to the increase in temperature, yet some are undoubtedly caused by direct action of electric attractions. Electric furnaces will be fully described in a subsequent article.

When an electric discharge is passed through a sheet of paper moistened with a starch solution in water containing potassium iodide or iodine combined with potassium, a decomposition is produced. The iodine, appearing at the anode, stains the paper blue. By this test, it is not only shown that an electric current is passing, but the direction in which the current passes can also be determined, for an electric discharge or current always passes from the positive to the negative or from the anode to the cathode. Since the blue color appears at the anode it is thus shown that the wire or terminal touching the paper at this point is the anode or positive terminal.

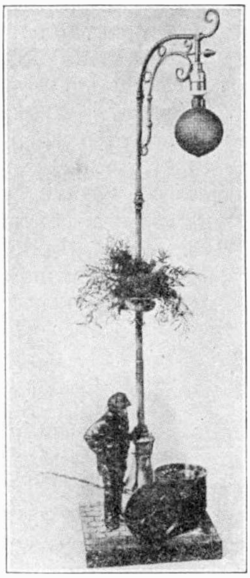
(To be continued.)

SMOKE RINGS AND HIGH-TENSION WIRES.

At a recent meeting of a technical society, Dr. Carl Hering of Philadelphia related a rather interesting incident. He was riding on a train near the high-tension transmission wires at Niagara Falls when he noticed that as the smoke and steam from the locomotive crossed the wires it formed into circular rings around the wires as centers. It was quite a striking phenomenon. Evidently there must be some dissipation of energy from the wires to cause the smoke to form into rings. This represents a loss, although trifling, of course, and is a subject which has recently been carefully investigated. It is now thought that at a certain voltage of transmission, called the "critical point," a very appreciable loss begins, and it is at this point that the luminous discharge, visible at night, becomes manifest.

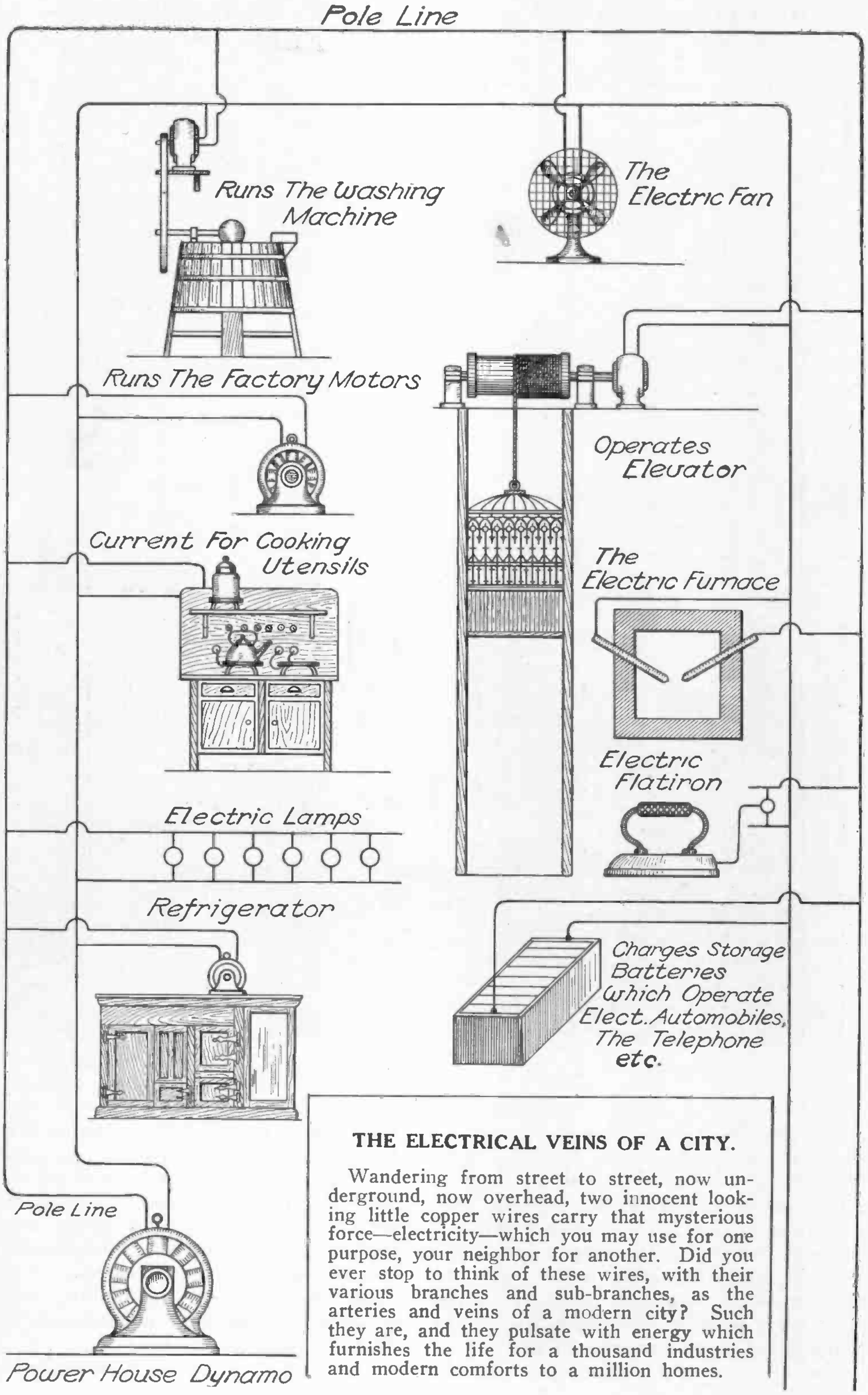
LAMP POSTS WITH FLOWER BOXES.

In Vienna in the public parks and in the Ringstrasse, which is much like a park, the city authorities have provided some very handsome lamp posts one of which is illustrated herewith. These poles are of rolled steel and are much higher than those commonly used in the United States, the lamps being suspended from 33 to 40 feet from the ground.



LAMP POST AND FLOWER BOX.

Each is provided with a flower box about half way up, and this receptacle is kept filled with flowers or ornamental plants. The effect is most pleasing. Two of these beautiful poles are to be placed in a Boston park. But American engineers criticise the height of the arc lamps, for in this country a height of from 20 to 25 feet is considered best for practical illumination. However, the flowers and the beauty of design could be adapted to a shorter pole without difficulty.



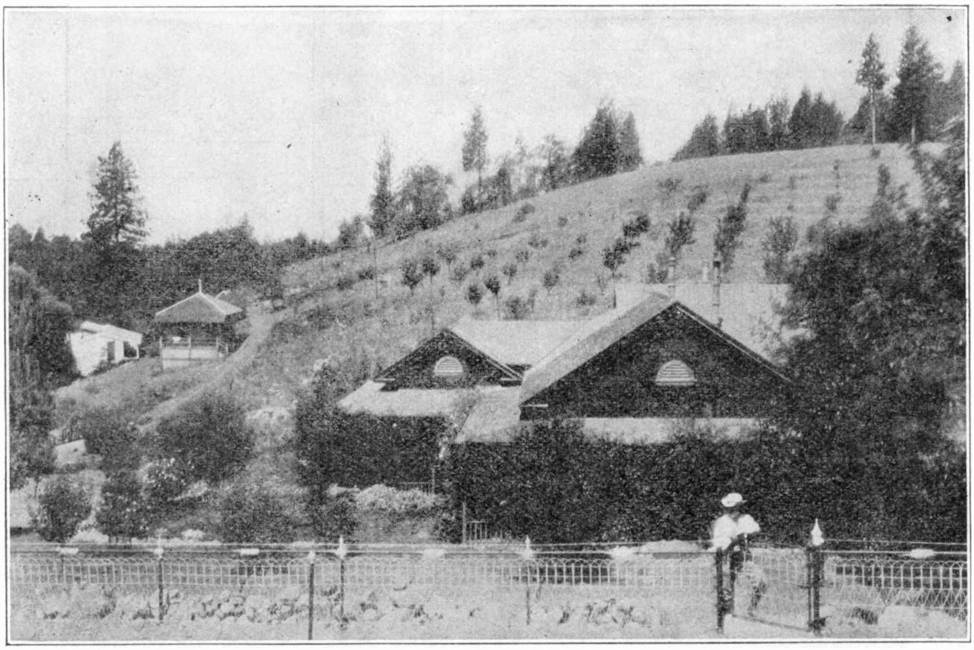
THE ELECTRICAL VEINS OF A CITY.

Wandering from street to street, now underground, now overhead, two innocent looking little copper wires carry that mysterious force—electricity—which you may use for one purpose, your neighbor for another. Did you ever stop to think of these wires, with their various branches and sub-branches, as the arteries and veins of a modern city? Such they are, and they pulsate with energy which furnishes the life for a thousand industries and modern comforts to a million homes.

"SIERRA CASA," THE HOME ELECTRICAL.

BY P. J. O'GARA.

IN the foot-hills of the Sierra Nevada mountains, about 50 miles east of Sacramento, near the little town of Colfax, is situated the farm of Mr. Ellis Franklin, a retired business man of prominence, of Sacramento. Throughout the foot-hills there are many beautiful trout streams, and one of these winds its way through Mr. Franklin's farm where, after a series of falls and rapids, it finally plunges into the turbulent Bear river. At times this little stream becomes a raging torrent, but during the summer months the flow is restricted to a few miners' inches. Without materially lessening the beauties of the natural scenery, this little stream has been harnessed to do the heating, lighting and cooking and most of the mechanical operations on the premises.



"SIERRA CASA," THE HOME ELECTRICAL.

Nor is this all, the power plant furnishes energy for pumping water which is piped through the house for the kitchen, bathroom and laundry. Then, too, there is water for the lawn and the small garden, and in case of fire, a hose connected to the standpipe can be brought into action. The washer and wringer no longer require the old Chinaman for their operation.

As the flow of water during the summer months is relatively small it was first necessary to provide a reservoir to store up a considerable supply of water. Happily the problem was soon solved and at a very slight expense. An old miners' ditch which had been used by the early placer gold miners was so situated that a part of it having very little fall could be used as a reservoir, having a maximum storage capacity of about 100,000 cubic feet.

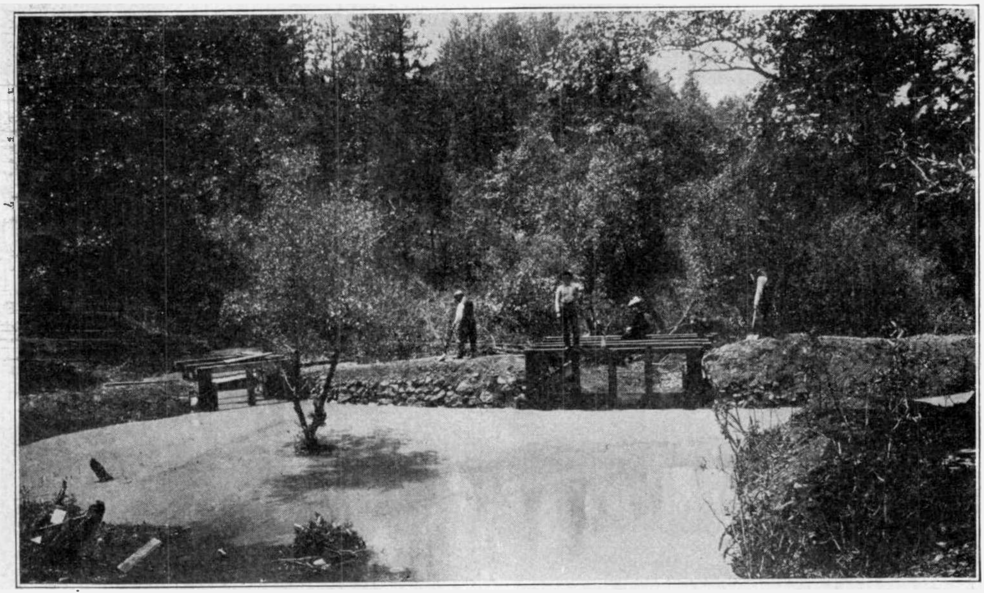
From the lower end of the ditch, which is provided with a pressure box, admitting water to the intake, a six-inch, No. 14, riveted steel, slip-joint pipe 445 feet in length was carried to the fo t of the falls, where the power house is situated. There is no trouble from snow or ice, for we must remember that "Sierra Casa," as the place is familiarly called, is situated in the most delightful part of "Sunny California."

The power house is surrounded by

magnificent oaks and pines. It is a well built structure, 18 by 8 feet, with a seven-foot wall plate, and strong enough to support machinery much heavier than is needed to furnish the required amount of power. The water wheel is a two-foot Pelton of special design and is furnished with ring-oiling bearings, thus requiring practically no attention. It works under an effective head of 75 feet. One end of the shaft carries a 24-inch pulley with a six-inch face and extra heavy rim, so that with the heavy water wheel the couple act as a flywheel in maintaining absolutely constant speed which is so necessary in the operation of dynamos for incandescent lighting. The other end of the shaft carries the governor pulley. Three nozzles, one inch, 1¼ inches and 1½ inches, respectively, are provided and can be easily interchanged as desired. The size of the nozzle to be used depends upon the amount of power required, although a minimum amount of water may be used with the largest nozzle in place through control at the gate-valve which admits the water to the wheel. However, where economy of water is desired, in case a small amount of power is needed, the smallest nozzle with full gate is most economical.

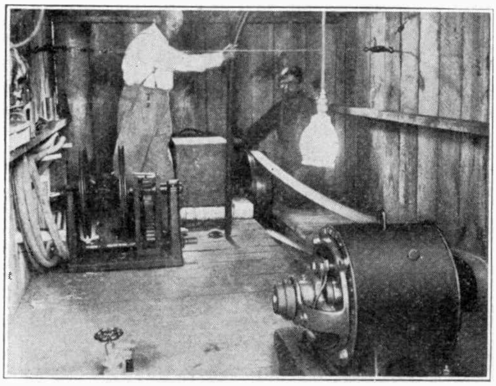
Careful tests showed that the one-inch nozzle develops 2.74 horsepower and the 1½-inch nozzle, six horsepower. The water is supplied to the wheel through a 3½-inch valve operated by a five-foot lever, full valve being obtained by swinging the lever through 80 degrees of arc. The lever may be operated either in the power house or from the residence about a quarter of a mile distant. The manner of operating it will be described later.

The electrical machinery in the power house consists of a compound wound, 240-volt generator, with a normal capacity of 4½ kilowatts, or about six horsepower. It is driven at a constant speed of 1,200 r. p. m. by a four-inch, four-ply rubber belt from the water wheel pulley.



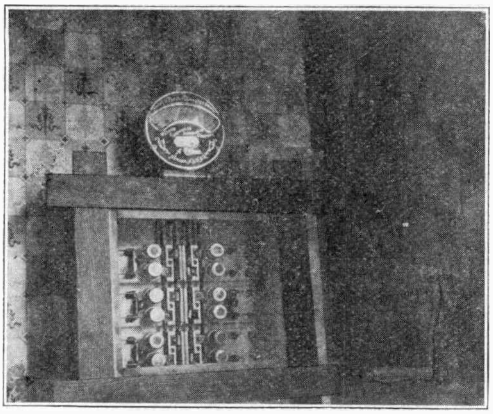
AN OLD MINERS' DITCH FORMED THE RESERVOIR.

Current, at an initial pressure of 240 volts, is carried to the distributing board in the residence about a fourth of a mile distant, over a No. 8 hard drawn copper transmission line, strung on 20-foot poles with four-foot cross arms, the poles averaging about 100 feet apart. The voltage drop is such that the voltmeter on the switchboard at the residence indicates 220 volts. The residence and Mr. Franklin's den, an artistic log cabin, are lighted by four circuits carrying a total of about 50, 220-volt, 16-candle power incandescent lamps. The other lighting circuit runs to the barns and other outbuildings. The motor circuit connects with a three-horsepower, 220-volt motor, which is placed in the



MR. FRANKLIN IN HIS POWER PLANT.

basement, and besides operating a centrifugal pump, this little machine, through line shafting, drives the washer, wringer, churn, cream separator, grindstone and a circular saw for sawing up wood into stove lengths.

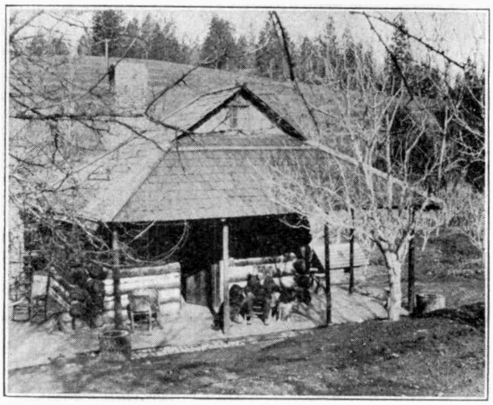


DISTRIBUTING BOARD IN THE RESIDENCE.

It is not necessary for anyone to go to the power house to turn the power on or off; that is, to start or stop the water wheel. To the right of the switchboard is a crank attached to a shaft passing through the wall to the outside. This shaft carries two winding drums about two inches in diameter and securely keyed to it. Around each drum is wound a flexible wire cable. The cables pass from the drums upward to pulleys fastened to the side of the house, then through a single block tackle and the ends returned to a staple in the wall. The pulley blocks are attached to two

POWER PLANT IN OPERATION.

galvanized iron wires strung over pulleys on the poles just beneath the copper transmission line. These wires pass through bushings into the power house, the ends being connected to a flexible wire cable passing through two pulleys,



THE "DEN."

one on each side wall and directly in line with the gate valve lever before mentioned. The upper end of the lever, which is about five meet long, passes through an iron ring which is connected by two single pulley blocks to the flexible cables. When the crank at the residence is turned to the right, or in the direction marked "On," the gate valve lever is drawn to the right and the valve opened, admitting water to the wheel. Turning the crank at the residence in the opposite direction, closes the valve. Owing to the small diameter of the winding drum and the added purchase of the pulley blocks, the valve is so easily operated that a child can turn the power on or off. An electric buzzer on the switchboard tells when the gate-valve is tightly closed.

The residence is beautifully lighted. Lamps aggregating fully 900 candle power make the rooms as cheerful and pretty as any city home. Elegant fixtures, harmonizing with the interior, make one almost forget that he is living on the farm. Outside, the broad verandas, with their pendant electric bulbs and lanterns, add to the charm of this country home. The farm laborers also share in the luxury of electric lighting. In their little cottage, which is apart from the residence, electric lamps are provided for the bedrooms and for the library where the men pass their evenings.

But lighting is only one use to which the power is put. Down in the basement the three-horsepower motor, which has its own switch and starting rheostat at the switchboard, runs a horizontal centrifugal pump, which lifts water from an almost inexhaustible well to a reservoir dug in the hillside and connected to the pump by a two-inch pipe 250 feet long. The reservoir has a capacity of about 6,000 gallons, and is placed 40 feet above the level of the pump, furnishing kitchen, bathroom, and laundry with water at a good pressure. In the front yard there is hose connection with a hydrant which furnishes water for the lawn and also adds security to the home in case of fire.

In the kitchen electrical cooking and heating devices are liberally employed. During warm summer days the electric stove is often connected to one of the lamp sockets on the veranda and the luncheon prepared in the cooling breeze of an electric fan, thus avoiding the use of the hot kitchen stove. The use of electric flatirons also does away with the old stove formerly so necessary on ironing day.

During the winter when there is always sufficient water for continuous operation at full load, electric heaters are used instead of the small wood stoves, which formerly kept a man busy most of the time.

As all farm plants should be, this little electric plant is as nearly "fool proof" as was possible to make it. Further than this, it requires practically no attention, and the power house need not be visited more than once a week, if as often as that.

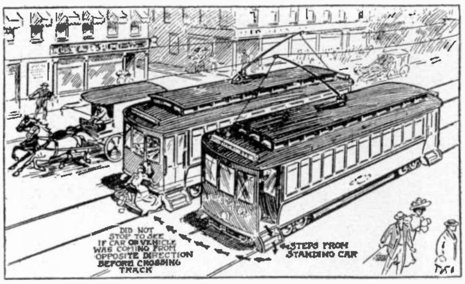
Every night in the year the plant carries an average of 30 to 40 lights from dusk till midnight and after that time a lesser number. With the other services it performs during the daytime, the amount of electrical energy used on this farm, if valued at the rate of ten cents per kilowatt-hour, would be worth more than $700 per year. When we consider the fact that the plant did not cost more than $1,500, which includes costly fixtures, the water works system and all appurtenances, we find that it is paying a handsome profit on the investment. But this is only one way of looking at it. The pleasures and conveniences it has added to farm life cannot be measured by dollars and cents. It has added a charm to country life, such as no other investment of an equal amount could possibly have done.

TEA TIME IN THE HOME ELECTRICAL.

HOW IT MIGHT HAPPEN.

Many street car accidents occur through the carelessness of the victims themselves, who fail to observe the ordinary rules of caution. These rules have been explained time and again, but they apparently need constant repetition. Realizing this to be the case, Stone & Webster of Boston, who operate 25 or 30 railway properties in various parts of the country, have instituted a comprehensive campaign of public education.

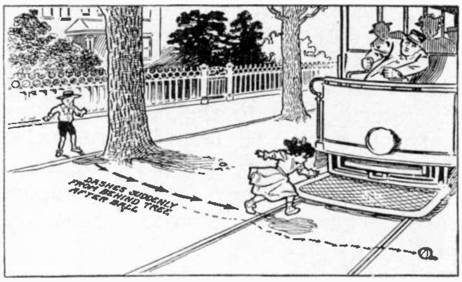
The idea is to take space in the newspapers of the cities wherein their lines are operated and fill this space with "copy" consisting of 31 heart to heart talks on the various phases of the accident problem. These advertisements are frank and concise and point out that it is to the interest of the traction company as well as the patrons of the road to avoid such accidents, and pointing out means by which the people may co-operate with the company in reducing the danger.



This company is trying to prevent this accident happening to you. You ought to be interested. You ought to be willing to be careful enough not to get off a car and walk behind it in front of another, or, where there is a single track, in front of a swiftly moving vehicle. Remember that no-one expects to see you dive out from behind the car. The first that is seen of you is when you are under the wheels or the horse's hoofs.

Wait a second. Look. Open your ears. Then cross safely and go home without the help of an ambulance. It will surprise you to find out how careless are the women in your family—at least in this matter. Watch them. It will call attention to your own carelessness, perhaps.

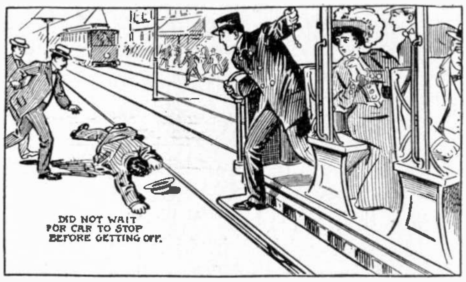
Sample of Advertisement Used in Educational Campaign



The motorman knows that this is the saddest accident in the whole list. A little child comes out suddenly from behind a tree or wagon and runs quickly across the track—after a ball perhaps. The child is busy—intent upon its play. The motorman is straining every muscle in his body to stop the car! But it simply CANNOT be done in time. Not with the best car ever built or the best motorman who ever handled a brake. The wheels go over and —— Suppose it was YOUR little boy or girl.

Keep the children from playing in the streets. Tell them EVERY day to look out for wagons and street cars.

Sample of Advertisement Used in Educational Campaign



Suppose it were you? A long time spent in repairing your body. Expense! Perhaps death TOMORROW.

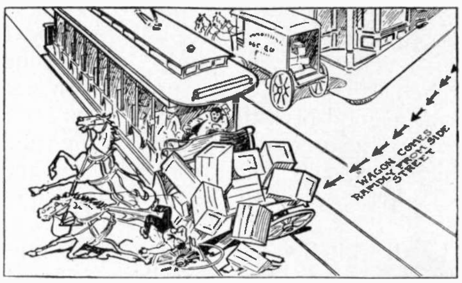
What difference would it make that you had got off moving cars safely—"over a thousand times?" That fact would not remove your pain, heal your skin, wipe the blood out of your eyes or pay the doctor's bill. It would not bring back health. Or comfort your family if you were buried.

Why not let the "thousand times" be enough.

Once more?—It might be the last time! Your fault. "Wait till the car stops"—actually STOPS.

Say this to your wife or husband, your children, your pupils or employees. If they met death because you had not cautioned them you would blame yourself all your life.

Sample of Advertisement Used in Educational Campaign



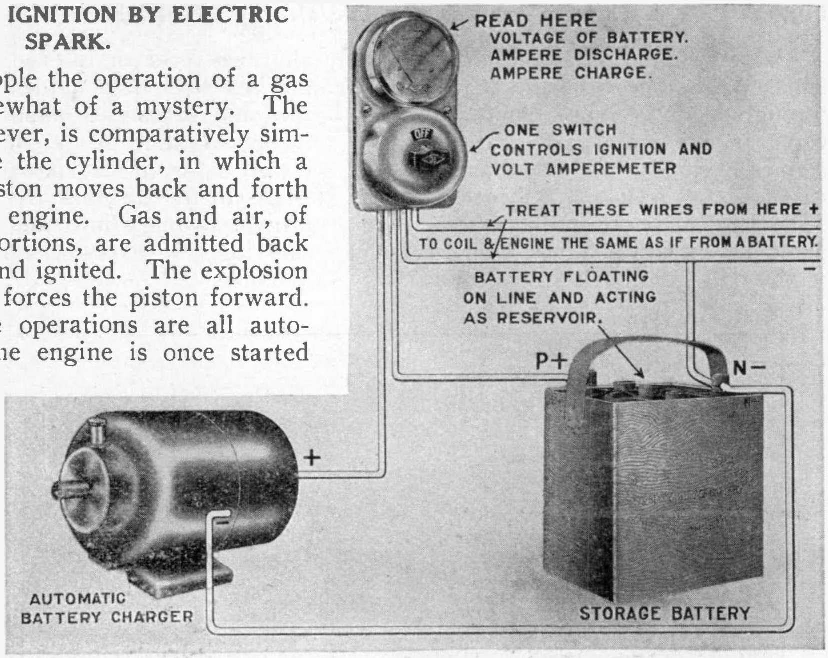
Here is a catastrophe that would not happen if drivers of vehicles would not drive rapidly out of a cross street and across the tracks. A driver was asked once what he did all day. "Sometimes I sit on the seat and think" he said "and sometimes I just SIT." Caution your driver to think—and listen and look—and go slow—when he comes out of a cross street to go over the car tracks.

There would be no excuse for you if you read this and forgot it. What apologies would you make to the dead horse?

Sample of Advertisement Used in Educational Campaign

GAS ENGINE IGNITION BY ELECTRIC SPARK.

To most people the operation of a gas engine is somewhat of a mystery. The principle, however, is comparatively simple. We have the cylinder, in which a close fitting piston moves back and forth as in a steam engine. Gas and air, of the right proportions, are admitted back of the piston and ignited. The explosion which follows forces the piston forward. Of course the operations are all automatic when the engine is once started and there are factors involved outside of the general principle just stated; for instance, the gas and air must be compressed by the return stroke of the piston to just the right "compression" before they are ignited, and this compression must be carefully regulated to secure best results.



GAS ENGINE IGNITION SYSTEM.

There are various ways of igniting the explosive mixture, but the most effective is by the use of an electric spark. Two methods of producing the spark are chiefly employed, known as the "make-and-break" and "jump-spark" methods. The first consists in simply breaking an electric circuit within the cylinder at the proper time. This break results in a small spark which ignites the gas. By the second method a spark is caused to jump across between two slightly separated terminals within the cylinder. In order to make the spark jump it is necessary to employ an induction coil with a high voltage secondary winding.

Current for the electrical ignition systems is provided by small dynamos, magneto generators, storage batteries or primary cells. An admirable ignition system has recently been perfected which is called a "dynamo-floating storage battery ignition system." How this system is connected and operated is shown plainly in the diagram.

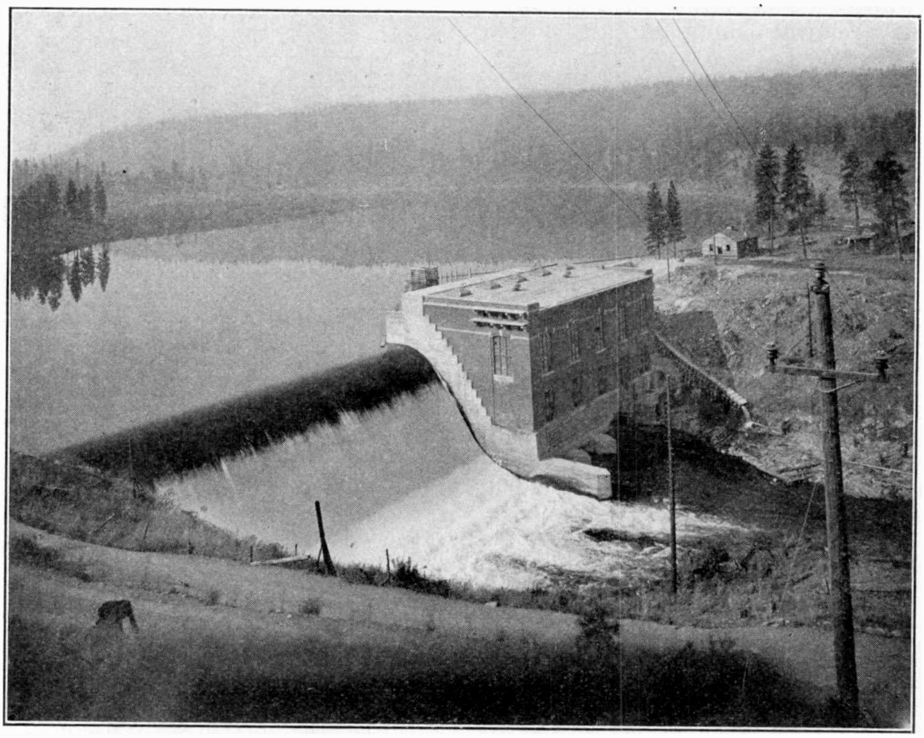
There is first an automatic ignition dynamo which is driven by the gas engine itself and which generates the current for charging the storage battery. An automatic device connects the dynamo to the battery only when the former attains the proper speed and voltage to charge the battery. The battery in turn furnishes the current for ignition; it acts as a reservoir to provide current of constant voltage to operate the coils successfully. In addition it provides current for ignition when starting the engine, at which time the dynamo is of course standing still. The ammeter on the switchboard at the top enables the operator to ascertain at a glance the amperes being consumed by the spark coil, or, by simply turning the switch, the rate at which the dynamo is storing current in the battery.

Every village and hamlet on the Canal Zone, Isthmus of Panama, between La Boca and Gorgona, is lighted by electric lights.

POWER GENERATION FOR THE INLAND EMPIRE.

About 13 miles from the city of Spokane, Wash., the Spokane River passes through a picturesque granite rock canyon. In a narrow part of the gorge a dam of cyclopean masonry has been constructed, 228 feet long, 58 feet high and 66 feet in thickness at the bottom. This dam, and the power house which is built, at one end, hold back an enormous body of water, capable of generating continuously 15,000 horsepower of electrical energy. This new plant is now furnishing all the electric current required for the operation of the Spokane and Inland Division of the Inland Empire System of electric railways, comprising 130 miles of well-built track with cars and electric locomotives. In addition it furnishes the lighting current for the town of Rosalia, Wash.

Four great generating units, of 5,000 horsepower capacity each, are installed in the power house, one unit being at all times held in reserve. Water from the reservoir falls under a head of 58 feet and turns the blades of the water turbines located in a compartment in the lowest floor of the power house. The shafts of the turbines are horizontal and project through into the dynamo room, carrying the revolving armatures of the dynamos.



By Courtesy of the Street Railway Journal.

POWER PLANT OF THE INLAND EMPIRE SYSTEM.

A man at the switchboard, by the aid of a simple electrical device, controls the governing arrangement on the water turbines, which in turn controls the speed of the turbines within 1½ per cent. The rotating parts of each dynamo weigh 44,800 pounds and turn at the rate of 240 revolutions a minute. The power of these moving parts can hardly be comprehended. It is equal to that of a 574,400 pound weight being revolved on an arm one foot long at four revolutions a second. It is no wonder, then, the power generated is capable of moving whole trains miles away on the railway lines.

Yet all this mighty power is controlled and manipulated with ease by one or two men at what is called the master switchboard, which is situated in a gallery overlooking all the machines in the dynamo room. The man at the switchboard does not, by his own efforts, throw the great switches which actually cut the dynamos in or out of service, or the rheostats which control the strength of the dynamo fields. This work is no longer done by hand in the big power plants. He simply pushes a button or throws a little hand switch which closes secondary circuits to electric motors, and these latter do the actual work of moving the heavy parts of the main switches, rheostats, circuit-breakers, etc. From this same point he also controls the flow of water to the turbines, starting and stopping any unit at will.

Current, after it is generated by the dynamos, at 2,200 volts, is carried to great oil-insulated, water-cooled transformers. These transformers, which weigh 42,000 pounds each, take the comparatively low voltage current and "step it up" to a high voltage for the transmission lines which transmit it to the various centers of distribution many miles away, where it is stepped down to a voltage suitable for the operation of the cars.

LOCOMOTIVE DISCHARGES AND INSULATION.

In the electrification of steam railroads one interesting point that has been developed by actual service is the effect of steam locomotive discharges upon insulators. Experience has proved, according to Mr. W. S. Murray of the New York, New Haven & Hartford, that just about double the amount of insulation is required that it was thought would be necessary. It was quickly noted that the greatest number of insulator failures occurred wherever the insulation was subject to the direct blast of the steam locomotive. It was necessary to provide special means to meet this difficulty, and the fact is of interest as showing the one of several factors that enter into the problem of electrically equipping railroads on which steam locomotives are still employed.

ELECTROCUTING AN ARMY OF ANTS.

A peculiar and destructive ant had defied all efforts to put it out of business in the gardens and dwellings of the people whom the work on the Panama Canal had called to that tropical region by the thousands. The cultivation of vegetables, which was a very important matter, was made next to impossible, and the ants likewise invaded the houses and bored into and honey-combed the woodwork and furniture. All sorts of insecticides and deadly chemicals proved to be but temporary checks to the attacks of the ants, which came from the jungles in regular army ranks and array—millions of them.

Edward Schildauer, an electrical and mechanical engineer on Col. Goethal's designing staff, concocted all kinds of enticing "mixed drinks" calculated to appeal to the tastes of the hymenopterous insects. He mixed chemical solutions in which the ants were supposed to bathe and then die. His experiments met with no success, however, until he turned his attention to electrical methods.

Mr. Schildhauer went into his garden at Culebra one morning armed with a dozen batteries, a few yards of insulated wire and two files. He had observed that the ant army entered his garden from only one point, and he found the path. He laid across it two parallel steel files and connected up each on the circuit. As the ants stepped from one file to the other they were electrocuted, but they soon found out something was wrong and they diverted their path, marching around Schildhauer's electrical dam.

Believing then that electrical destruction was impracticable, Mr. Schildhauer gave it up, whereupon Mr. Tucker, his associate, saw greater possibilities, and he went to work with an electrical plan large in scope and scale. He smoothed off the ground around his garden and made a level path for about 50 yards of copper wire, and protected it from short circuits. He connected the wire with a powerful battery, and the moment an ant army approached it the leaders were killed. With their generals, majors and captains gone, the army shifted to another route, but the electrical destruction was repeated. Repeatedly the ants assaulted the garden barrier, but without success. Then they retreated to the jungle and gave up the attack for several days, only to return with unlimited numbers. The attack on the wires was a bold one. The indomitable little creatures literally stormed the copper breastworks, but only to meet defeat. Not until the wire barricade, every touch of which was death, was piled with tens of thousands of dead ants did the assault on it cease, and Mr. Tucker's garden and premises became conspicuous by the absence of all ants.

WHY THE TUNGSTEN LAMP IS EFFICIENT.

The question is often asked, "Why is the new tungsten lamp more efficient than the carbon filament lamp?" The reason lies in the fact that the tungsten filament can be operated at a much higher temperature and consequently greater brilliancy than can the carbon filament. The fusing or boiling point of carbon is in the neighborhood of 4,000° C., but long before that temperature is reached the carbon begins to slowly vaporize, coating the interior of the lamp bulb with a dark deposit which screens the light and destroys the effectiveness of the lamp. Carbon filament lamps must therefore be designed to operate at a temperature just below the point where this vaporization becomes objectionable.

The metal tungsten, of which the tungsten lamp filament is composed, has a boiling or fusing point lower than that of carbon. But tungsten does not vaporize to any appreciable extent even up to its fusing temperature, consequently the tungsten filament can be operated at a temperature nearly up to the fusing point, and this temperature is considerably higher than the practicable temperature of the carbon filament, which is the point where vaporization becomes objectionable.

As brought out by Dr. C. P. Steinmetz in a recent lecture before the Chicago branch of the American Institute of Electrical Engineers, although carbon has now lost first place as a filament material, as far as efficiency is concerned, having now been out-distanced by several metals, there is a possibility that it will sometime take the lead again. As stated above, carbon has the highest fusing temperature of any substance, and if only some allotropic form of carbon can be discovered which will not noticeably evaporate before the fusing point is reached we will have the ideal substance for lamp filaments, which may be operated at a temperature and brilliancy rivaled only by the carbon arc.

When we look at the little, hair-like filament in a lamp it does not appear to be much—we are inclined to think almost any substance ought to do the work. But on this same little filament, since the days of the first Edison lamps, the energies of hundreds of engineers and scientists have been expended. And they are still working on the same problem; some trying to find new metals for the purpose, others delving in chemistry to discover allotropic forms of carbon—all seeking to get just a little more light for the energy consumed.

THE ILLUMINATING ENGINEER.

For the past 20 years a little band of tireless workers has been specializing in one department of modern science. This little coterie of men has been dealin the mysteries of light and artificial illumination until the practical application of their discoveries has given rise to a new profession—the illuminating engineer.

A few years ago there were no men who specialized on planning for artificial light. Such work was turned over to the architect of every new building and he did the best he could with his meager knowledge of the subject. Now the illuminating engineer is of a recognized profession, and his services are required wherever a large building is being planned, be it public or private.

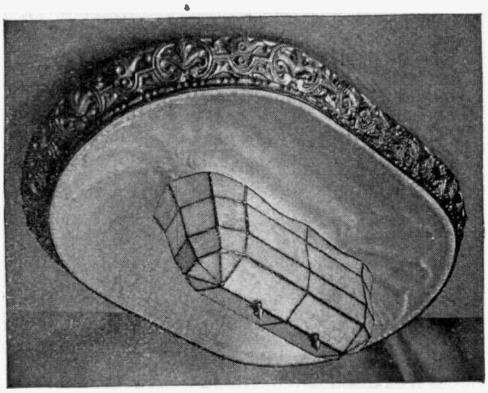
It was the invention of the electric lamp in the early eighties which made it possible to develop new and improved ideas in regard to correct lighting. At first the ingenuity of the embryo illuminating engineer was taxed to develop new scenic effects for the theaters. Then began the study and application of electric light for large halls and public buildings, while for the lighting of the home, the stores and churches, the simplest methods were long continued in use, often without regard for the precise results which might be obtained.

It was the invention of the more powerful illuminants which made necessary the illuminating engineer. The incandescent lamp, the improved electric arc lamps and the new metallic filament incandescent lamps, such as the new tantalum and tungsten, gave abundant opportunities for illuminating effects, and at the same time offered a wide field for the study of light concentration and human health and happiness in rooms artificially lighted.

THE EXTENSION DIFFUSER.

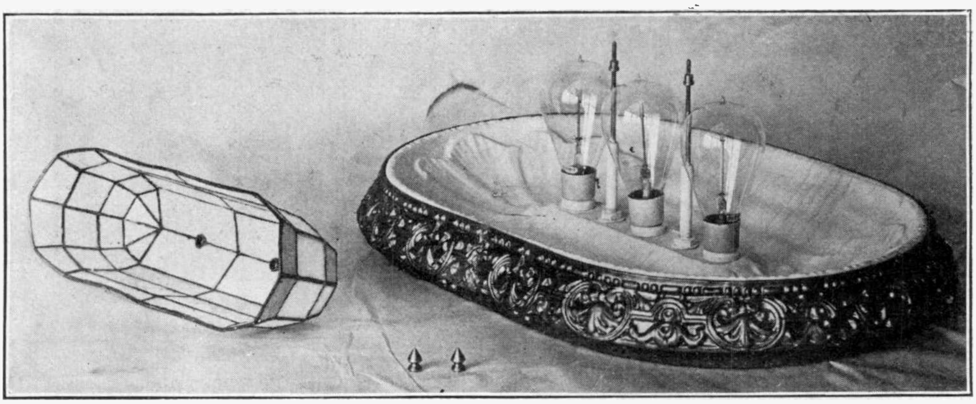
Demands of high-grade illumination require observance of both the esthetic and scientific principles of illumination. Some kinds of lighting fixtures present a very beautiful appearance but tire the eye in a very short time owing to poor distribution of light or too strong light. Inversely, the light may be extremely good for seeing but the fixtures may be inartistic and out of harmony with their surroundings. To meet the demands of artistic and efficient illumination for stores and also for rooms with low ceilings the extension diffuser has been designed.

This diffuser consists of a concave reflector body of ornamental design to be fastened to the ceiling. From this reflector three or six tungsten lamps are suspended. Below the lamps, and hiding them from vision is a shade of white opalescent art glass, strongly bound together and specially constructed for rigidity. The glass used in the shade is selected and arranged so as to give maximum diffusion with the minimum absorption of light. The shades are made in two different styles, known as the deep and the shallow types. The shallow shades are used with lamps of sizes up to and including 40-watt tungsten, 40-watt tantalum, and 40-watt Gem lamps. The deep shades are necessary for use with lamps up to and including 100-watt tungsten, 80-watt tantalum, and 125-watt Gem lamps. Clear glass lamps only should be used as the light is thoroughly diffused by the upper and lower shades.



THE EXTENSION DIFFUSER.

The distribution of light from the extension diffuser is not symmetrical about the vertical axis as in most lighting units. At angles approaching the horizontal the diffuser emits more light laterally than longitudinally. This is of special advantage in stores when the equipments are installed longitudinally over the center of the aisle, the maximum light being thrown out toward the counters and stock shelves, very little light being thrown directly in the eyes of the customers.



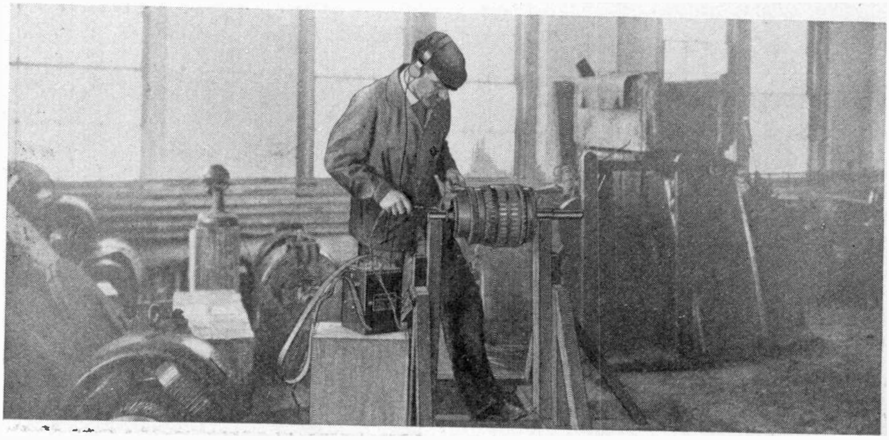
LAMP MOUNTING IN THE EXTENSION DIFFUSER.

ELECTRIC FAULT FINDER.

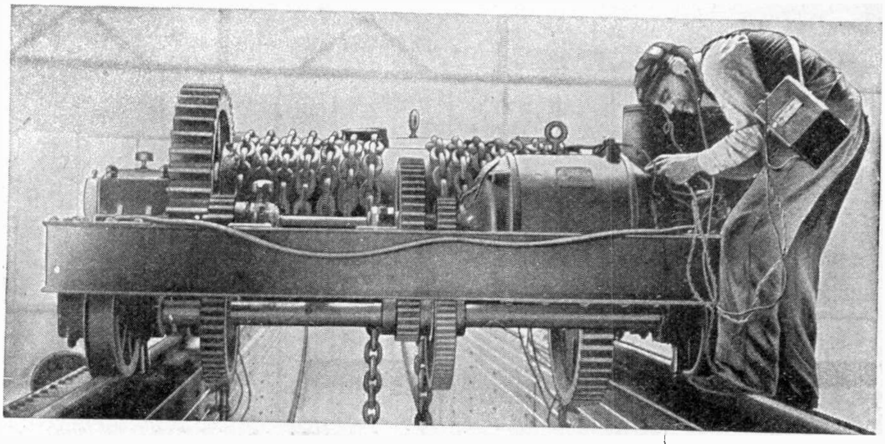
Armatures and field coils of motors and dynamos, transformer coils and electrical apparatus of a similar nature are oftentimes defective. A wire may be broken or the insulation may be punctured at some point not visible to the eye. One way of ascertaining if such faults are present is to use a magneto and "ring" out the armature or coil, that is, connect the terminals of the magneto to those of the coil and turn a crank. If the coil is continuous the magneto bell rings.

A new way of ascertaining the presence of such defects is with the electric fault finder, which not only detects the faults but locates them as well. It consists of a battery box with suitable terminals and switches, which is easily slung over the operator's shoulder. A telephone receiver is connected to the terminals and held in place by a head band. An adjustable rheostat is also added. The test terminals are held on the terminals of the circuit to be tested and if the circuit is complete a loud sound is heard in the receiver. In the same way, to discover leaks, one test terminal is held on one terminal of the armature and the other on the frame of the machine or armature shaft.

With this device it is possible to discover leaks, locate grounds and short circuits, locate coil ends, locate open circuits, etc.



TESTING ARMATURE WITH ELECTRIC FAULT FINDER.



TESTING CRANE MOTOR WITH ELECTRIC FAULT FINDER.

COMMUTATOR "SPARKING".

BY JACOB GLOGAU.

Commutator sparking is classified into three forms, namely: Static; scintillating; greenish-yellow.

Small bluish white sparks that are often noticed are not dangerous, only producing a slight heating effect. They may be designated as static sparking.

The scintillating sparking can not exactly be called sparking because it is caused by dirt or carbon dust, being brought to a white heat while passing under the brushes and appearing to circle the whole commutator.

The greenish-yellow sparking is the dangerous form of sparking on account of the heating and destructive nature. In such cases every effort should be made to locate the trouble and remove it as quickly as possible, because the longer this is delayed the more trouble will be met with at the end.

Following is a table showing the different causes of sparking:

Static		
Scintillating	(1) Dirty Commutator	
	(2) Incorrect setting of brushes.	Spacing around commutator wrong. Armature rotating against brushes. Brushes not fitted to commutator.
	(3) Grooves in commutator.	Brushes not accurately fitted. No end play. Brushes not staggered. Brushes improperly set.
	(4) High or low commutator bars.	Excessive temperature. Unequal wear.
Greenish Yellow	(1) Dirty commutator.	Lack of attention. Excessive lubrication
	(2) Commutator out of round.	Excessive temperature. Unequal wear.
	(3) Brush tension too small.	
	(4) Open circuit in armature coils.	
	(5) Short circuit in field windings.	

Sparking at the commutator is a very common trouble and is not an objection if it is moderate and of short duration, but when kept up for a long time serious trouble will ensue, such as a burned or rough commutator, and excessive heating. This can be remedied a little by proper design of the machine and by use of carbon brushes.

One of the principle causes of sparking is overloading of the armature; that is, too many lamps being fed by the generator. The armature becomes overheated and the belts (if of the belt type) will begin to slip and the only remedy is to reduce the load at once.

Brushes not set right—The brushes must be placed in the neutral point on the commutator, which can be found by shifting the brushes by means of the rocker arm until all signs of sparking disappear. The usual position for the brushes is opposite the space between the pole pieces, but it does not always follow in all machines.

A bad commutator—Sparking is caused by a commutator which has high or low bars, or is rough, or with mica sticking out, thus preventing good contact for the brushes. A bad commutator can be tested by placing the finger on the commutator while it is rotating, and feeling the rough spots. This is also shown by the brushes making a clattering noise while operating. To remedy this the commutator should be turned down, then smoothed off with sandpaper (not emery cloth) and then cleaned with a little gasoline, so as to remove all traces of copper dust. A good commutator should have a dull glaze of a brown color. It is also advisable to use a little vaseline or dynamo oil on the commutator. I may add here that in one of the traction companies of New York it is the generator attendant's duty to put vaseline on the commutator and collector rings of the rotary converters in fairly large quantities every hour.

Poor brush contact—The brushes sometimes only touch the commutator at one spot, because there may be dust at the other end of the brush, or some of the surface of the brush has a glassy appearance. To have good carbon contact, the carbon to be used is placed in the brush holder and tension applied to the brush. A piece of sandpaper is put on the surface of the commutator and is drawn back and forth under the brush, thus making the brush contact surface round and with the same curvature as the commutator, giving the very best kind of contact. Then the brush is cleaned with an oily rag and is ready for use.

Short circuit coil in the armature—In a motor the armature will take excessive current. In the dynamo the armature will require considerable power. The coil will become heated and probably burn out. The machine should be stopped and a new coil replaced for the damaged one.

Reversal of polarity of dynamo—When compound or series wound machines are running in parallel, reversals take place, closed circuits are formed and a large amount of current results, causing serious sparking.

Short circuits in field magnets—If one of the coils is short circuited, the faulty coil remains cool and the good coil gets overheated, thus giving rise to sparking at the commutator. To test, examine all connections and test out with battery and voltmeter, and if the short circuit is not accessible the best way is to rewind the coil.

An open circuited armature—Produces violent sparking at the commutator. The flashing takes place when the commutator bar near the break is passing from under the brush. If the bars are examined they will be found to be burned, and the mica between them all eaten away. The remedy is to solder the two bars together, or use a jumper, as it is called. This is done by connecting the two bars with a piece of wire.

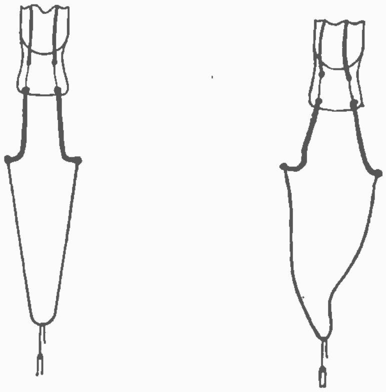
Weak field magnetism—May be due to a short circuited field coil. This can be detected easily by testing the pole pieces with an ordinary piece of iron, the coil will show very little attraction for the iron. This distorts the armature magnetism, thus shifting the neutral point and causing sparking.

Sparking is also caused by vibration of the machine. This can be lessened by putting more tension on the brushes. Variation of speed sometimes causes sparking, and, lastly, a ground will overload the machine, thus causing excessive current to flow, and excessive current causes sparking.

Motorists who suffer with cold hands while driving their cars may have relief by using a steering wheel provided with electric heat. An English invention describes a steering wheel with a core that carries two electrically heated coils insulated one from the other and from the outer rim.

TUNGSTEN LAMPS WITHSTAND LIGHTNING.

During a severe storm in Hackettstown, N. J., last summer, the series incandescent line used for street lighting was struck by lightning, the discharge passing through 33 tungsten lamps. The



EFFECT OF LIGHTNING ON TUNGSTEN FILAMENT.

filaments were slightly curled as is shown at the right in the illustration, but the lamps did not burn out. This same stroke of lightning burned out three transformers then jumped to a private house ripping off a door sill, knocking a woman unconscious and passing into the ground through a steam radiator.

A NOVEL CANNON.

Electric cannons, utilizing the principle of the solenoid, have been proposed for the last twenty years, although nothing very definite has come of the talk. A man in South Bethlehem, Pa., is now exploiting an electrically fired gas cannon, but simply as a toy. A cork is placed in the muzzle of a small gun, and when an explosion is produced in the breech, on the principle of the gas engine, the projectile is thrown out with considerable force. Ignition is produced by an electric spark, or the spark needle is scratched against a block of pyrophoric alloy. This is an alloy of iron and lanthanum, and when it is scratched it is said to give off sparks, like the sparks produced by flint and steel in other days. Acetylene gas is used, and the inventor makes the curious claim that it is "the safest material under the sun that can be used to make a noise."

A THEORY OF ELECTRICITY.

To The Editor Popular Electricity:

Within the field of chemistry there is no more active element than oxygen, and hand in hand with it goes hydrogen. Every drop of water formed embodies the union of hydrogen and oxygen. Every fire lighted gives off these elements of hydrogen and oxygen, the hydrogen largely from the burning substance and the oxygen drawn chiefly from the air to unite with the carbon as carbonic oxide and with hydrogen to form water vapor. Since the actions and reactions of these elements in combustion and in the formation of water are going on continually and the association of the composing elements of all bodies has been effected through the action of either fire or water it may be stated, as a self-evident truth, that the composing elements have been arranged in an order to permit the passage of either hydrogen or oxygen; by their actual passage as they left the bodies as evaporated moisture or as hydrogen thrown off by combustion or heat. Since oxygen and hydrogen are known to exist in their free state in all parts of the universe and are capable of passage by chemical action through solids, it must transpire that a union of these gases under the required conditions to ignite must take place at times within or at the surface of bodies offering considerable resistance to the passage of the gases. This would undoubtedly give rise to an observable phenomenon very similar to that of electricity where the chemical action was continuous. As these chemical actions are of vast extent and there is no apparent manifestation as a result other than in the force of what is designated as electricity, in the judgment of the writer they are identical. The hydrogen-oxygen flame is identical in appearance with that of the electric spark and produces the only heat equal to it. There are two electric currents corresponding to the gases, they move in opposite directions as they would if they were drawn to a common point to feed a combustion. In the arc light twice as much of one carbon is consumed as compared with the other. In ordinary combustion two parts of hydrogen unite with one of oxygen to form water vapor. We observe the lightning's flash at a time when these gases are the most active in the condensation of moisture; the natural inference is that this action is elecrticity and the lightning stroke the ignition of currents of hydrogen rising from the earth by chemical action.

C. E. BAKER.

LABOR SAVING IN OFFICE WORK.

Undoubtedly in the future a widespread use of electric power will be made in the ordinary work of business offices.

Electric typewriters, for example, are now available, and it would not be surprising if they come into use to considerable extent. The keys are operated by small electro-magnets, and only the slightest touch on the part of the operator is necessary to do the work. Another advantage is that the touch is perfectly uniform, and therefore the work has a neater appearance than it is possible to obtain when the keys are struck by hand rather than being merely subjected to a light touch, the machine doing the rest.

Where large numbers of letters or circulars are sent out addressing machines are often used, and now-a-days these machines are frequently driven by a small electric motor, enabling the work to be turned out much more quickly than by hand.

Something of a novelty in the office appliance line is the letter-folding machine. It is said that by the use of this device ordinary letters or circulars 8½ by 11 inches may be folded at the rate of 9,000 an hour. The machine is not complicated, and by its use, letters can be folded so rapidly that the efficiency of the office force will be greatly increased. Here too it is a simple matter to attach a small motor to drive the folder by electric power from the nearest lamp socket.

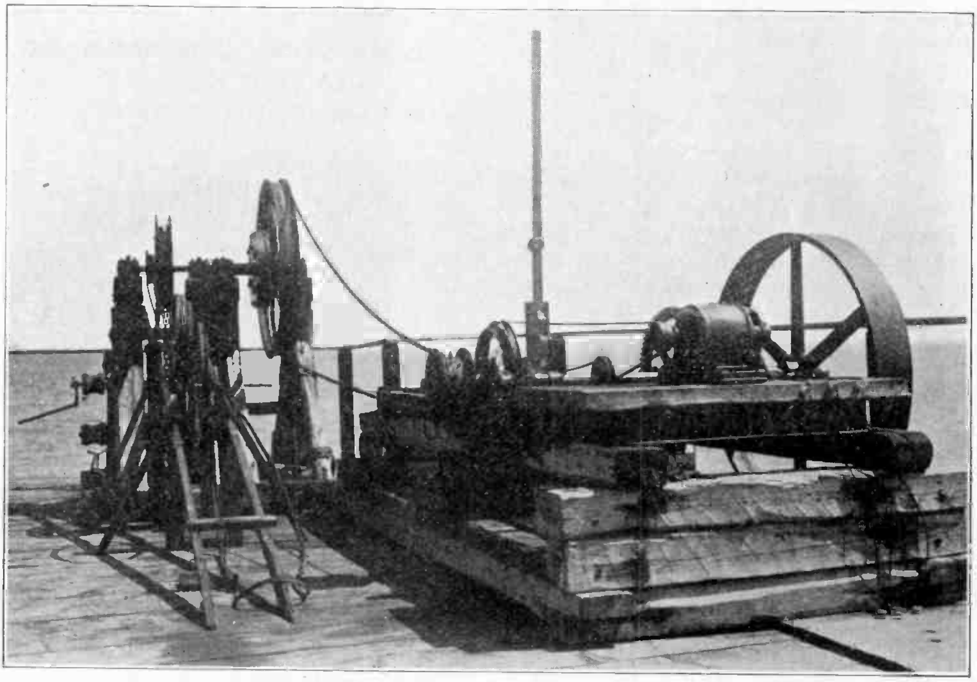
Electric signs add much to the brilliance and attractiveness of the streets of cities or villages. They are good for the electric light company, of course, but their chief merit lies in their drawing power for the merchant who uses them and the air of being up-to-date which they give to his place of business.

GENERATING ELECTRICITY BY SEA WAVES.

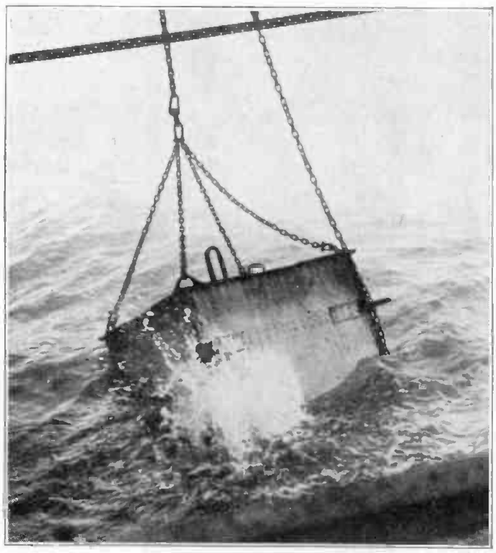
Modern engineers are fully aware of the fact that the coal stores of our earth are destined to be exhausted in a possibly not very remote future, and they are accordingly intent on developing additional direct sources of energy.

The idea of utilizing the power of sea waves has appealed to many inventors, none of whom has, however, been able heretofore to carry it out in practice on a commercial scale.

Recently an Italian officer, Sig. Ed.



ELECTRIC GENERATOR DRIVEN BY SEA WAVES.



PROPELLING FLOAT OF SEA WAVE GENERATOR.

Pirandello, succeeded in erecting on the coast of Rimini a plant allowing the power there developed by the breakers to be utilized for the first time in a really practical manner. In connection with a series of conclusive tests recently made, this plant was able to keep a few electric lamps burning and to decompose water electrolytically into its component gases, the oxygen being compressed in the familiar cylinder reservoirs, while the hydrogen could be used for feeding ordinary explosion motors.

The success of those experiments has resulted in a company being founded at Florence for the construction of the novel apparatus. The experimental plant erected at Rimini was built at a cost of less than $4,000.

The most important part of the plant is a pneumatic float of special design, which constitutes the motive device proper. This comprises a closed floating box-like arrangement. A tube, fitted with valves, forms a connection, through the float, between the closed compartments and the atmosphere. After first placing this float on the water, the air is exhausted from a lower compartment in the box by opening the valve. After closing the valve, the float is found to cling to the surface of the water, owing to the pressure of the atmosphere. It can therefore be made to transmit the reciprocating vertical motion of the sea waves to a chain running over a pulley and toothed wheel. A set of pegs fitted on another wheel engages with the teeth of this wheel, provision being made for those pegs to mesh with the teeth and to transmit to them the motion of the float only during the descent of the latter. During the ascending motion of the float, the wheel thus does not receive any impulse and the chain fixed to the float is kept tightened by a counterpoise fitted to its other end.

The second wheel, which corresponds to the chain wheel, is fitted with an escapement, controlling a heavy flywheel. The reciprocating motion of the float is accordingly converted into a non-continuous motion of the wheel corresponding to the chain wheel, which motion is of constant direction. The escapement then serves to convert this motion into the continuous rotation of the flywheel, which transmits rotary motion to the transmission gearing which drives the dynamo.

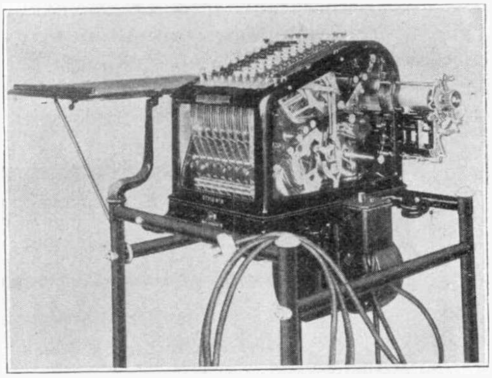
THROUGH THE CASCADE TUNNEL BY ELECTRICITY.

Passenger trains hauled by electric locomotives are being used in the Cascade Tunnel of the Great Northern Railroad. The electrification of this long tunnel, which has been such a source of trouble and annoyance since the road was built, is the largest undertaking of its kind ever attempted in the West, and the Great Northern is the first of the great western roads to adopt electric propulsion for any considerable portion of its road.

Not only is the Cascade development the largest of its kind in the West, but it is the first three-phase railroad system to be installed in this country and one of the first in the world. The most unusual feature of this electric service, as planned by the General Electric Company's engineers, is the fact that the motors, which pull the electric locomotives and trains up the grades, will naturally and inherently become generators on the down grades and return electrical energy to the line.

AN IMPROVED ADDING MACHINE.

The ordinary adding machine will do the work of from four to six expert computers, and it would seem that there is no need for quicker work than this; but electricity has been applied and makes the machine capable of doing the work of from six to nine human computers more correctly and with less labor.



ADDING MACHINE AND MOTOR.

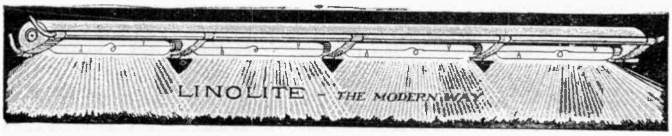
One large adding machine company is equipping its machines with Westinghouse motors, and trials have shown that when thus equipped they accomplish the foregoing remarkable results. In the unimproved form the only mechanical work necessary is the pressing of the keys and the operation of the handle projecting to the right of the case, but the latter has been eliminated by the application of the electric motor. Now the numbers are written by simply pressing a key on the keyboard of the machine, which throws in a clutch and connects the shaft of the motor with that of the handle. The increased speed and accuracy are due to the elimination of the tiresome manipulation of the handle and consequent interruption of the work.

A GREAT ELECTRICAL SOCIETY.

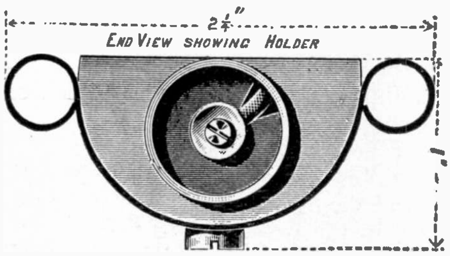
Some idea of the widespread interest taken in electrical work in this country may be gained from the statement that the American Institute of Electrical Engineers has now over 6,000 members. This society has had a remarkable growth in the last few years. It was founded in 1884, and it has branches all over the country. That at Schenectady alone has a membership of between 800 and 900. Mr. Ralph W. Pope is secretary of the organization, and to his steady, even, unending work much of its success is due.

LINOLITE.

Linolite is a comparatively new system of illumination and, as its name (line o' light) implies, consists of long, tubular incandescent lamps arranged in series. These lamps have single filaments running from end to end, with suitable terminals for connecting the lamps together in succession. The lamps are finally mounted in a continuous semicircular reflector, made of a single sheet of sheet metal, usually aluminum. Linolite, so to speak, may be cut off by the yard to suit any purpose, which is generally window lighting, picture lighting or ceiling illumination.



LINOLITE SYSTEM OF ILLUMINATION.



END VIEW OF LINOLITE UNIT.

The whole fixture, reflector and all, will pass through an oval ring 2¼ by one inch, so it is readily seen that the system economizes space in a vertical direction.

The light may be fitted inside the frame work of a window or back of the fillets in such manner that the fixture is invisible or practically so, and the source of light screened entirely from the eye of the spectator. No light is wasted outside the window, and the intensity of illumination inside becomes so much greater than the general illumination surrounding the window that attention is instantly attracted to the window itself. Goods displayed as close as one inch to the window are properly illuminated, as the light is close to the glass.

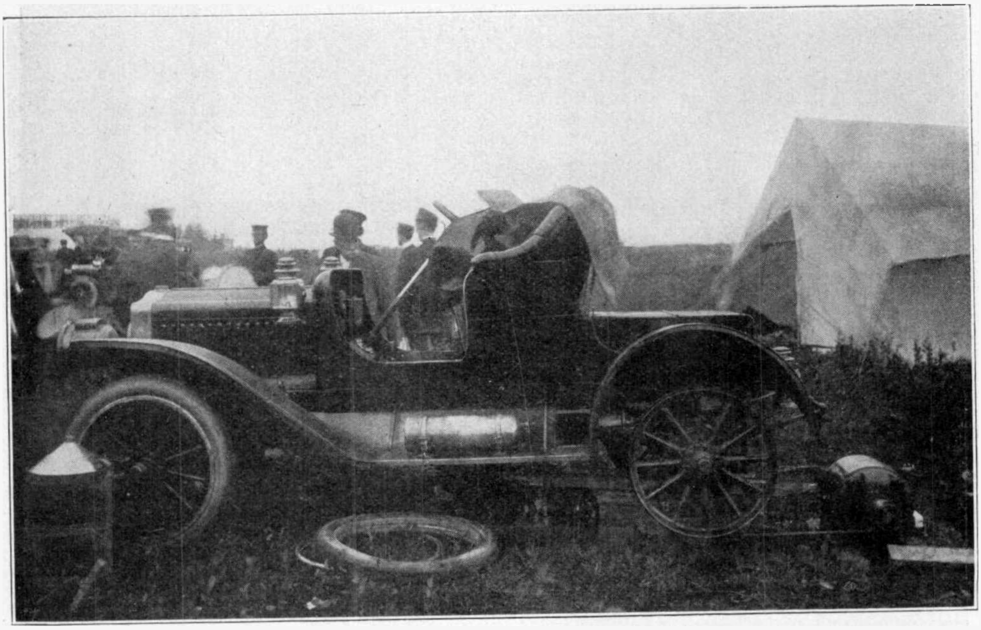
METERS, GRAMS AND LITERS.

Electrical men should take particular interest in the metric system of weights and measures because all the electrical units of measurement likewise are based on the decimal system. It is interesting to know, according to a floating newspaper paragraph, that the use of the metric system is now compulsory in the Philippine Islands. Various attempts have been made to make the use of this system mandatory in this country rather than permissive as at present, but so far without success. However, it is a good thing for all persons who wish to be well-informed to familiarize themselves with the metric system, for it is in use in a very considerable proportion of the civilized countries of the globe. Once mastered it is very convenient, for measures of length, volume and weight are derived from the same fundamentals.

As the metric units are used very largely in the scientific literature of all languages, it is convenient to remember that the meter is a trifle over 39 inches or somewhat longer than a yard. A centimeter is a hundredth part of this or about two-fifths of an inch. A liter is a little less than a quart dry measure and a little more than a quart liquid measure. The kilogram is a trifle over two pounds and three ounces. With these simple equivalents in mind, and remembering that the prefix centi means the hundredth part and the prefix kilo means multiplied by 1,000, it is easy to translate metric expressions encountered in ordinary reading into the corresponding values in the ordinary English weights and measures.

AUTOMOBILE EMERGENCY ELECTRIC LIGHT PLANT.

The modern automobile can be utilized for emergency power service at a residence, factory or in the field for operating an electrical generator and can be made to do excellent service for short periods of time.



AUTOMOBILE EMERGENCY ELECTRIC LIGHT PLANT.

During the Vanderbilt cup races on November 24, 1908, it was necessary to have incandescent electric lights at a certain point on the course, and a motor car was pressed into service with an electrical generator as an improvised electric light plant. The car used was a 30 horse power roadster and the back tire was removed from one of the wheels, a belt being attached for driving the dynamo as shown on the picture. In this manner 55 incandescent electric lamps of 110 volts were operated, each of 16 candle power. It will be seen that an emergency plant can easily be rigged up in this way with any automobile, by jacking up one wheel, the others remaining on the ground, so that the differential gear allows the free wheel to operate the dynamo, taking the full power of the gasoline engine.

HOTEL SIGNAL SYSTEM.

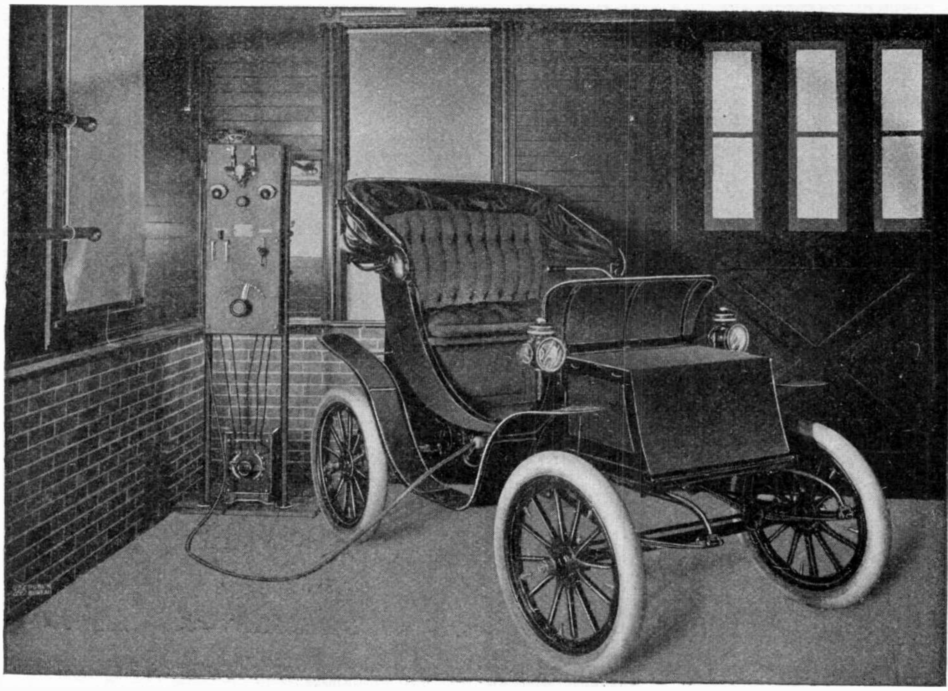
One of the newest pieces of electrical equipment for hotel use is a system of little lamps of the switchboard type, by which it is possible for a guest or the management to locate instantly the room in which chambermaids are working. This is a great convenience both to the guests and management, for the girl having charge of any particular room may be communicated with without any loss of time. Each maid is provided with a key which serves as a switch handle for lighting a small lamp at the doors as she enters a room and simultaneously lighting the indicating lamp at the desk of the chief of employes.

By means of an illuminated sign for each guest he is notified immediately when mail matter reaches the office for him. The placing of a letter in the post-office box corresponding to his room closes a switch and lights a lamp.

THE MERCURY ARC RECTIFIER.

By the term "rectify" in electrical phraseology is meant the changing of alternating current, which reverses its direction of flow many times each second, to direct current, which flows continuously in one direction. This operation is performed in various ways, on a large scale by machines such as motor generators or rotary converters, on a small scale by various types of electrolytic rectifiers, which are of low efficiency. There is still another device which has been developed in the last few years called the mercury arc rectifier which accomplishes the same result at high efficiency.

Broadly speaking, the mercury arc rectifier consists of a mercury vapor arc enclosed in an exhausted glass vessel, sealed-in electrodes being supplied for attachment to the terminals of the electric circuit as shown at (A), (A′) and (B) in the diagram. Mercury vapor has a very high resistance to the passage of current under ordinary conditions, but if an arc can once be formed in mercury vapor, the vapor becomes "ionized"; that is, broken up into extremely small particles, smaller ever than atoms. This "ionized" vapor of mercury is a good conductor, and, when once formed by an intial arc, is continuously given off by the negative electrode, and keeps the arc in operation. Only a few volts are then necessary to maintain the current flowing in one direction, but a very high voltage would be required to sustain it in the opposite direction. Therefore current can only flow through such a tube from positive to negative.

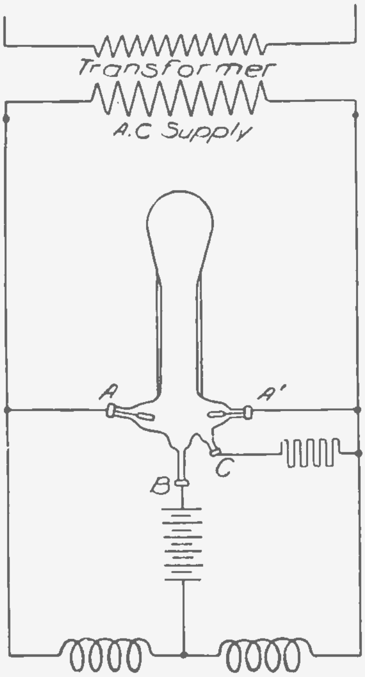


MERCURY ARC RECTIFIER CHARGING AUTOMOBILE STORAGE BATTERY.

Operation of the mercury arc rectifier, as shown in the diagram is as follows: The little starting anode (C), which is positive, contains metallic mercury. The tube is slightly shaken or tilted until the mercury runs down into (B). The mercury thus forms a bridge between (B) and (C) which allows current to flow.

As the stream of mercury breaks it draws out an arc between (B) and (C), which arc ionizes the mercury vapor in the tube and allows current to flow from (A) and (A′) down through (B). (B) thus becomes the cathode or negative pole and continually throws off ionized vapor which maintains the tube in operation when once started. Now (A) and (A′) are connected to opposite sides of an alternating current circuit, and as the current in this circuit is constantly changing in direction, (A) and (A′) are intermittently positive.

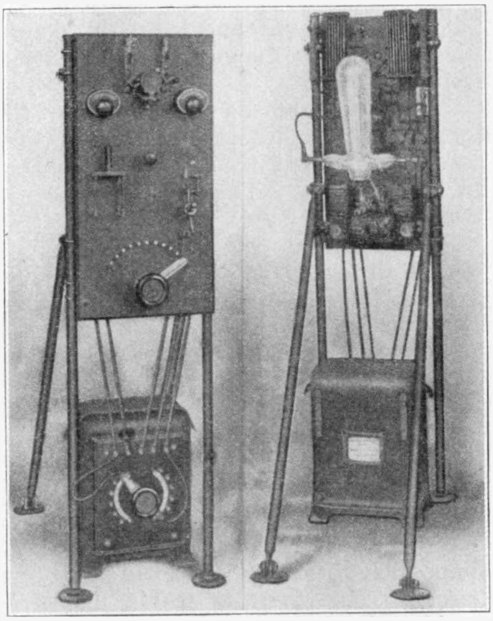
Since, as explained above, current can only flow with ease in one direction through the vapor, (B) always remains negative and current flows out at (B) in one direction (direct current), coming one instant from (A) and the next instant from (A′) and so on. Thus we have obtained direct current from alter-



CONNECTIONS OF MERCURY ARC RECTIFIER.

nating current by simply using a little glass tube and a few ounces of mercury.

When first introduced the mercury arc rectifier was used principally for charging electric automobile storage batteries where only alternating current service was available. But it is now being used for many other purposes; for instance, charging storage batteries on telephone systems, ignition batteries for automobile and stationary gas and gasoline engines, operating arc lamps for



FRONT AND REAR VIEW OF MERCURY ARC RECTIFIER PANEL.

moving picture machines, searchlights and similar apparatus, dental and other small direct current motors, railway signal systems, electroplating, and in fact almost innumerable purposes.

ODDS AND ENDS.

To find circumference of a circle multiply diameter by 3.1416.

To find diameter of a circle multiply circumference by .31831.

To find area of a circle multiply square of diameter by .7854.

To find area of a triangle multiply base by ½ perpendicular height.

To find surface of a ball multiply square of diameter by 3.1416.

To find contents of a sphere multiply cube of diameter by .5236.

Doubling the diameter of a pipe increases its capacity four times.

A cubic foot of water contains 7½ gallons, 1,728 cubic inches, and weighs 62½ pounds.

RESPECT BUT DON'T FEAR ELECTRICITY.

While electricity is a powerful force and one to be respected, still, in its ordinary applications to everyday life it should not be feared, for it is never, in these days of up-to-date construction, allowed to "lay around loose" in quantities or voltages dangerous to the "innocent bystander."

There is no reason to be afraid of the ordinary incandescent lighting circuit such as is used in houses illuminated with electricity. This circuit ranges in voltage or pressure from 110 to 118 volts. Incandescent lighting current is not at all dangerous. If a person should pick up the naked wires of such a circuit with his bare hands he would get but a trifling shock, if his hands were reasonably dry. If he should pick up the same wires with wet hands and take a firm hold he would get a jolt.

The precautionary measures now used in installing electric lighting systems and the general improvement in all lines of electrical engineering make it practically impossible to get a shock from a lighting circuit. The wires are heavily insulated, making them proof against sparking, and when installed by competent electricians the fire danger is eliminated.

In electrical engineering circles any voltage below 700 volts is called "low" and anything above that figure "high voltage." Broadly speaking nothing below 700 volts is dangerous.

The ordinary street car systems use electricity at 500 volts, although there are a very few in this country using more pressure than that. Such circuits are of course out of the reach of persons on the ground unless a trolley wire is broken and hangs down. Touching such a wire does not mean death. It is only deadly when grasped in the hands; then it is dangerous because the victim cannot let go and consequently remains in contact for a considerable length of time.

The "deadly third rail" which is so often spoken of, also operates at 500 volts, and is no more deadly than has been already shown, except for the probability of a person, who is thrown down by the shock, falling across the third rail and the track or return rail and becoming unconscious. This, of course, is as serious a case as that of the man who is unable to let go of the wire.

Wires used for street arc lighting may always be regarded with suspicion; they are exceedingly likely to carry a current of 2,000 volts or more, but contact with them is next to impossible unless a person goes "looking for trouble," as, for instance, the small boy who is playing "follow the leader" and climbs a light pole. A fatal accident of this nature was actually recorded which at the time caused much talk about the "deadly electric current." But there were a hundred other ways by which the unfortunate lad might have met his death which would excite little comment.

Electricity is a force to be respected as we would respect the force of steam or of a traveling belt; but there should be no false alarms about its deadly character. It can be brought into our homes and be made our willing servant with absolutely no danger to us.

GRADUATED STREET LIGHTING.

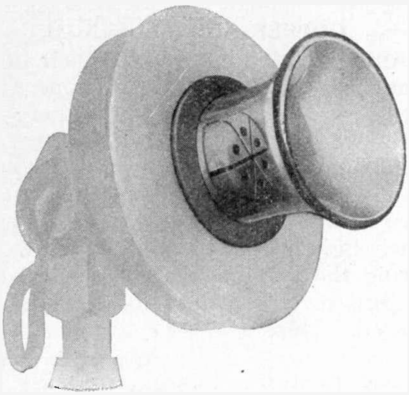
In his presidential address at the recent convention of the Illuminating Engineering Society in Philadelphia Dr. Louis Bell of Boston, taking as his subject "Street Lighting," pointed out that one great trouble in American cities is that there is no careful discrimination between streets which demand considerable light and those which are perfectly well illuminated with a much less quantity of light. For lighting purposes streets should be divided into three distinct classes—first, the principal arteries of traffic, which need all the light they can get; the secondary streets, making up the bulk of an ordinary city, which should be well lighted but do not require a blaze of illumination, and a third class of streets in which the lighting is intended merely to show the way. As to the absolute amount of light, there should be enough in the chief streets so that one could see to read a paper without walking perhaps half a block to the nearest lamp. Less illumination is needed in the secondary streets, while those of the third class require still less.

Diffusion of light is an important requirement. Moonlight is good because, although of slight intensity, it is widely diffused. Thus no trouble is experienced in driving an automobile in moonlight with a good head-lamp, but one might have difficulty in guiding the car, even with a good head-lamp, in a lighted street, because the lamps in the street flash straight in the face.

More light and all-night lighting are needed, not only for general purposes but fór public safety. It is a familiar saying among electrical men that one arc light is as good as a policeman. Certainly a city well lighted all over is a safer city at night than the average poorly lighted city. This is well understood in Europe, where in the chief cities one can read fine print at night in all the principal streets for every step of the way.

A TELEPHONE MOUTHPIECE OF GLASS.

Physicians contend that the ordinary hard-rubber telephone mouthpiece may easily become unsanitary, if not frequently cleaned, by the deposit of germs from the breath of people talking into it



GLASS TELEPHONE MOUTHPIECE.

and also from the atmosphere. A mouthpiece of glass has now been devised, which is so attached that it can be instantly removed for cleaning or boiling if desired. Clear glass is used, and it is said to give even better telephone transmission than the ordinary mouthpiece. The invention is of interest as illustrating the constant tendency to make all every-day appliances as sanitary and healthful as possible.

PROCESS OF COLORING INCANDESCENT LAMPS.

One of the readers of Popular Electricity recommends the following process for coloring incandescent lamp bulbs: Dip the bulbs in white shellac thinned with denatured alcohol. The lamps should be connected and the current turned on when they are dipped, so that the bulb will dry immediately upon being taken out of the bath. This preparation gives the bulb the appearance of frosted glass. If special colors are desired dyes may be added to the shellac.

ELECTRICAL CROSS EXAMINATION.

Under intense mental excitement, no matter how outwardly calm an individual may be, the hands will involuntarily relax according to the intensity of the emotion and the susceptibility of the person affected. This fact was once turned to advantage in a criminal trial in which the defendant was so hardened that he was outwardly calm to all appearances during cross-examination.

The prosecuting attorney then reasoned that if the arms of the chair could only be made to communicate the pressure of the invisible contractions of the muscles of the hands and arms of the witness, an important light might be thrown on the case. He called an electrician to his aid, and during the absence of the prisoner from the court room the arms of the chair were removed and split in half and in each was placed a hard carbon plate, which served as a variable resistance. Wires were run from the metal plates, placed on either side of the carbon, through the legs of the chair and under the floor to a telephone receiver and battery placed in an adjoining closet. The arms were again upholstered and the chair replaced. Every increase of pressure on the arms of the chair now affected the transmitter, and caused sounds to issue from the mouth of the receiver.

On the resumption of the trial a court official was placed in a closet, and by a series of signals arranged beforehand signified the feelings of the prisoner as they were betrayed through the muscles of his hands. The main points against the prisoner were thus determined. They were presently formulated and read to him in privacy, and he was so overcome that he made a confession of his crime.

HEAD LAMPS PROTECT THE STREET SWEEPER.

The unusual spectacle of little lights bobbing at night, like fire-flys, in the highways and byways of Chicago's boulevard system, has aroused some curiosity. These mysterious lights are nothing more or less than little electric head lamps worn by the industrious street

STREET SWEEPER AND HIS HEAD LAMP.

sweepers to prevent them from being run down by rapidly dashing automobiles.

Two-volt tungsten lamps, in special sockets, are attached to the caps of the wearers. Current for each lamp is supplied by a storage battery cell carried in the pocket of the wearer. This storage cell is about an inch in thickness and is 2¾ inches wide by six inches long. It contains, besides the lead plates, "solidified" sulphuric acid, which is the consistency of jelly.

The lamps are serving their purpose admirably and are a source of evident pride to their wearers.

IN CASE OF SHORT-CIRCUIT.

In electrical literature one often reads of a "short-circuit." What does the expression mean? Simply that wires have become crossed or connected so as to form a shunt or by-path of comparatively low resistance, through which so much of the current passes as practically to cut out that part of the circuit through which the current originally flowed. In case a short-circuit should occur at or near the generator, or if an arc should be formed at a switch or fuse block, and hold on, the man in charge is usually directed to throw all resistance in the field rheostat and if necessary shut down the engine at once.

The following order should be observed: First throw in circuit breakers; then the main switch. In opening a circuit, trip the circuit breaker; then open the switch. If a line fuse blows, first open the switch corresponding with that line and then replace the fuse. Afterward close switch. If a second blowing of fuse follows, there is something wrong on the line, probably a short-circuit, and this should be corrected at once.

COPPER AND ALUMINUM.

Although aluminum is not such a good conductor of electricity as copper, it is used to a considerable extent where bare wires are put up to transmit current, particularly when copper is high in price. Aluminum is seldom or perhaps never used for insulated wire. It is, of course, much lighter than copper, and in comparing the two metals as electrical conductors several factors have to be considered. Here are some of them:

	Copper.	Aluminum.
Specific gravity	8.93	2.68
Conductivity for equal area	100.	63.
Weight for equal conductivity	100.	48.
Area for equal conductivity	100.	160.
Diameter for equal conductivity	100.	126.

It will be noted from the relative diameters that an aluminum wire to be of equal conductivity with a copper wire is almost exactly two sizes larger by the Brown & Sharp wire gauge.

The conductivity of aluminum wire is 63 per cent that of copper; but an aluminum wire of equivalent conductivity will have 48 per cent of the weight and 160 per cent of the strength.

DROP A PENNY—GET A SHINE.

This rival to the industrious shoe shiner is run by electricity. Dropping a penny in the slot starts a motor, and this causes the brushes to revolve. The foot is inserted in a box containing the brushes and is held there until a bell rings, which is the signal for the left foot to be changed for the right, or the right for the left. When the machine has given the customer his penny's worth of polish

ELECTRIC SHOE SHINER.

it quietly ceases to revolve. If he is dissatisfied with the result he can drop in another penny and have his shoes polished a little brighter.

AMPERE MEMORIAL TABLET.

Appropriate tribute was paid to the memory of Andre-Marie Ampere, the famous French physicist, at Ampere, N. J., on December 3. This was the occasion of the unveiling of a beautiful tablet erected in the new railroad station at Ampere, and the gift of Dr. S. S. Wheeler.

Andre-Marie Ampere was the man who founded the science of electro-dynamics and his name is to-day used throughout the world to designate the unit of electric current, which is the ampere.

AMPERE MEMORIAL TABLET.

The tablet, a beautiful piece of bronze, is shown in the picture. It bears bas-relief of Ampere with appropriate inscription. It was unveiled by the French Ambassador, M. Jules Jusserand, and many prominent men were present, including representatives from the four national engineering societies.

A NOVEL PAY SYSTFM

A novel pay system, designed to save bookkeeping and clerical work, is to be put into effect on the Philadelphia Rapid Transit system. There will be a daily payment of wages to motormen and conductors. Each employe will be paid at his respective car barn as he finishes his run for the day. The receiving clerk at the barn will take the conductors' returns and audit them immediately. Should no error be found in either the returns or report, the crew will at once be paid the day's wage, the money being taken from the cash collected for the day by the various conductors.

HIGH FREQUENCY CURRENT EXPERIMENTS.

BY H. L. TRANSTROM.

In an article which appeared in the August issue of Popular Electricity it was mentioned that long discharges could be taken through the body, at very high voltages, from the secondary of a Tesla coil. It must be remembered that the discharges are not confined to the upper terminal but can be taken along the whole length of the coil, decreasing

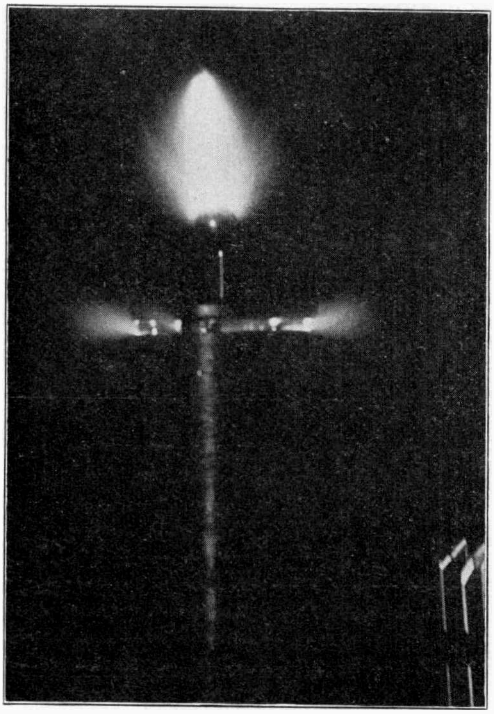


Fig. 1.

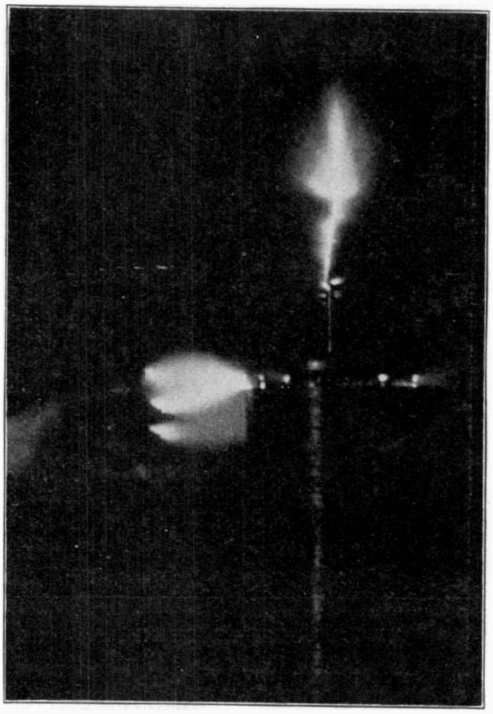


Fig. 2.

100,000 VOLT DISCHARGES TAKEN THROUGH THE HAND.

in length until the bottom is reached. This is true when the lower terminal is grounded or connected to some conducting body equivalent to a ground. If, however, the secondary coil length is increased sufficiently it will be seen that no discharge whatever takes place at the upper terminal, but instead gives the best results at a point equidistant from the terminals.

If the number of plates is changed this point of maximum spark length changes also; if plates are added the point moves upward, if fewer plates are used the point moves downward correspondingly, but at the same time another discharge point is noticed at the upper terminal.

This effect is caused by the differences in length of electrical waves. If we use sound waves as an analogy we can understand the action of electrical waves better. Sound as we know travels about 1,120 feet per second. If a sound is made that vibrates 100 times a second it is readily seen that each wave is 112 feet long. Electricity, however, travels at the rate of 186,500 miles per second, so to get an electrical wave of such a short length as used in the analogy it would be necessary to have about 10,000,000 waves a second. If these waves are sent along a wire, every 100 feet would be a point where one wave would end and another begin. But electrical waves are each composed of two alternations, first in one direction, increasing from zero to maximum value and then decreasing to zero again, and reversing from zero to maximum in the opposite direction and then to zero again. Each wave therefore consists of two zero values and two maximum values or points.

If the secondary wire of the Tesla coil is lengthened sufficiently the zero value will be reached and therefore no spark would result at the end of the wire.

Fig. 1 shows how discharges can be taken through the body at about 100,000 volts and a frequency of about 1,000,000. without the sensation of pain. The hand in this case is above the heavy flash, but does not show in the picture. In this experiment one terminal is grounded. The experimenter should be careful not to stand near the nails in the floor if there are any, as he would be likely to receive an unpleasant spark from them.

In Fig. 2 the lower terminal of the Tesla coil secondary is grasped firmly in one hand, while the other is extended towards the upper end. The hand receiving the spark is plainly shown. A fine wire is fastened vertically from the top terminal.

These pictures were not taken by flashlight.

STEAM BOILERS.

Men having to do with steam power plants will find much valuable information condensed in the following paragraphs, taken from the Pittsburg Reduction Company's Handbook:

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into one cubic foot of steam (approximately).

The weight of 27.2 cubic feet of steam, at atmospheric pressure, is one pound, while 13.8 cubic feet of air weigh 1 pound.

Boilers require for each nominal horse power about one cubic foot of feed water per hour.

Locomotives average a consumption of 3,000 gallons of water per 100 miles run.

The best designed boilers, well set, with good draft and skillful firing, will evaporate from seven to 10 pounds of water per pound of best quality coal. The average result is from 25 to 60 per cent below this.

In calculating horsepower of tubular or flue boilers, consider 15 square feet of heating surface equivalent to one nominal horsepower.

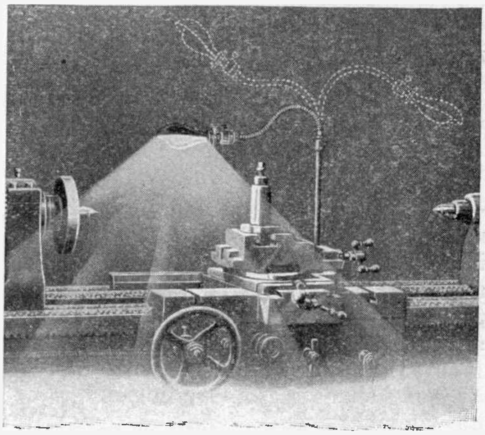
One square foot of grate will consume on an average 12 pounds of coal per hour.

Condensing engines require from 20 to 30 gallons of water to condense the steam represented by every gallon of water evaporated—approximately say from one to 1½ gallons per minute per indicated horsepower.

A boiler horsepower is defined by the American Society of Mechanical Engineers as the evaporation of 30 pounds of water per hour from 100° F. under 70 pounds gauge pressure.

GOOD LIGHT IS FACTORY ECONOMY.

It is said that 75 per cent of the errors in any shop are made during the last few hours of the day. There can be but one reason for this—poor light. No laborer can keep up his standard of efficiency while working under the handicap of poor light. Not only are many shops provid-



AN ADJUSTABLE MAÇHINE LAMP.

ed with insufficient light, but what lights there are only too often are badly placed. To get the best results each machine should have individual illumination. An arrangement such as the one shown in the picture is a very good one. The lamp is carried on a flexible arm or "gooseneck" and can be moved around the work in any direction so as to turn the broad side of the lamp in the direction in which the light is desired, whether downward, upward or horizontal.

THE CHICAGO ELECTRICAL SHOW.

The science of electricity as it pertains to heat, light and power; the marvelous strides and wonderful development in electrical invention; the thousands of electrical applications in the movement of the world's social and industrial life, all are exemplified at the Chicago Electrical Show, which is in full swing at the time this issue reaches its readers.

The great exhibition is held each year in the Coliseum, the period this year being January 16th to 30th. From a trade standpoint this annual exposition is a great business getter, bringing together the seller and the buyer and educating the latter to the newer and later devices and inventions for saving time and labor.

To the housekeeper the Electrical Show is of great importance, particularly so this year owing to the many new inventions to lighten the burden of household routine in cooking, heating, lighting and decoration. Inventions are seen on every hand that save time and labor and add comfort in the home, such as vacuum cleaners, improved laundry apparatus, vibratory machines, etc.

One of the interesting features about the show is the fact that many of the exhibits are active, illustrating the advantage of motor-driven machinery. The area of the Coliseum is 40,000 square feet and every available foot of space is utilized, the list of exhibitors including all the leading electrical concerns of the United States.

Long before the show opened, special arrangements were completed with the United States Navy Department at Washington for the installation of the complete electrical equipment of a modern battleship. Neither the public, nor the electrical trade itself, fully comprehends an electrical equipment of this character as a whole, but the simple fact that it costs in the vicinity of $300,000 to electrically equip one of the great armored sea fighters of today gives some idea of the greatness and importance of an exhibit of this character. This exhibit will not only be of great interest to the general public, but will open a new field for electrical manufacturers who have never bid for United States Navy work.

A NEW USE FOR A NEW LIGHT.

One of the largest cigar manufacturing firms in the world has solved the hitherto impossible task of packing cigars by night under artificial light. Previously this work could only be done in the daytime, and then only under the most favorable conditions. The men trusted with the shading, sub-shading and packing of cigars worked only a few hours of the day. Their benches were located near large windows on the north side of the factories, away from the brilliancy of actual sunshine, and on cloudy days, or when it began to get the least bit dusky, the work had to be suspended altogether. This inconvenience was one of the most serious drawbacks to the cigar industry. The factories would work night and day, if necessary, but the sorting and grading of the finished product before shipping could only be done in the pure light of perfect day.

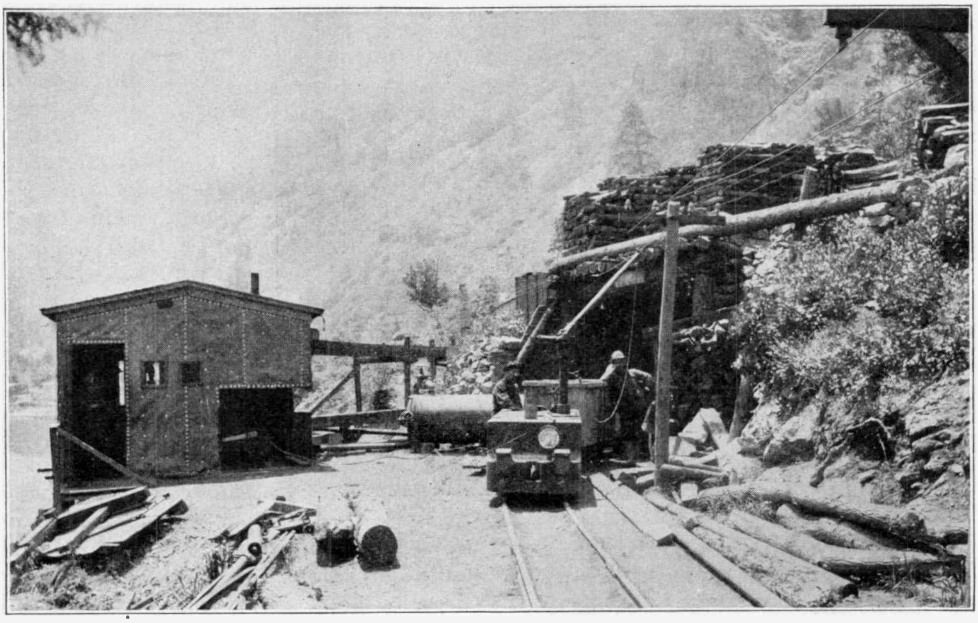
In one of the large cigar factories in Columbia, Pa., only a few weeks ago the work of packing the finished cigars was far behind, owing to intense smoke from the great forest fires, which practically hid the sun. The superintendent of the factory was discussing his troubles with the superintendent of the electric light station, which led easily into a talk on the merits of the new metal filament electric lights. As a result of this argument an illuminating engineer from Harrison, N. J., was called in and asked to make a series of tests in the factory, utilizing the new lamps, to see if any of them were suitable for the difficult task of sorting and packing cigars.

All the new types of electric lights which have been developed in the past few years were given a thorough test but it was not until the new tungsten electric incandescent lamps were used that the experiment showed any signs of success. A number of the new tungsten lamps were suspended directly over the sorting tables. They give a pure white light, which is very closely allied with actual sunshine, and every color of the spectrum, with every degree of shade and tint, stood out as clearly as though the sun was shining. After several hours, wherein not one of the experts could detect any flaw in the work, the cigars sorted under the rays from the tungsten lamps were laid aside until the next day. A careful inspection of the lot under the natural rays of Old Sol failed to disclose a single mistake. The work done the night before was pronounced perfect, and an order was immediately given for the wiring of the sorting room and the installation of tungsten lamps.

THE GUNNISON IRRIGATING TUNNEL.

One of the most important irrigation systems of the West undertaken by the United States Reclamation Service is that of the Uncompahgre Valley project in the west-central part of Colorado, in which the Gunnison tunnel is an important feature. This tunnel is nearly six miles in length and therefore one of the longest tunnels in America. It is a remarkable fact that the tunnel ranges in materials from hard rock to soft mud and is a remarkable undertaking when the height of the mountain penetrated is considered and the fact is noted that nearly five miles of the tunnel were driven from two headings, one at each end, without intermediate shafts for the removal of excavated material or for ventilation.

The Gunnison tunnel, forming a part of the Uncompahgre Valley Irrigation project, is designed to reclaim nearly a sixth of a million acres of land in Colorado. The grade of the tunnel is about six feet below the lowest point of the bed of the river, and it is designed for a capacity of 1,300 cubic feet of water per second, with a velocity of 12.6 feet per second, the tunnel being 10 feet in width at grade. The height from the floor to the highest point is about 12 feet, the walls slightly sloping to the base of the arched roof or invert.



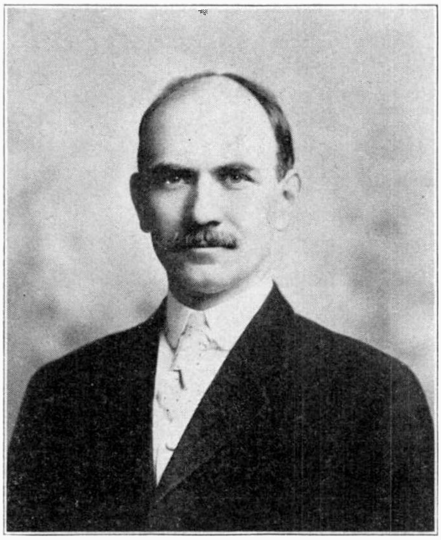
PORTAL OF THE GUNNISON TUNNEL WITH ELECTRIC LOCOMOTIVE IN FOREGROUND.

Electric power was used almost exclusively in the construction of the tunnel, and a plant of 1,000 horsepower to furnish the necessary energy was built on the spot. As work on the tunnel progressed, the big tube was lighted by electric lamps, and electric locomotives hauled away the excavated material. The accompanying picture shows the river portal of the tunnel and one of the electric locomotives.

ELECTRICAL MEN OF THE TIMES.

DUGALD C. JACKSON.

Dugald Caleb Jackson, professor of electrical engineering at the Massachusetts Institute of Technology, Boston, is a man who is at once a prominent educator, a consulting engineer of wide practice, a versatile inventor, a man of considerable business interests, an author of technical books, an expert in patent litigation and one who has put his knowledge of electrical engineering to several and varied uses, such as being a juror of award at international expositions, a member of state and municipal commissions to investigate questions of public utility, and the like. This is a combination which is difficult to parallel in any country except the United States, and indeed it may be said that few engineers or college professors in this country have had the exceptional experience which Professor Jackson has to his credit.



Coming from Quaker stock, Mr. Jackson was born in Kennett Square, Pa., February 13, 1865. He graduated from Pennsylvania State College in 1885, and afterwards spent two years at Cornell in graduate study of electrical engineering. In 1887, with J. G. White, he organized the Western Engineering Company, at Lincoln, Neb. This company built important electric railways and lighting plants and also one of the first hydro-electric installations in the country. Later the subject of this sketch became associated with electric manufacturing companies, eventually becoming district engineer for the Edison General Electric Company, with headquarters in Chicago. Here he had to solve the electrical problems of a territory covering thirteen states, and in those days there were important electrical problems; no less important than those which arise at the present time.

In 1891 the department of electrical engineering was established in the University of Wisconsin at Madison, and Mr. Jackson, whose work had attracted attention, accepted an invitation to become professor of electrical engineering in that university. For 16 years he held this chair. The department established a high reputation, and this fact was largely owing to Professor Jackson's conspicuous ability and untiring labors. Two years ago he was made professor of electrical engineering at "Tech" in Boston, which has a reputation second to that of no other engineering school in the country. This position he still holds.

Professor Jackson has never relinquished his independent practice as consulting engineer. Withal, he has an interest in several manufacturing companies, and is a member of various engineering and scientific societies, both at home and abroad, as well as a number of social clubs. In short, he is a man of quite unusual capacity, energy and enthusiasm.

Of late this indefatigable engineer has served on several public commissions, notably those to report on the equitable price of electric lighting in Boston, on the telephone situation in Chicago at the expiration of the local company's former franchise, and on the telephone situation in the state of Massachusetts as taken up by the Highway Commissions. He is a strong advocate of the establishment of schools to give instructions in trades.

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.

A GOOD START.

Since the announcement was made in the January issue of the organization of Popular Electricity Wireless Club every evidence of enthusiasm in the project is being shown. Application blanks and letters were sent out before the appearance of the last issue to a limited number whom we already knew to be interested in wireless work, and these almost without exception have responded favorably and are now members of the Club. After the announcement in the magazine appeared requests for membership immediately began to come in and there has been apparently no let-up, so the prospects for a large membership are very flattering.

The Club buttons or pins are not quite ready as yet, but will be soon, and when they have been made up one will be mailed to each member.

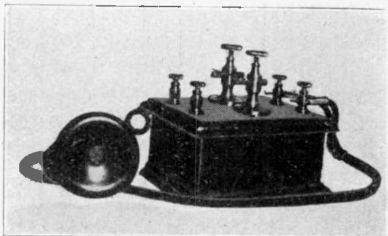
Now in order to make the Club a success we want as many members as possible. So please do not rest with merely sending in your name. Send in the names and addresses of all those you know who are eligible to membership. Every individual member can do a great deal to "boost the game." Remember, we are after those 1,000 names by January, 1910.

COMPLETE WIRELESS RECEIVING SET FOR AMATEURS.

Readers of the Junior Section who are experimenting in wireless telegraph will be interested in the receiving set which is illustrated herewith and which is known as the A B C receiver and which works on the principle of the Hughes microphone. The carbon pencils with the needles across them form a high resistance path, which on the passage of a wireless wave, lowers its resistance and gives the signal in the receiver. The moment the wireless wave ceases to flow, the resistance goes up again, until another wave strikes it.

The instrument is an instantaneous de-coherer, and when kept in a space free from vibration, it is very sensitive.

Formerly, in order to receive wireless messages, it was always necessary to have an antenna pole, and if very excellent results were desired, an expansive aerial had to be erected. In connection with this, tuning coils, potentiometer, condensers, a pair of high wound receivers, and a detector, were all necessary to receive messages. With all these complicated instruments, a more or less thorough electrical knowledge was also necessary.



WIRELESS RECEIVING SET.

With this set all that needs to be done now is to run one wire from the instrument to the water pipe and the other to the gas pipe, and messages can be received in any house. Or else run one wire to the fire escape and the other to the water pipe, which will give the same results.

To install the set, scrape six inches of insulation from a piece of bell wire, firmly connect the bare wire to the water pipe, which has been scraped clean with an old knife. Do the same with the gas pipe. Now connect the wire from the water pipe to one post of the instrument and from the gas pipe to the other post. Fasten the tips of the telephone receiver cord to the remaining two posts, which are unmarked.

Place the instrument on a solid straight, flat surface, free from vibration; lay the needle straight across the two knife edges of the two carbon pencils and place the telephone receiver to the ear. Lightly tap the finger pail on one of the posts, holding the carbon until a slight boiling noise is heard. When this is obtained, the instrument is adjusted sensitively.

WONDERS OF "WIRELESS" IN A NEW SPHERE.

Crash!

The sound made itself heard above the whistling of the wind on the roof of the Bellevue Hotel.

Crash! Crash! — New York was speaking to the operator of the wireless station newly installed on the roof of Philadelphia's fashionable hostelry. Over the heads of sleeping thousands of Gotham, across the Hudson, high up in the atmosphere that curtained Newark, through the clouds that overhung Trenton, straight to the Quaker City and so to the wireless man's eyrie traveled the mysterious waves, until they found their destination and aroused to life the machinery in the operating room of the aerogram company. To the ears of the lone operator, locked in the "wireless" receiving office eighteen stories above the level of the street, came the faint tap, tap, tap of the Morse code.

"Tell James Vernon, guest of hotel, his wife seriously hurt in auto accident. Return immediately."

A little later the sparks flew again, the giant awoke to life once more and this message came tapping through the receiver:

"Relay to Havana steamer, now off coast: Mr. James Devereux, bound for Cuba—Birthday greetings from us all to our dear daddy at sea—Dorothy."

One minute the rigging high over the Bellevue roof catches a message of joy, the next one of sorrow, then comes a despatch fraught with deep significance to some business man, and again the wires will catch a jocular greeting to a passenger arriving on an incoming steamer. The wireless wonder, as yet like that other aerial problem, the flying machine—in its infancy—will reach the voyager anywhere on the Atlantic coast.

The operator on the Bellevue roof, catching messages from New York, will relay them to points down the line until the farthest point south is reached. Sometimes it is difficult to complete the chain. A link will be mysteriously missing somewhere and the operator is then confronted with the interesting task of searching the air for a relay point. With the general adoption of "wireless" by passenger ships it is becoming less and less difficult to find a lodging place for a Morse message. Sometimes a wandering warship will catch and transmit the message. Possibly a kindly liner will come within the zone of the message and will pass along the aerogram to the next relay station. It is seldom that the patient persistency of the operator fails to keep the message from reaching its destination.

Contrary to popular belief the "wireless" message is not read by the flashing of a spark of greater or lesser length. The operator listens to the message and reads it by the sound in his ears. He wears a harness over his head, of the kind that arches the wavy locks of a "hello" girl when she is at work in telephone headquarters. With the sounding pads of this harness at his ears the operator in the "wireless" room hears the click, click of the Morse code and reads the message.

In front of the operator at the Bellevue station is a square box that contains the newest and most important of the "wireless" improvements. It is known to the craft as the "tuning box." The sprite in this box reaches out for the messages intended for that particular station, sorts them from numerous other aerograms that may be cavorting around loose in the atmosphere and brings them to the ears of the one operator who is entitled to receive them. Before the invention of this device the wireless service was run in a sadly hampered fashion. There was nothing to prevent messages from wandering into strange operating rooms, and confusion doubly confounded prevailed when the air was full of aerograms.

With much misgiving and incredulity the guests at the Bellevue are induced to try the aerogram method of transmission. It is customary for one of the women guests to hand in her message with the air of one who would like to believe that it can be transmitted to the address she gives, without the agency of wires, but finding it too much a stretch of the imagination she tries it as a sort of joke and as something to make conversation

SHE APPROACHES THE INSTRUMENT WITH SOME MISGIVINGS.

with when she meets her friends. Great is the astonishment when the message cast on the air not only reaches its destination in New York or Washington, but secures a reply by the same remarkable route.

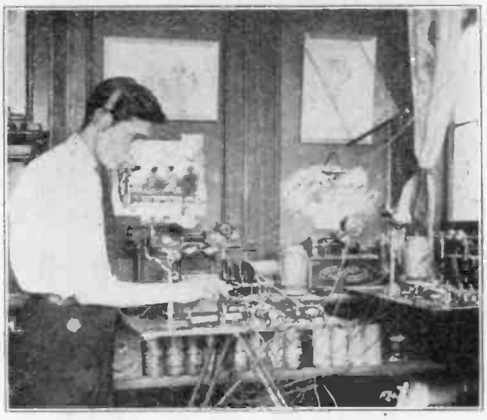
The appearance of the plant does much to impress those who are favored with a view of the wireless office on the roof. The enormous power that awakens to life with a grinding crash, the vivid life in the spark, the lurking demon in the wire that the operator can drag into fiery vitality are impressive enough. On a windy day, too, there is a dramatic interest in

CONTROLLING THE GENII OF THE WIRELESS.

the weird sighing of the wind through the wires that stretch from the tall pole over the aerogram office. It seems as though the genii of the "wireless" are imprisoned in the singing stretches of insulated copper, pent there for the especial purpose of enabling the human family to converse from far removed centers without intervening wires.

AMATEURS WIRELESS OUTFIT.

Few amateurs experimenting in wireless telegraphy have a more complete equipment than the one shown in the picture, which is a view of the laboratory of James Cruso, Newark, N. J. The instruments shown comprise a combination set over which the experimenter is



AMATEUR'S WIRELESS OUTFIT.

able to send and receive telephone, telegraph or written messages by wireless. The written messages are recorded by a pen marking on a revolving paper cylinder, in the Morse code. The movements of the pen are controlled by wireless waves. Mr. Cruso owns a small store, but all his spare time is spent in the laboratory and his ingeniously built apparatus is a source of much interest not only to himself but to his customers as well.

WIRELESS TELEPHONY BY THE FESSENDEN SYSTEM.

BY V. H. LAUGHTER.

Following closely on the heels of wireless telegraphy is the still later art of wireless telephony. To the casual observer who has not gone deeply in the study of the art, it was puzzling why we should not have wireless telephony with the telegraph. The investigators who took up the subject, however, soon found that the actual working was vastly different, and broad changes would have to be brought about to place wireless telephony on a practical basis.

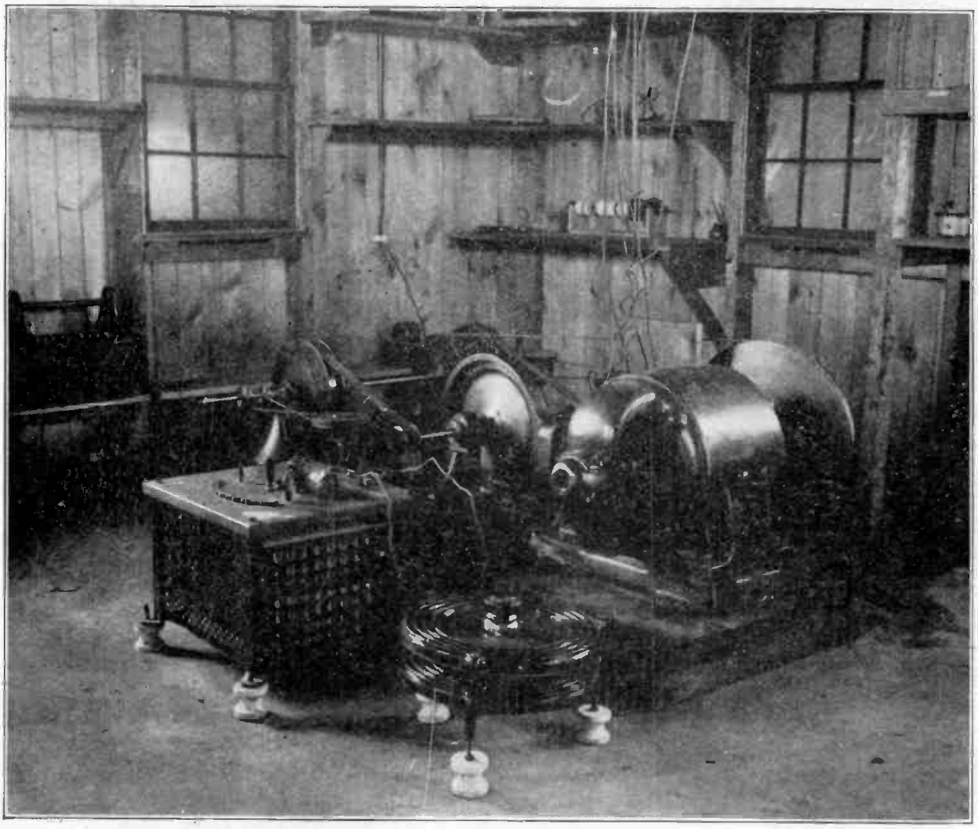


FIG. I. FESSENDEN WIRELESS APPARATUS.

In wireless telegraphy communication is established by having a transforming device which steps up a low voltage current to several thousands of volts, one terminal of the high voltage side leading to an aerial radiating wire and the lower imbedded in the earth. A telegraph key is included in the low voltage side, this key being used to break the current up in the respective dots and dashes of the Morse code. When the key is pressed the transforming action is started and the high voltage current is discharged through the aerial and ground setting up a wave disturbance in the ether which is picked up by a receiving end and transformed into the code.

This wave disturbance which is set up by the transforming device is periodic in character, as the spark coil employs a mechanical break, and if a commercial transformer is used the natural reversals of the alternating current give a periodic motion. Hence in either case the

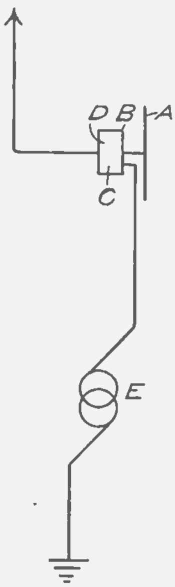


FIG. 2.

dots and dashes of the code would contain several hundred such breaks, and if it were tried to impress on this current the modulations of the human voice the breaks would destroy all inflections of speech and give a rumbling noise at the receiving end.

To overcome this factor and render it possible to transmit speech over space a number of investigators have turned their time to the perfection of a constant wave generator which would set up continuous wave motion, and it would only remain to impress on this wave the inflections of speech which would be picked up by a suitable receiving end.

The earliest form of such a generator was discovered by Prof. Elihu Thomson in 1892. The value of this device for wireless telephony was not realized at that time, but was afterwards given publicity by Poulsen in his system of wireless telephony and later on by a number of American investigators all using the same method with slight variations. A complete description of a system employing this type of generator was given in the July issue under the heading of the "DeForest System of Wireless Telephony."

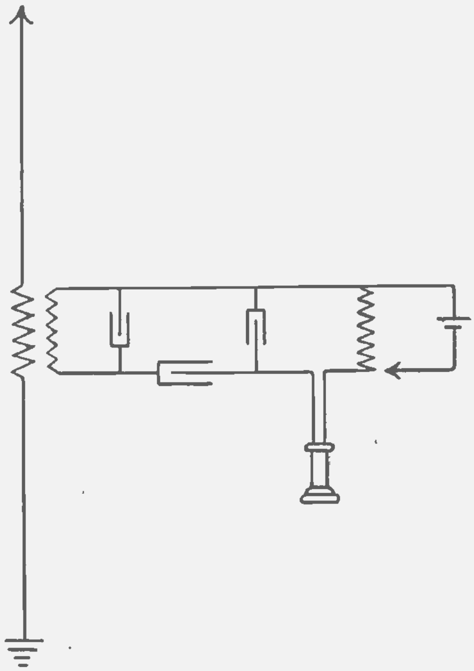


FIG. 3.

Prof. Fessenden has devoted his time to the perfection of a system which bears his name and which is designed to transmit long distances. This has been developed to such an extent that speech has been heard over a distance of 200 miles.

The Fessenden wireless telephone differs broadly from that of other investigators, namely, in the method of generating the alternations, for which is employed a high frequency alternator. This alternator has been run at a frequency of 100,000 cycles per second, but has a normal speed of 80,000 for general use.

In Fig. 1 is shown one type of high frequency alternator, dynamo, rheostat and other instruments.

The plan for connecting up the sending end is shown in Fig. 2. Here (E) represents the high frequency alternator. The complete transmitter comprises the diaphragm (A), the internal diaphragm (B), the cup containing the loose mass of conductive filings (C), and the back diaphragm (D).

The receiving end is shown in Fig. 3 and consists of the transformer coil with the primary terminals connected to the aerial and ground. The secondary leads to the receiver, with suitable condensers connected in the circuit as shown.

High frequency alternations flow from one side of the commutator to the ground and from the opposite side to the aerial wire through the transmitter. If the diaphragm (A) be spoken against while the current is flowing, the internal diaphragm (B) will vibrate with (A) and set up a like vibration in the mass of conductive granules which rest in the chamber (C). This will change the current flowing through to the same proportion and set up a wave disturbance in the ether impressed with the variations of the spoken words. This wave motion is picked up by the aerial wire of the receiving end and transformed into words in the telephone receiver.

WIRELESS QUERIES.

ANSWERED BY V. H. LAUGHTER.

WIRELESS ON THE GREAT LAKES; SILICON DETECTOR:

Questions.—(A) Are there any other boats on the great lakes equipped with wireless sets except the City of Cleveland? (B) Could a silicon detector such as described in the July issue be used in receiving up to five miles? If so how many ohms resistance would the telephone receivers have to be? (C) Should the surface of the silicon button be pointed or flat? How large should it be and where could it be procured? (D) How high should the aerial be, and what size wire? (E) Would you recommend this style of detector for this purpose?—S. R. R., Chatham, Ontario, Can.

Answers.—We would refer you to the Clark Wireless Telegraph-Telephone Co. of Detroit, Mich., who can no doubt give you this information.

(B) The silicon detector will receive up to several hundred miles. The silicon detector works best when used with high wound receivers of at least 1,000 ohms.

(C) The surface of the silicon button usually comes pointed, as it is very hard to finish off flat. The working is the same with pointed and flat surfaces. The size employed varies, being about ⅛-inch thick and ½-inch wide for the smallest size. We cannot give the names of manufacturers in this department. You should consult the advertising pages.

(D) See the "Wireless Telegraphy Made Simple" series in the August, 1908, issue of this magazine, which treats of different styles of aerials.

(E) The silicon detector is especially recommended for the above use.

CONDENSERS; PRIMARY WINDING.

Questions.—(A) How are the number and size of sheets of tinfoil for condensers determined for any given coil? (B) If I have two or three small condensers could not they be made to answer for a larger one by connecting in parallel? (C) Does the voltage developed by each layer of primary winding decrease in value as the distance from the core is increased? (D) What is double cotton covered or silk covered magnet wire used for? (E) Will it do any harm to place the secondary terminals of a coil together while in operation?—O. H., Rumford, N. J.

Answers.—(A) This is not determined by mathemathical methods, but by the "cut and try" rule. The number of points involved brings in quite a lot of theoretical matter and the dimensions are usually misleading owing to the large variations. The manufacturer sets up tables from actual experiments and from these the dimensions are had.

(B) Yes. The more condensers connected in parallel the greater the capacity.

(C) The magnetic effects of the winding decrease as the distance from the core increases, and in view of this fact the primary winding is placed as near the core as possible. However, suitable insulation should be interposed between the two, as otherwise the current will seek the more conductive path of the iron core.

(D) The wire in question is used for a variety of purposes such as the winding of coils, telephone ringers, etc.

(E) This is not advisable as the current, if strong enough, would melt some portions of the secondary winding, making it necessary to rewind the same to find the break.

SPARK COIL.

Questions.—(A) in using a ¾-inch spark coil for sending wireless messages I get a good spark without the aerial and ground, but as soon as the switch connecting the aerial and ground is thrown in I can hardly get an ⅛-inch spark. My aerial is well insulated to prevent undue leakage. Will you explain where the trouble lies? (B) How many dry cells should be used for the above coil? (C) Are dry cells practical for this use?—D. H., New Brighton, N. Y.

Answers.—(A) The reduction of the spark in the case you mention is a very common occurrence when the small size coil is used. With the aerial and ground connected to the opposite sides of the gap, the greater portion of the energy is dissipated at these two extremities, and in consequence the spark across the gap is reduced. To remedy the trouble reduce the spark gap to at least ⅛ inch and bridge two small Leyden jars across the circuit. This will make the spark fat and heavy.

(B) Four to six cells should operate the coil.

(C) Yes.

SPARK COIL DESIGN.

Questions.—(A) I have wound a spark coil with two pounds of No. 36 double cotton covered wire for the secondary and three layers of No. 16 double cotton for the primary. The condenser is made up of 25 feet of six inch wide tinfoil and the core is ⅞ inches by seven inches, of soft iron wire. The length of the coil is six inches. Could you tell me what size spark I should get? (B) What are the dimensions of a six inch coil for wireless use? (C) Is the Leyden jar a good condenser? (D) What is the best kind of interrupter to use?—F. G. H., Chicago, Ill.

Answers.—(A) The coil will probably give a 1½ inch spark with a good vibrator and strong storage cell. However, the dimensions are not the best. You have placed too much of the secondary wire in too small a space to get the maximum results. We would recommend a core 8½ inches long wound with two layers of No. 14 magnet wire, the secondary having a total length of 7½ inches. This will give a good magnetic field which is necessary to get results.

(B) The dimensions of a standard six inch coil are as follows: Core 13 inches long 1¼ inch in diameter, wound with two layers of No. 14 wire for the primary. For the secondary, 6½ pounds of No. 36 magnet wire. For wireless use the core should be slightly increased in size with a larger amount of heavy wire for the secondary.

(C) The Leyden jar is one of the best condensers known.

(D) This is matter of choice, but for your purpose we would recommend a good adjustable vibrator of the "make and break" type.

AERIALS AND TRANSFORMERS.

Questions.—(A) How high does the antennae have to be to receive messages 300 miles distant with a carborundum detector? (B) What size wire is best suited for the antennae? (C) Where can I buy a 750-watt transformer and what is the price? (D) Can this transformer be attached to a 110 volt circuit or will it ruin the meter?—O. R., Tacoma, Wash.

Answers.—(A) We would say anywhere from 100 to 180 feet. This will also depend on the strength of the sending end and the sensitiveness of the receiving end.

(B) For experimental use one made of No. 14 copper will answer.

(C) We cannot give the names of manufacturers in this department.

(D) The transformer can be operated on the circuit without damage to the meter.

WIRELESS SYSTEM.

Questions.—(A) What size coil is necessary to send up to 2,000 feet and how can I make it? (B) How high should the aerial be for this distance? (C) Will a single pole bell pattern receiver be of any use? (D) What form of detector is best to use with the telephone receiver and how can I construct it? (E) Is a tuning coil necessary?—P. E., Minneapolis, Minn.

Answers.—(A and B) A ½ inch coil will send up to the distance you name. For the construction of the coil and points on the construction of a simple set we would refer you to the "Wireless Telegraphy Made Simple" article in the May, 1908, issue of this magazine.

(C) The receiver can be used in connection with any type of self restoring detector such as the liquid, carborundum, etc.

(D) By referring to the article "Wireless Telegraphy Made Simple" in the July, 1908, issue you will find the method for constructing the liquid detector.

(E) No.

WIRELESS RECEIVING END.

Questions.—(A) Up to what distance should I be able to receive with the following equipment: Antenna 190 feet long and 65 feet high, tuning coil, potentiometer, adjustable condenser, carborundum detector and 75 ohm receiver? (B) What are the call letters of the following stations: Sea Gate Coney Island, Fort Totten Long Island, Plaza Hotel, Belmont and Waldorf of New York City? (C) How is the wave length of a tuning coil determined? (D) How is a Marconi magnetic detector constructed? (E) Will rust on an antenna have any effect on the sending and receiving of messages?—G. J. C., Flushing, N. Y.

Answers.—(A) The receiving end you have described is standard with the exception of the receiver. By employing 1,000-ohm receivers in place of the 75 ohm you should be able to catch messages from stations several hundred miles away. There is no necessity, however, in making the antenna 190 feet long. Elevate as high as possible and reduce the length to about 25 feet.

(B) We have examined several lists of wireless stations, but do not find those you have named. The stations have not yet been entered and consequently we cannot give the call letters.

(C) On the standard size tuning coil the wave length is usually two meters (about 78 inches) to the turn. Thus a tuning coil of 400 turns would have a wave length up to 800 meters. The respective turns are usually about 10 inches in diameter.

(D) The making of a Marconi magnetic detector would require too much space to be taken up in this department. The plans for making and connecting can be had from the writer, Byhalia, Mass., who is the author of "Wireless Telegraphy Made Simple," which appeared in the first five issues of this magazine, and will furnish additional information not contained therein.

(E) For short distance use no appreciable difference will be noticed; but when greater distances are desired the antenna should be smooth and free from rust and sharp projections.

TWENTY MILE WIRELESS SYSTEM.

Question.—Will you give me an estimate on the cost of a complete 20 mile wireless set?—J. G. D., Moss Point, Minn.

Answer.—We could hardly give you a safe estimate on a plant of this size without understanding the conditions under which it is to work.

CONDENSERS.

Question.—Please let me know the difference between the condensers which are built up in alternate sheets and those built up of two long strips of tinfoil; and which is the best for spark coils?—C. E., Chicago, Ill.

Answer.—The rolled type of condenser is not as efficient for use across the vibrator contacts of the spark coil as the alternate sheets. In fact, it is only the more inferior type of spark coils that are equipped with the rolled type of condensers. The rolled type, however, is much cheaper to make and for this reason is used to quite a large extent. The electrical difference lies in the fact that the rolled type cannot absorb or discharge as quickly as the short alternate layers, and the spark is not so rapid or heavy.

INDUCTION COIL DATA.

Question.—(A) What amount of voltage and amperage is required to operate an induction coil giving ½ to ¾ inch spark?

(B) Have you any books on experiments with these coils?—C. V. V. T., Helena, Ark.

Answer.—(A) Four to eight volts, five amperes.

(B) "Electrical Experiments," by G. E. Bonney; "How to Make and Use Induction Coils," by Edward Trevert; "Induction Coils," by H. S. Norrie.

KITE ELEVATED AERIAL.

Questions.—(A) Will a large kite do for an aerial provided a wire is run up to the kite? (B) What kind of kite is best? (C) Can an induction coil be run by 110 volts direct current if the current is reduced down, and how can the current be reduced?—W. W. H., Clay Center, Kan.

Answers.—(A) The kite will answer well to elevate an aerial for experimental use. This is the method Marconi used for signaling across the Atlantic.

(B) The Eddy tailless kite is most commonly used. However, the box kite or any other good type will answer.

(C) The induction coil can be operated on the 110 volt direct circuit by introducing lamp resistance in series with it.

DETECTOR SOLUTION.

Question.—What solution is used in the type of detector employing a carbon cup and platinum wire?—L. S., Kansas City, Mo.

Answer.—Nitric acid diluted with four parts of water is commonly used with the type of detector you name.

ELECTRICITY IN THE HOUSEHOLD

ELECTRICAL MASSAGE.

Massage is beneficial to the health and a valuable assistant in producing a clear, healthy skin. Ordinary hand massage was known to the ancients, but the electric massage, of recent date, is a great improvement. The modern electric massage device consists of a roller to produce the mechanical kneading so beneficial to

ELECTRICAL MASSAGE.

the skin and muscles. At the same time the roller forms one electrode of a battery and induction coil outfit, while the handle, which is insulated from the roller, forms the other electrode. In this manner a stimulating electric current passes from the roller through the body tissues and out through the hand.

CAUSES OF POOR LIGHT.

The study of illumination has not only become an exact science in these days of perfection in artificial lighting, but every householder is eagerly reading anything that will give a greater insight into this most difficult study.

Many a poorly lighted room can be easily remedied by changing the light fixtures or repapering. It was formerly the custom to blame the oil, or the gas, or the electricity if there were dark shadows in the room or if the light failed to dispel the evening darkness. Now it has been proven that these same rooms, be they at the home or the office or the store, can be made almost as light as day with even less candlepower than before.

A wallpaper which will "absorb" light is the greatest enemy to artificial light in the home. An illuminant is powerless to light a room if the color of the walls absorb most of the rays. Illuminating engineers claim that a white wall will reflect 50 per cent of light, whereas a red wallpaper will reflect only 15 per cent. A light buff or yellow will reflect 45 per cent; a dark brown about 12½ per cent. A light apple-green wallpaper will reflect 40 per cent; a dark green will give us 15 per cent. Dark wood trimmings absorb light; white wood reflects it. Velvets, chintzes, burlaps, will also absorb light; so will wallpaper, whatever its color, but a tinted-surface wall reflects the light. Wallpaper in patterns is not only one of the greatest of all known absorbers of light, but it also has a bad effect on nerves and eyes.

The plainer the wallpaper the better for nerves and eyesight, and the smoother the surface the more light it will reflect. In selecting wallpaper the way the room faces must also be taken into consideration. Those rooms facing north and east require lighter colored papers than do rooms facing south and west.

Care in the selection of tints and wallpaper will not only lead to a better and a cheaper artificial light but will protect the eyesight, and save nerves and tempers. It will emphasize to the greatest degree the many advantages of artificial light from the electric current where many are now using some inferior illuminant because of an incorrect impression that electric light is too expensive.

ELECTRICITY DOES THE DRUDGERY.

If you could do 35 complete washings for a total cost of 50 cents for power, wouldn't you think that electricity was your friend? That is what the electric washing machine has done. Wash day is generally a dreaded day, but now electricity does away with the drudgery, in short, it does everything but hang out the clothes.

You can do fancy work while the little one-sixth horsepower motor turns the machine, which makes 50 strokes a minute and will wash a tub full in 8 or 10 minutes. The operation is as follows: Insert the attachment plug in any ordinary incandescent lamp socket. See that the controlling lever on the side is in the vertical or neutral position, and turn on the current.

To wash, draw the lever toward the operator when facing the ringer. To wring throw the lever over toward the wringer. This latter piece of apparatus has ball bearings and inclosed cogs and makes 55 revolutions per minute.

All the working parts are mounted on a platform built beneath the machine, with nothing dependent from the bottom of the tub.

When the current is turned on, with the lever in the neutral position, the motor starts under no load, which is the ideal condition.

TALKS ON "CURRENT" TOPICS.

F. L.—You need not fear that your meter will go on registering current when the lamp switch is turned off. The switch in the lamp socket breaks or opens the circuit at that point as effectually as though one of the wires were cut. You are not alone in your anxiety on this point, however, for we know of one woman who carefully unscrewed every bulb in the appartment from its socket as soon as the light was turned off, fearing that if this were not done current would continue to flow.

G. L.—When you are through using your electric flatiron it is not safe to break the current at the socket by turning the lamp switch. The current should be broken by pulling the special switch plug out of the part which screws into the socket or else by a special switch which is provided on some types of irons. The reason you should not turn the lamp switch in order to turn off the current is because the parts of that switch are designed to break safely only a small current such as is taken by an incandescent lamp. The iron takes considerably more current than a lamp, which cannot be broken by the lamp switch without causing an arc to form and possibly burn up the comparatively small parts of the switch. The special plug or switch is therefore provided. Use it religiously.

W. A. W.—In putting up the electric festoon you should have followed the directions given, exactly. The reason one of the sections of the festoon did not light up when the current was turned on undoubtedly was because one of the lamps was not screwed clear into its socket; or else the connection at one or more of the lamps was open. When you opened the insulation and connected one branch of the festoon with one of the other branches you put a "short circuit" across the terminals in the lamp socket; that is you left the lamps out altogether and virtually connected a heavy wire from one terminal of the socket to the other. This allowed a heavy current to flow right across and that is what melted or "blew out" the fuse

WHEN DUTIES BECOME PLEASURES.

It is an open question whether or not the present day proneness to save all the trouble possible and cut across lots to attain results is commendable. Many say that the constant progress of scientific endeavor in the direction of substituting machinery for manual labor is causing the race to deteriorate and become automatic. But there is a great deal of comfort nevertheless in the knowledge that science is eliminating the drudgery from life. If this is a comfortable age it is saying a great deal for the advantages of living in it, instead of in that age of perspiring discomfort that caused despairing women to coin such phrases as "Man works from sun to sun, but woman's work is never done." Nowadays there are so many mechanical helps that the reproach that the housewife is the only person who has no leisure is rapidly being removed.

Few advancements in the household line are more remarkable than those to be credited to the designers of electrical household articles. One of the most interesting is a new carpet cleaner, to be used in connection with the electric light that is rapidly superseding gas as an illuminating agent in modern houses. The carpets of the house can always be kept in a condition of dustless brightness by the use of this novel machine, which works on the vacuum principle, drawing the dirt and dust from the carpet and simply causing it to disappear from view.

THE VACUUM CLEANER DOES NOT "RAISE A DUST."

Instead of the carpet cleaning process being a mere stirring up of innumerable germs that would best be left to their unwholesome repose in the fabric, this electrical method, in a cleanly and simple way, extracts the dust from the rugs and floor coverings without the necessity of removing these from the rooms at all. It is only necessary to switch on the current, as in turning on the electric light, to start the vacuum carpet cleaner going. The work is done by passing the nozzle of the machine over the carpet. It is easier than sweeping and infinitely more desirable.

Have you ever been saddled with the work of cleaning the family silver? If you haven't pray that something may happen to relieve you of it when the day

A WAFFLE IRON THAT "BROWNS TO A TURN."

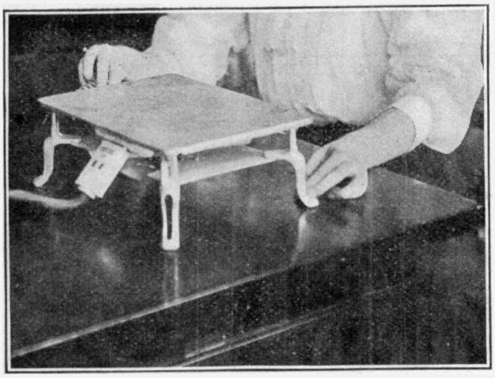
comes. Of all the tiresome jobs—but here again electricity comes to the tired housewife's help. There is a new electric silver cleaner that polishes bright as the sun without any more labor than the guiding of a brush as it revolves at the end of a tube. All the rubbing and scouring and polishing is done away with. You attach the little machine to the thrice blessed electric current and the mysterious sprite that lives in the big dynamos somewhere off in the power house sends the wheels whirring around in a strenuous effort to remove the tarnished spots and bring the silver back to its original brilliancy.

POLISHING THE SILVER IS NO LONGER A TASK.

There is a new electric coffee urn for which the advantages of cleanliness and economy of time are claimed. The gas urn is good, but this electric urn is better, for no flame is needed. Again it is only necessary to switch on the current and the urn is alive with a burning desire to get the coffee to the point of perfection in time for breakfast.

ELECTRIC COFFEE URN.

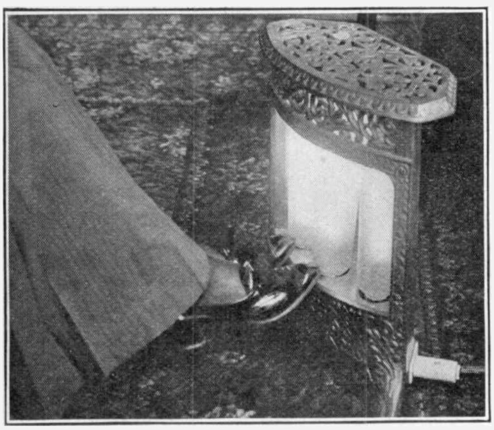
These winter nights, when one wishes sometimes to supplement the usual heating apparatus in the house with some small means of warming the feet or heating a room that the usual source of



ELECTRIC TOASTER.

supply does not reach, a new electric radiator will be found desirable. It is an unobtrusive little foot warmer and again is less trouble than the gas heater, for it can be switched on and off in a second, and the heat that comes from it is astonishingly great.

A new toaster on which toast can be



TOASTING BEFORE THE ELECTRIC RADIATOR.

made by the use of the electric current is shown; also a new electric waffle maker that is ready for business when connected with the ever ready electricity that lurks in the wires on the wall.

An ordinance was recently introduced in the city council at Cleveland, Ohio, prohibiting the use of candles on Christmas trees. Nearly ninety per cent of the fires around the holiday season are caused by the ignition of resinous Christmas trees. This danger can be avoided by using the tiny electric lights of many colors which are even more pleasing in effect than candles.

ELECTRIC LIGHT THE SAFEST IN THE HOME.

Since the days when our grandmothers first hailed the kerosene lamp as a great step in advance over the tallow candle, wonderful progress has been made in developing a better, brighter and safer method of illumination for the home, until now we have in electric light a method which is practically perfect from the standpoints of health, convenience and safety.

Everyone knows how convenient and adaptable electric light is in the home and nearly everyone realizes the fact that gas and all other light sources which burn with a flame take out of the air its health-giving qualities and substitute deleterious gases instead, while electric light consumes no oxygen and leaves the air absolutely pure. But few people realize the great advantages of using electric light at home from the standpoint of safety.

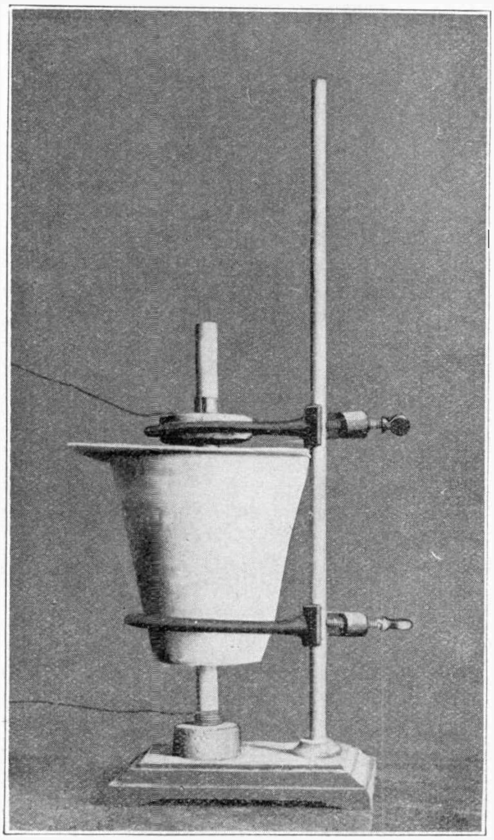
With the modern methods of electrical wiring and construction there is absolutely no danger attendant upon the use of electric light, and although a slight shock might happen to be felt under some exceptional circumstances the pressure, or voltage as it is called, is so small, after it is led into the house, that no injury would result. It is foolish to compare lighting current with lightning or with the effects of the strong electric currents used out on the streets, as the currents used inside of our buildings is reduced in voltage to only a fraction of that of high tension currents, and the incandescent lamps used inside will operate only on these small pressures.

Again, as there is no flame from the electric light the danger of fire is eliminated. There is no hazard as from lighted gas jets into which lace curtains might be blown, or a sleeve become ignited or which might cause fire in a hundred other ways. With electricity no matches are required, and thus one of the greatest sources of danger from fire is removed, especially in homes where there are children. In a home which is properly equipped with electric lights no excuse exists for scratching a match to find the way to the basement, to search for something in a closet, or to visit the garage. A snap of a switch turns on the light ahead.

HOW TO MAKE AN ELECTRIC FURNACE.

BY PAUL H. WOODRUFF.

A small electric crucible furnace, producing a heat sufficiently intense for the reduction of nearly all metallic oxides and the demonstration, on a small scale, of most of the high temperature experiments, may be readily constructed by the amateur.

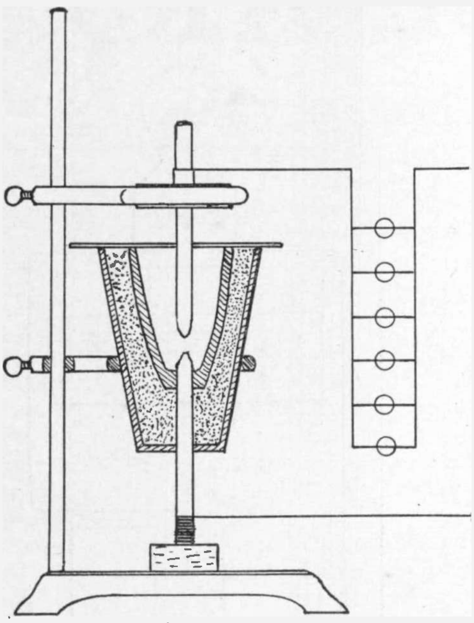


HOME MADE ELECTRIC FURNACE.

A two-ring chemical retort stand forms a convenient support for the apparatus. The lower and larger ring supports a common flower pot. In this is placed a small crucible, the space between being filled with granulated fire-brick. A sheet of rather thick mica covers the flower pot, and a hole in the center of the mica permits the passage of an ordinary arc light carbon. This carbon is supported by the upper ring of the stand, which is provided with an asbestos plug. The central aperture of this plug is bushed with a split brass tube one inch long, in which the copper-plated carbon rod is held securely, yet slides readily enough to permit of easy adjustment. This brass bushing forms one terminal of the furnace.

To give access to the other carbon, a hole must be chipped or bored in the bottom of the crucible just large enough to admit the carbon rod. There is probably already a hole in the bottom of the flower pot. Through this, its end just entering the crucible, passes the lower carbon. Its lower end is clasped in a helix of No. 14 copper wire, and rests in a block of asbestos on the base of the retort stand.

This furnace requires six or eight amperes of current. Using 110 volts, either direct or alternating current, a parallel bank of six or eight 32-candle-power incandescent lamps must be connected in series with the furnace. Be sure that the parts of the apparatus are properly adjusted, and that everything is firm and solid before switching on the current. The carbons should be separated at first. When their ends have been brought together in the crucible, and the lamps light up, the upper carbon may be slowly withdrawn a fraction of an inch. A little experimenting will determine the proper point, which varies with the material in the crucible.



CROSS SECTION OF ELECTRIC FURNACE.

When the lower carbon becomes shorter, the flower pot and its crucible may be lowered by moving the ring of the retort stand. The upper carbon is simply slid in its holder.

It is best to operate the furnace with the crucible empty for some minutes before introducing any materials, to make sure that everything stands the terrific heat generated. No. 14 wire should be used for all connections. The use of smoked glasses is strongly advised while using the furnace, as the intense glare of the arc at short range produces an unpleasant effect on the eyes.

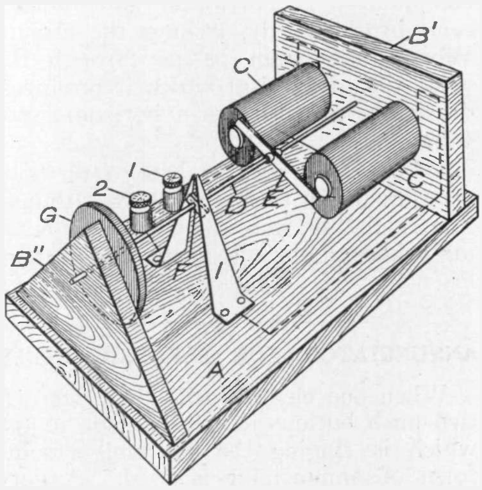
By the use of powdered charcoal, most of the metallic oxides are readily reduced in this little furnace, including alumina.

The diagram gives a cross section of the furnace, showing the proper relations of the parts as well as the electrical connections.

A SIMPLE MAGNET MOTOR.

A simple motor which does not employ a "wound" armature may be made at little expense as shown in the cut. Of course, it does not furnish much power but nevertheless it provides considerable amusement.

Secure a strip of board (A) and fasten two upright pieces to it as shown by (B′) and (B″). To (B′) fasten two



SIMPLE MAGNET MOTOR.

coils from an ordinary 1000 ohm telephone ringer, and midway between them run the shaft (D).

The armature (E) is a piece of strap iron two inches long and about 5/16 of an inch wide and 1/32 of an inch thick. It should be fastened solidly to (D), just missing the coils by a fraction of an inch.

The commutator (F), is a piece of strap iron ½ inch long, ¼ inch wide and 1/32 inch thick. This is securely fastened to (D) at right angles with (E). When (E) is vertical or straight up and down, (F) is horizontal, thus forming a circuit when it touches the brushes (I). The brushes are of thin brass, triangular in shape and fastened to the base (A). These are also placed so they will just touch the commutator when it is horizontal.

It is not necessary to have (G) the fly wheel, but this adds greatly to the appearance of the motor.

Connect one of the wires from the ringer directly to binding post (1). The other wire from the coil should connect with one of the brushes (I). Then connect a wire from the other brush to binding post (2). The motor is then completed and may be operated by two or three cells of dry battery connected in series with the binding posts (1) and (2).

When the armature is vertical the commutator is horizontal and touches each brush lightly, closing the circuit. When the current passes through the coils, the magnetism which it produces, draws the armature to a horizontal position.

When the circuit is broken the momentum which the fly wheel has attained rotates the shaft so that the commutator makes a circuit again and so on.

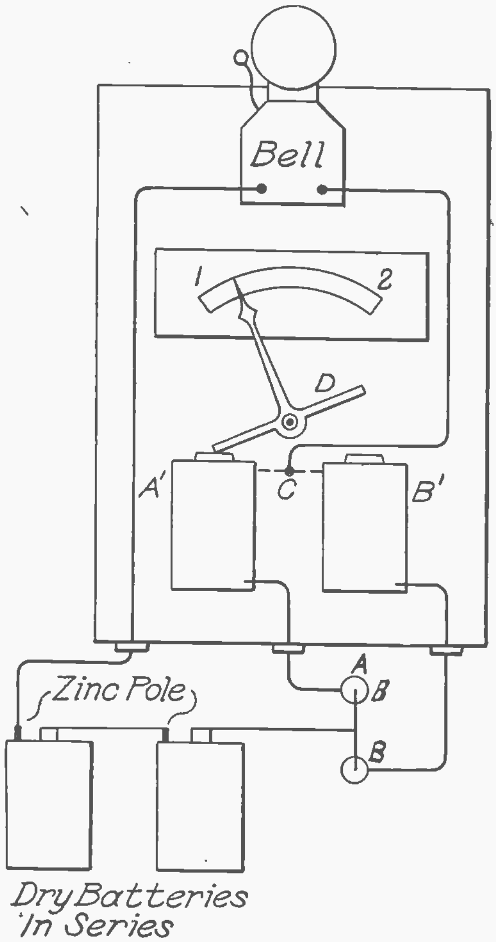
Arthur Arnold.

ANNUNCIATOR FOR ELECTRIC BELLS.

When one electric bell is operated by two push buttons it is impossible to tell which is ringing the bell unless some form of annunciator is used. A very simple one may be made from the two electromagnets of an old electric bell by exercising a little ingenuity.

On a small box mount the bell as shown in the diagram, mounting the old bell magnets (A′) and (B′) vertically inside the box. (A) and (B) represent the two push buttons in different parts of the building. One pole of the dry cells is connected to one of the terminals of the two push buttons. The winding of one of the magnets (A′) is connected to (C) and to the second terminal of (A). The winding of the other magnet (B′) is connected to (C) and the second terminal of (B). A wire is then run from (C) to the bell and another from there back to the other side of the dry batteries, the battery cells being connected in series as shown; that is, with the zinc and carbon poles together.

A rocking armature (D) is pivoted on a suitable support immediately above the two magnets (A′) and (B′) so that its ends may be attracted by either of the magnets. Suppose, now, that button (A) is pushed. Current flows from the batteries through (A) around (A′), pulling the armature (D) down so that the pointer indicates (1) on the scale. This shows the person at the bell that (A) has been pushed. Current flows on from (C), rings the bell and flows back to the batteries. If the other button (B) is pushed the magnet (B′) is energized,



ANNUNCIATOR FOR ELECTRIC BELLS.

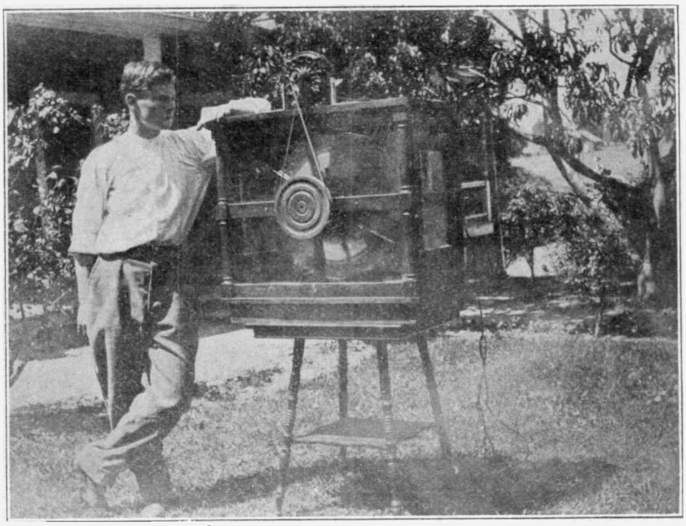
pulling the other end of (D) down and moving the pointer over to (2) and ringing the bell at the same time.

The number of batteries used will depend on the length of the line, but in any case no less than two should be used.

A HOME MADE STATIC MACHINE.

Static machines should not be considered out of the reach by the average boy experimenter, although they may seem a little complicated at first sight. Here is one which was built by a boy 18 years of age—Damion S. Reynolds of East Auburn, Cal. The machine is of the Toepler-Holtz type and works very satisfactorily.

The machine, as shown in the photographs, has six revolving glass plates 16 inches in diameter, and six stationary glass plates 20 inches in diameter, and all the work of cutting and boring was so carefully done that one would never suppose that it had been done by a novice with the crudest of tools. The shaft upon which the revolving plates are fastened is 17 inches long and three-fourths of an inch in diameter with the bearings turned to five-eighths of an inch. A pulley which is belted to a small fan motor is keyed to one end of the shaft. The speed of the revolving plates is 280 revolutions per minute.



DAMION S. REYNOLDS AND HIS STATIC MACHINE.

The Leyden jars are five by three and three-fourths inches. The buttons, combs, brushes, balls and rods are made of brass turned and fitted with great care, giving the machine the appearance of a factory-built piece of apparatus. The housing is 30 by 24 by 15 inches and the workmanship is equal to that of the best cabinet maker. Without being carefully dried before testing, the machine gave a continuous spark of over three and one-half inches, and in perfect operation gives a spark fully an inch longer.

SMALL MOTOR CONSTRUCTION.

The simplest form of electric motor consists of an electromagnet arranged to attract a pivoted piece of iron, or armature, intermittently, causing it to revolve. Such a motor is inefficient; but its historical interest is great, as all of the early forms of motors were constructed upon this principle.

The armature of our model may be found ready made in the shape of an iron wheel with six straight spokes, four inches in diameter and with about ⅜-inch face. This wheel may be an old iron hand wheel, a narrow pulley, or a small fly-wheel. All the spokes of the wheel, or armature, should be filed and scraped clean and bright. It is then mounted centrally on a steel shaft; a piece of rod 3-16 of an inch in diameter and 1¾ inches long. If it is already drilled for a larger shaft, a brass bushing of the proper size may be driven into the hole and centrally drilled for the 3-16-inch shaft. A set screw in the hub of the wheel is the proper means of fastening to the shaft.

The base is an oak block, three inches square and one inch thick. A channel ⅜ inch deep and ⅝ inch wide is cut clear across it ¾ inch from one edge, to clear the armature.

The piece of ⅛-inch brass shown in Fig. 1 forms both bearings and the magnet support. It is bent and drilled as shown in the illustration; provisions being made, of course, for attaching it to the base. Small brass washers should be placed on the shaft on each side of the armature as these parts are assembled, so that while the armature turns very freely, there is little or no end play.

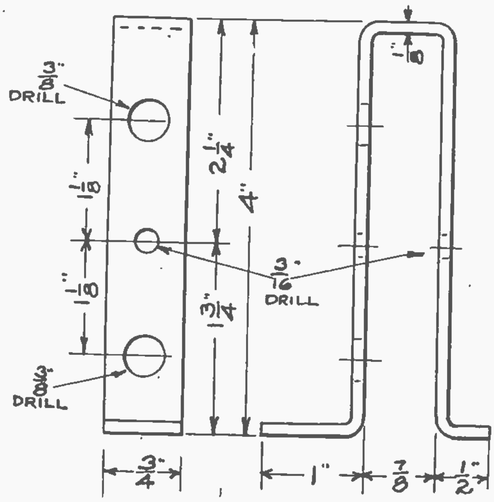


FIG. 1. BEARINGS AND MAGNET SUPPORT.

idly in place. The ends of the core should just clear the spokes of the revolving armature.

A mark is now made on each limb of the core just back of its brass support, and the core withdrawn. It is now thoroughly covered with shellac. When dry, the space between the marks is wound with three layers of No. 20 double cotton covered magnet wire. The winding is continuous, following the curve of the bend as neatly as possible. The two

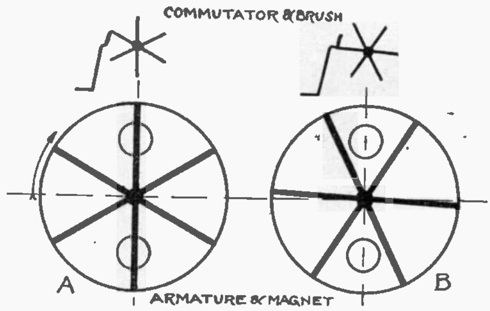


FIG. 2. RELATIVE POSITIONS OF MAGNET AND ARMATURE.

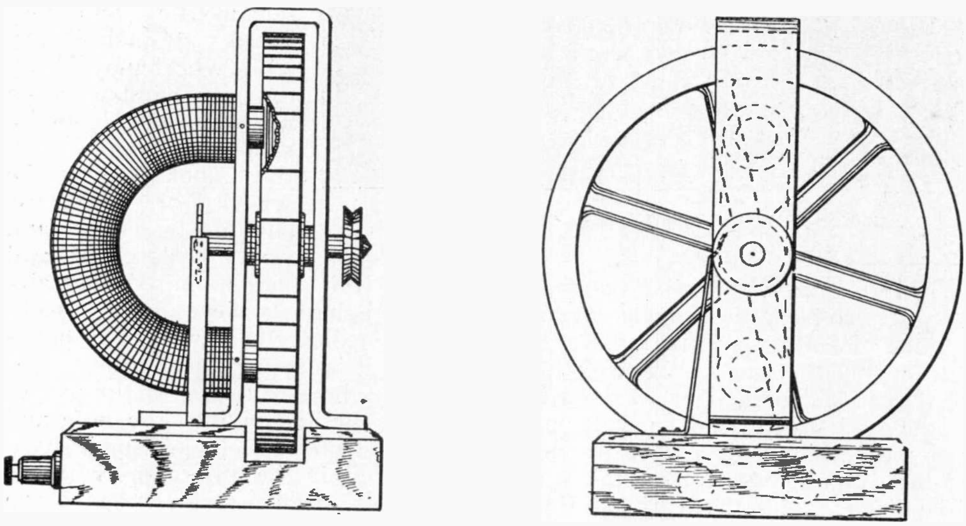


FIG. 3. TWO VIEWS OF MOTOR COMPLETE.

The electromagnet is made by bending a piece of 3/8-inch soft round iron into a U shape. The distance between the centers of the limbs is just 2¼ inches, and the total length two inches.

The ends of this iron core are now inserted into the holes in the brass cross piece on the front bearing, where it should fit tightly enough to hold it rig-

ends of the wire are left about three inches long for connections.

It is plain that a commutator or collector of some kind is necessary for interrupting the current as the spokes of the armature come opposite the poles of the magnet. A brass wheel with six spokes may be obtained from the works of an old clock. The rim of this wheel is then cut away, leaving simply the spokes projecting from the hub. This is now soldered to the inner end of the shaft. A brush, consisting of a narrow strip of thin sheet copper, has its lower end screwed to the base, the upper end bearing lightly against the ends of the brass spokes. The final adjustment of this contact requires a little calculation. Fig. 2 shows the relative positions of the magnet and armature, and the brush should break contact when the armature is in position (A) and make contact as it arrives at position (B). This will, of course, be repeated as each spoke of the armature approaches the poles of the magnet.

Two binding posts are arranged on the side of the base. One connects with the brass frame of the machine and the other with one end of the winding. The other end of the winding is soldered to the copper brush. The current, being broken by the spokes of the brass commutator, traverses the magnet winding intermittently, and these successive impulses, acting on the spokes of the armature, cause it to revolve. A touch will start it.

Two to four cells of battery may be used with the motor. Some little experimenting may be necessary to secure the most efficient adjustment of the commutator and brush. When it is reached, the motor will attain quite a high speed. A small pulley may be fitted to the projecting end of the shaft, and used to operate mechanical toys, etc.

The front and side views of the completed motor, shown in Fig. 3, give no dimensions, but they are drawn to a scale. Not much ingenuity is required to adapt the construction to such material as may be at hand, changing the dimensions accordingly.

A BUZZER TELEGRAPH.

It is not necessary to have expensive telegraph sounders to set up a short telegraph line, for two ordinary "buzzers," which can be bought at an electrical supply store for about 25 cents each, can be made to do the work satisfactorily. One of our boy readers up in Winnipeg, Manitoba, sends in the following description of his line, which is built on this plan:

First buy two buzzers, and two ordinary push buttons for the keys, the latter costing about 10 cents each; also enough wire to go three times between the two houses. Wire up the buzzers and keys as shown in Fig. 1, putting two or three cells of dry batteries in the line at each house as shown. The middle wire is for the purpose of short circuiting the buzzer at the sending station, so that it will not sound. For instance, if the key at station (A) is closed, current will flow from the battery (B) through the buzzer at (B), through the middle

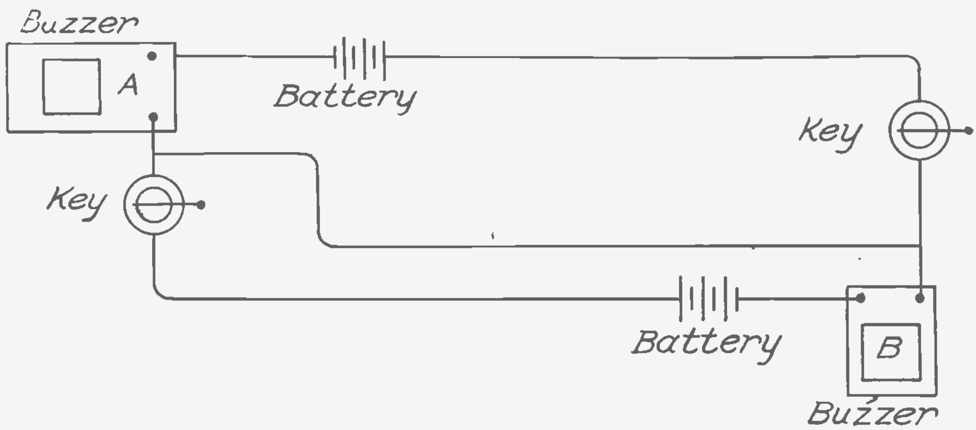


FIG. 1. CONNECTIONS OF BUZZER TELEGRAPH.

wire to the key at (A) and back to the battery at (B). The key at (B) being open, no current flows through the buzzer at (A), the sending station, and it is therefore quiet. Similar conditions hold when (B) is the sending station, and in that case buzzer (B) does not sound.

Now, in order to make the instruments operate like regular telegraph sounders—that is, by clicks instead of buzzes—a switch is added to each buzzer as shown in Fig. 2. You will readily see how to connect the switch by taking off the cover

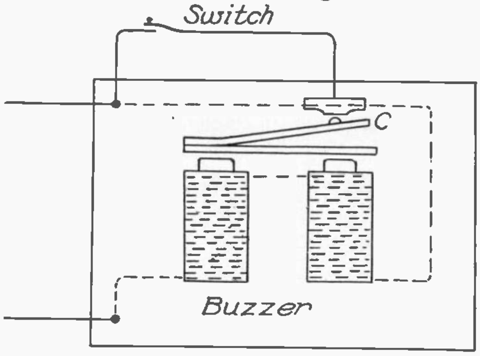


FIG. 2. BUZZER SWITCH.

of the buzzer. Ordinarily the switches at both stations are left open. When (B) calls (A), for instance, he closes his key and the buzzer at (A) gives a prolonged buzz, as long as the key is held down. When (A) comes to the line he signals back in the same manner, then both open their switches.

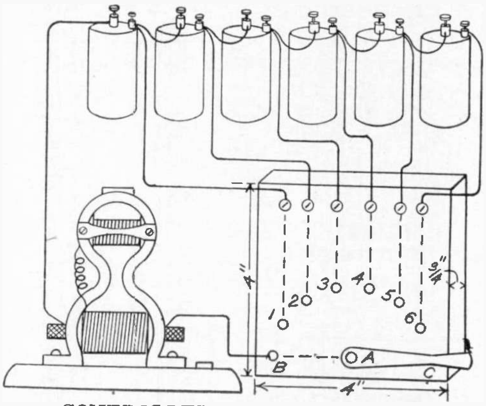
Opening the switches makes the buzzers operate as telegraph sounders—that is, by clicks. The reason for this is that when one key is pressed down current flows through the coils of the magnets at the other station and continues to flow through them and out through the closed switch, bringing the armature down with a sharp click and holding it there as long as the sending key is depressed. In this way dots and dashes are easily sent. When the switch is open, however, as for signaling an operator to come to the line, the current flows through the magnets, draws down the armature, which breaks the circuit at (C), Fig. 2. This causes the magnets to let go of the armature, which flies up by spring action and closes the circuit at (C) again, and so on intermittently. This action is very rapid and gives out a loud buzz as long as the sending key is depressed.

The push buttons are not very handy to operate as keys, so they may be removed from the contacts and a key of some sort added to close the contacts rapidly. In the instruments described above this was done by taking a clapper from an old electric bell and mounting it on a bent nail over the contacts of the push button, so that when it was raised and lowered the contacts could be opened and closed in quick succession. Other ways of doing this will no doubt suggest themselves.

SIMPLE CONTROLLER FOR TOY MOTORS.

The amateur electrician who desires to run his electric motor by six dry batteries and to use any number of them at once, will find the following method easy and satisfactory.

Connect the motor to the batteries as in the diagram. The rheostat may be made from a piece of oak board four



CONTROLLER FOR TOY MOTOR.

inches square and ¾-inch in thickness. At (1), (2), (3), (4), (5) and (6) bore holes and put little bolts through. The little binding-posts of batteries will answer.

A handle (A) is used to switch on the number of batteries required. A wire from (A) is led to binding-post (B). When handle is in the position as shown in drawing, the current is off. The dotted lines show where wires are put under the board. To start the motor push the handle (A) upward. The numbers may be put near the points to indicate number of batteries used. (C) is a point upon which the handle (A) rests when power is off.

Frank S. Reid.

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.

OPERATION OF TOY BATTERY MOTOR.

Question.—Can an ordinary toy battery motor be run without burning out, on a 110-volt lighting circuit using the rheostat described in the "Junior Section" of the August issue? H. R. C., Chicago, Ill.

Answer.—Yes, but not safely. These motors are usually not insulated to stand a pressure of 110 volts, and in case of a breakdown you can readily see by Ohm's law, $C = E \div R$, that with $E = 110$, the current would burn out such an outfit. Fire underwriters do not approve the operation of toy outfits on 110 volt circuits. Knowing this, manufacturers have to date put on the market two approved alternating current transformers from the secondaries of which low voltage may be taken off to operate electric toys and miniature lights. No approved device has as yet been put out for reducing the voltage of a direct current circuit for a like purpose.

Your question regarding design of an electro-magnetic engine will be answered in a future issue.

COMMUTATOR TROUBLE.

Question—In the sub-station where I am employed, we have five rotary converters. We receive alternating current from generators driven by gas engines. Have been troubled sometimes with our brushes picking up copper and pitting. The commutators run very hot at times, and have begun to show black bars. State what care should be given such commutators. What lubricant would you use?—F. G. H., San Francisco, Cal.

Answer—From the wording of your question, we believe that your main fault lies in the adjustment of the brushes. That is, the brushes may be in a wrong position, which always will cause excessive sparking, or they may bear too hard on the commutator. The pitting of the surface of the commutator may be due to high current densities, caused by the contact surface of the brushes being too small, or the contact itself being poor. The blackening of a commutator denotes sparking underneath the brushes, which in combination with excessive amounts of oil and dust will be the most valid cause for the blackening. The above is, as stated, with the assumption that no armature and field coils are defective, as that always will cause trouble with the brushes and commutator. Cleanliness is the main point in taking care of commutators. The surface should be kept free from dust and excessive amount of oil and the brushes should be kept in good contact with the commutator, without bearing too hard on it. Use as little lubrication on the commutator as possible and when used it should either be a clean acid-free oil or vaseline. However, the dynamo manufacturers carry a special lubricant which is to be preferred. See also article elsewhere in this issue on "Commutator Sparking."

CONSTRUCTION OF A SMALL STORAGE BATTERY.

Question—I would like to know how to construct a small storage battery to work one four volt, 12½ watt, 10 candlepower lamp for lighting a room. Could you give me a little practical information regarding the battery? I would like to use it for two nights a week, and from four to five hours at a time.—E. F., Chicago, Ill.

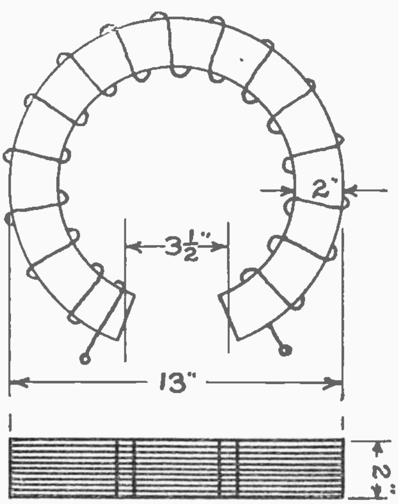
Answer—The simplest storage battery for amateur construction is the old Plante cell. You will want two cells. For each cell take two plates of thin sheet lead three feet long, six inches wide and not over 1-16 inch thick. At one end of each plate a lug one inch wide extends two inches to the side. Both sides of both plates must be roughened by hammering with a piece of coarse file. On one of the plates lay three strips of rubber, asbestos cloth, or other insulating material not affected by acid, a little longer than the plate, and ½-inch wide. Lay the second plate on these strips, and three more strips on this. Then take a round bar of wood, heavily paraffined, eight inches long and one inch in diameter. Place this across one end of the plates, and roll the whole affair into a compact spiral or cylinder. Hang in a suitable jar, and fill with one part sulphuric acid to 10 parts water.

The cell so made must now be "formed" by sending a current through it until oxygen bubbles appear at the positive plate, then reversing the current for the same length of time, and so on until the plates have become spongy, which may take a week. Then one lug must be marked positive (+) and the cell always charged in the same direction.

INDUCTIVE RESISTANCE.

Question—I wish to build an inductive resistance of the transformer type, one in which the line voltage will pass through the primary. The voltage is 110 A. C. I wish to use it on an arc lamp used for projection purposes (hand feed), dispensing with an adjustable rheostat. There is too much heat from the rheostat. I use about 25 amperes on the lamp and desire to use the resistance as an economizer.—J. B. Milford, Mass.

Answer—In your question you have failed to give the frequency of your current. We have assumed that it is 60



INDUCTIVE RESISTANCE.

cycles. With such a current at 110 volts, the following impedance coil in series with an alternating current arc lamp would allow 25 amperes to pass through. The iron construction may be made in different shapes, as long as the length of the air-gap and approximate length of the magnetic path of the iron core and its cross section remain the same. However, for our calculation we will assume a circular iron ring of rectangular cross section as shown in the diagram. The ring, preferably, should be built up of thin iron plates, so as to decrease the iron losses, thereby increasing the economy of its operation. The iron should first be insulated with tape and shellaced. Next, 500 turns of No. 8 B. & S. single cotton covered copper wire should be wound on in three layers. Such a coil as this, practically, will not waste any power in decreasing the 110 volt to 30 volts for the arc lamp. The power factor of the coil will be about 0.03. By inserting an iron piece in the air-gap, the current may be gradually decreased at will. We would suggest that by taking the matter up with some of the electrical supply houses, you might be able to purchase a suitable coil more economically than you can make it.

INSTRUMENT FOR REMOVING SUPERFLUOUS HAIR; INDUCTION MOTOR OPERATION.

Question.—(A) How is an instrument for removing superfluous hair constructed?

(B) We have a 60 cycle, three phase, 220 volt, five horse power induction motor which takes 13.5 amperes on load. By opening one line (one phase) the motor will continue running, taking about 20 amperes, and will get extra hot. An accident occurs in the power house which will stop the motor; but we have a 60 cycle, 220 volt, three wire, two phase generator. Can we, while our motor is running, switch over on to one phase of our generator, and what will happen to the motor?—C. H. W., St. Catherine, Ont., Can.

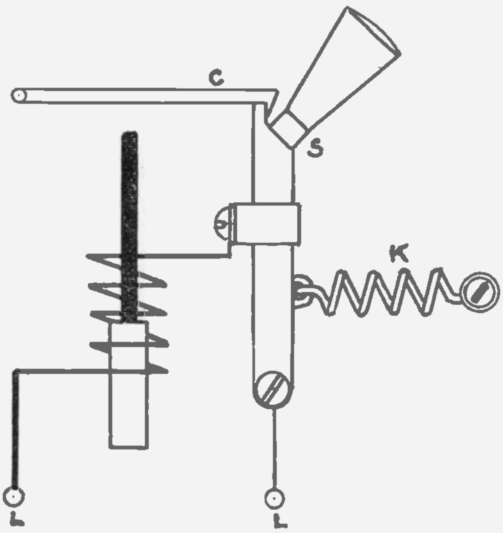
Answer.—(A) The instrument referred to is simply a fine platinum needle which forms one terminal of a battery of low voltage. The other battery terminal is connected to the body. The needle being introduced into the hair follicle and the current switched on, the root of the hair is destroyed by electrolytic action.

(B) A three phase induction motor will continue running after opening one or two of its three phases. However, by opening one phase, the current in the remaining phases is increased 1.5 times and opening two phases will increase the current in the third phase three times, which of course will result in increasing the heat of the motor.

With the exception of the above objection you may switch your motor over on one phase of the two phase generator. It is suggested that if the case is of sufficient importance you might install a Scott transformer between your two phase generator and three phase motor. Such a transformer will transform a two phase into a three phase current and the motor could be run just as successfully from the two phase generator as from the three phase mains.

CIRCUIT BREAKER.

Question—(A) I would like to know the action and makeup of a circuit breaker. (B) Do you think I can make a direct current dynamo out of a small magneto and use the same as a motor on alternating current house circuit?—K. U., Newark, N. J.



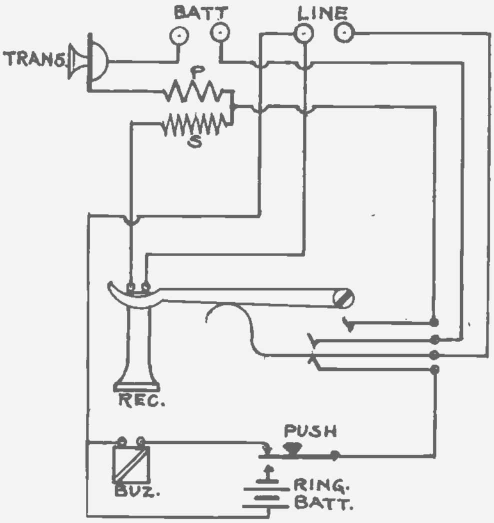
CIRCUIT BREAKER.

Answers—A circuit breaker consists of a switch (s) (see cut) which is held closed by a catch (c) against the pull of the spring (k). A solenoid is arranged so that its core, when raised, releases the catch. Normally, this core is adjusted so that it rests on a screw. When the current becomes stronger than is desired, the solenoid increases in power and lifts the core. This releases the switch arm, which flies open, breaking the circuit. It is reset by hand.

(B) A magneto furnished with a two part commutator forms a direct current dynamo. It is impossible, however, to operate such a machine as an alternating current motor.

HOW TO CONNECT A HOUSE TELEPHONE.

Question—I recently purchased parts for a telephone and attempted to put them together myself. I wish to use it for house telephone. I had the wires connected all sorts of ways but was unable to communicate with the other telephone without hearing myself, and when calling the other station my own buzzer would ring and not the other.—W. C. V., Brooklyn, N. Y.



CONNECTIONS OF HOUSE TELEPHONE.

Answer—The accompanying diagram shows the proper connections for your telephones. The push buttons should have upper and lower contacts.

DROP IN VOLTAGE.

Question.—How many 16 candle-power lamps connected in series on a 220-volt circuit will enable me to get 10 or 12 volts? R. J. R. Hayward, Cal.

Answer.—By connecting twenty-two lamps in series across the circuit, leads taken off the terminals of any one lamp will give 10 volts; that is, each lamp takes its portion of the drop, or 220 volts divided by 22.

REVIVING OLD DRY BATTERIES.

Question.—Is there any way of renewing the strength of old dry batteries? If so, how? A. W. H., Racine, Wis.

Answer.—See answer to question (E) of V. E. H., July, 1908, issue of Popular Electricity.

INDUCTION COIL QUESTIONS.

Questions.—I have an induction coil, with primary wire two layers No. 16, and No. 38 wire in the secondary. With a condenser this coil gives a two-inch spark using dry batteries. (A) Would it be possible to run this coil on an alternating current of 100 volts and five amperes? (B) What would be a safe current for the coil? (C) Would I have to cut out the condenser? (D) Could I cut down the current by inserting lamps in the circuit. H. L. D., New York, N. Y.

Answers.—(A) Yes, by inserting in series with the primary of the coil, an electrolytic interrupter made as shown in the diagram in answer to "A Reader," January, 1909, issue of Popular Electricity. If you have a "make and break" contact, place a jumper across it.

(B) The rated capacity of No. 16 wire is six amperes, but it is a fact known to coil manufacturers that wires in coils seem to be able to run at twice their capacity without serious effects.

(C) Yes.

(D) Yes.

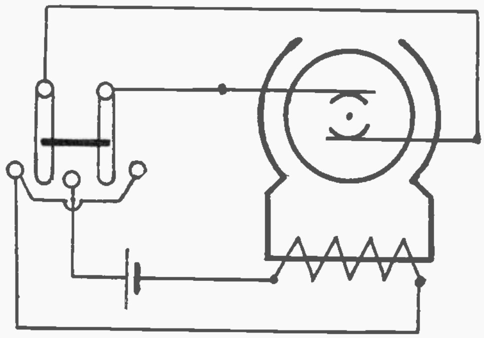
ELECTROMAGNET; BATTERY MOTORS.

Questions—Please explain the following: (A) How to make an electromagnet to be operated with batteries. (B) How to reverse a battery motor so that it can be run in either direction? (C) How to find out what part of a horsepower a battery motor is which takes two amperes at—volts and gives 1800 revolutions per minute, series wound.—G. F. R., Orange, Calif.

Answers—A bar of ½-inch soft iron five inches long, bent into a U shape, and each limb wound with six layers of No. 18 cotton covered magnet wire, makes quite a powerful magnet. The two coils should be connected so that the current traverses an S-shaped course in passing from one to the other.

(B) A motor is reversed by reversing the connections of either (not both) the field or the armature. The diagram shows the connections of a simple motor reversing switch.

(C) The voltage of your motor is omitted in your question, so no specific answer can be given. Multiply the volts by the amperes to find the watts. There are 746 watts in an electrical horse power; so the theoretical power is easily found. However, the efficiency of a battery motor is frequently not over 30 per cent.



BATTERY MOTOR REVERSER.

TOY MONORAIL SYSTEM.

Questions—(A) In constructing the toy monorail car shown in the October number, would not tin, sheet steel, or iron, take the place of brass for the track? The resistance would be a trifle more but the price would make up for more than that, as brass angle sells at about 35 cents a foot, while tin comes at about two to four cents. If tin is used would not two or three more batteries give sufficient current over the resistance to run the car? (B) In Fig. 5 you show one end of the right hand electromagnet connected to the journal of the front wheel. How does the current pass from the track back to the battery, when the track is not connected? In your explanation you say connect one terminal of the battery to the iron steps and one to the trolley. (C) Please give me a clearer description of how to make these steps. Are they separate pieces, or one piece cut out, or straight with one inch pieces bent back?

Answers—(A) Any metal will do for the track. Brass is preferable only because it usually affords a better contact with the wheels. If tin or iron is used, be sure the edge is clean, to connect with the wheel. The added resistance is negligible, and no extra battery power will be necessary because of the change.

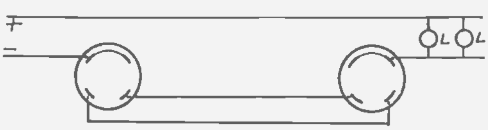
(B) The article reads "one terminal of battery to *rail,* the other to the trolley wire." Nothing is connected to the iron steps.

(C) The iron steps are bent, as shown in the article, of fairly thick sheet iron strips. It makes no difference whether each step is a separate piece, or one long strip is bent at intervals of one inch. The latter is the easier construction. No cutting is necessary in forming the steps. The idea is to present slanting surfaces, one inch long, to the electromagnet.

THREE-WAY SWITCH; STORAGE BATTERY CHARGING.

Questions.—(A) How may a light be turned on or off from two different points? (B) How may the polarity of a 110-volt, two-wire, direct-current circuit be determined? (C) How can I tell when a storage battery is charged to its capacity while it is attached to the charging apparatus? (D) Can a storage battery be charged on 110 volts, alternating current, by using the transformer described in a previous issue? W. W. H., Clay Center, Kansas.

Answers.—(A) By using a three-way switch at each point, wired as shown in the diagram. This way of connecting three-way switches complies with the rule of the National Board of Fire Underwriters, which reads, "Three-way switches are considered as single-pole switches and must be wired so that only one pole of the circuit is carried to either switch."



THREE-WAY SWITCH.

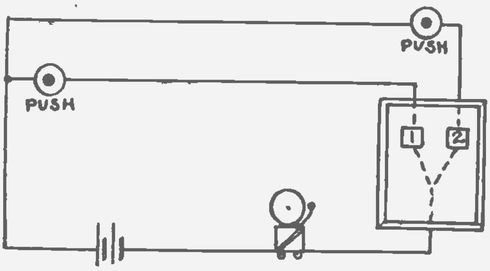
(B) Connect a wire to each side, placing a lamp in one wire to act as a resistance. Dip these ends into a glass of water, slightly acid, keeping them apart. Gas bubbles will be given off the negative lead. If you have a voltmeter, attach one of its leads to one main and touch the other main with the remaining lead. The voltmeter will be deflected along its scale when the positive lead of the meter is in contact with the positive main.

(C) A cell is fully charged: (a) If, with a constant current, the voltage and specific gravity do not change for 25 or 30 minutes. (b) When the plates decidedly increase the quantity of gas given off. (c) When the specific gravity measures 1.2, and the voltage from 2.5 to 2.7. (d) When the negative plate assumes a light gray color and the positive plate turns a dark brown.

(D) No, because storage batteries cannot be charged by alternating current.

BELL WIRING.

Question—Would like to know if bell could be wired to ring from two places and drop different numbers on an annunciator.—W. A. K., Montreal, Can.



BELL WIRING DIAGRAM.

Answer—The accompanying diagram shows the connection you wish.

POWER FACTOR FORMULA.

Questions.—(A) In your December issue, p. 516, X. Y. Z., Michigan City, Ind., gives a problem of a machine, 400 volts, three-phase, 500 amperes, or 166⅔ amperes per phase, 90 power factor lag, asking formulas to figure the load. If his ammeter reads 500 amperes, where does he get the 166⅔ amperes?

(B) If a three-phase machine had a delta winding in its armature, and the meter in each lead reads 500 amperes, then each phase in the armature would generate 288.6 amperes. W. E. T., Chicago, Ill.

Answers.—(A) Formula and solutions referred to are correct. However, to speak of a machine as being a 500-ampere alternator, where $3 \times 166\frac{2}{3}$ amperes (the current in each lead) is meant is not usual and perhaps somewhat misleading. Alternating current generators are generally rated on name plate in kilowatts as found by formula given. They are also rated in horse-power with current output per lead or phase noted.

(B) In figuring the power in a three-phase circuit, you substitute for A, in the formula $W = 1.732$ V. A. P., the current in one phase. In the example referred to this would be one-third of the total current (500 amperes) or 166⅔ amperes. You will note that it was specifically stated in the question "500 amperes or 166⅔ amperes per phase."

DYNAMO DESIGN.

Question.—(A) Does the quantity of electricity and its electromotive force increase in a ratio with the velocity of the armature for a given generator?

(B) In slow speed machines, is the loss of velocity of the armature compensated by the increase in the number of magnets, and in the number of coils in the armature? If I am right, this is the only way to obtain the same electric current.—A. C. R., Montreal, Can.

Answer—(A) The voltage of a dynamo corresponds to the speed of the armature, or number of lines of force cut per unit of time. The resistance remaining the same, the current would naturally vary proportionately.

(B) Slow speed machines usually have large, iron clad armatures and multipolar fields. The idea is to keep the peripheral speed, or the rate at which the lines of force are cut by the conductors, about the same in any case.

TRANSFORMER DESIGN.

Question—Will you kindly tell me how to make a transformer which will step up 110 volts to 250 volts. The supply is alternating current 60 cycles.—J. M., Chicago, Ill.

Answer—Your question is very indefinite, as you do not give any idea as to size desired. The simple transformer described in the November number of Popular Electricity may be wound to deliver 250 volts by making the secondary coil of 2,400 turns of No. 27 double cotton covered wire. Cover the primary with five layers of shellaced linen tape, and the secondary with the same amount. The secondary leading-in wires should be enclosed in sleeves.

ELECTROMAGNETIC ENGINES; ELECTROLYTIC INTERRUPTER.

Questions—(A) Can you tell me what size of copper magnet wire and how long must I use on bobbin 2½ inches long to get a very powerful magnet out of it? Want a pull on bar of at least 10 pounds (induction style). I am about to make an electromagnetic engine, the piston being soft iron runs inside of the magnet core, and want to know the correct size of the winding. The engine is to be operated on 110 volts, about 10 amperes, alternating current of 60 cycles, single phase. (B) Can you furnish me the data for construction of an efficient electrolytic interrupter for 10 inch spark coil on 110 volt alternating current system?—K. B. A., Cleveland, Ohio.

Answers—(A) We cannot think that you mean to use 110 volts and 10 amperes, or about 1½ electrical horse power, on a coil of the small size you describe. By winding with No. 28 single silk covered wire your coil will absorb about one ampere. The actual pull on the core will be problematical, owing to the complicated nature of small alternating current coil calculations. The brass tube of the spool will have to be slit its whole length if alternating current is used.

(B) The construction of a Wehnelt electrolytic interrupter is described in answer to "A Reader" in the January issue.

CONSTRUCTION OF SMALL GENERATOR.

Question—I have a set of castings for a small generator which I would like to wind for 110 to 125 volts, but I do not know what size wire to use on the armature and fields, machine to be compound wound. Armature drum type, to be wound in 12 sections; have room to wind to a depth of ⅜ of an inch; diameter of armature three inches, length 2¾ inches. Bipolar undertype fields. Length of fields 2¾ inches, diameter 1¾ inches. I have room to wind to a depth of ¾ of an inch.—B. W. M., Edgar, Neb.

Answer—Armature continuous drum winding, using No. 27 wire. Wind the fields with No. 33 wire for shunt coils, leaving space for three layers of No. 23 wire on each field coil for series connections. Three-eighths inch seems a rather deep winding for a smooth drum armature of the size described. You will have to determine the correct speed experimentally.

MAGNETO GENERATOR.

Questions.—I have a three-bar telephone ringing generator and a small steam engine which I wish to connect together. (A) Will continuous turning of the armature burn out the generator windings? (B) If this current be connected to an induction coil will the induced current be alternating or direct? (C) When the current is run through an induction coil will the coil increase the amperage and voltage together? F. R.

Answers.—(A) That depends on the size of wire on armature, and as the size of wire used varies with purpose of generator, it is impossible to answer this question without more definite information.

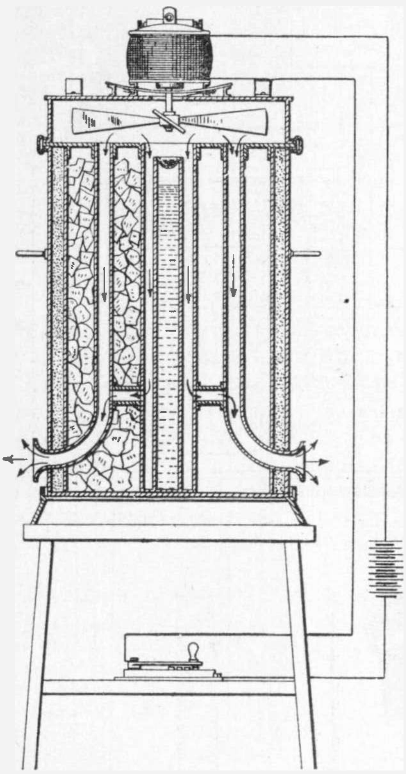
(B) See answer to "A Reader's" questions (B) and (C), January, 1909, issue of Popular Electricity.

(C) No. The induction coil cannot create energy. The total energy is practically constant. An increase in voltage means less current in the secondary.

NEW ELECTRICAL INVENTIONS.

APPARATUS FOR COOLING ROOMS.

In the December issue a new form of electric heater was described in this department, in which the heat generated by an electric heating coil was distributed through the room by an electric fan. A device constructed on similar lines but for a diametrically opposite purpose; that is, for cooling the room, is shown in the diagram.

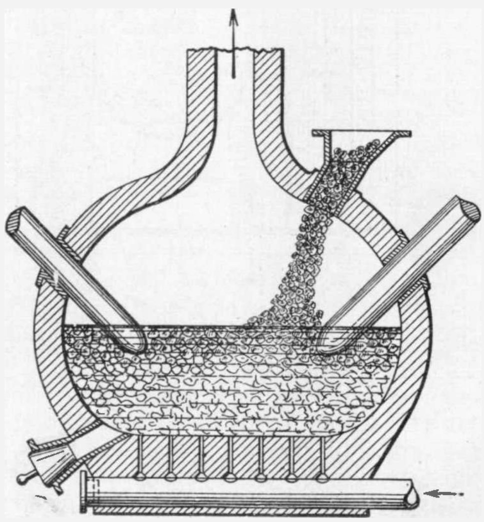


APPARATUS FOR COOLING ROOMS.

The cooling apparatus, which is the invention of Pauline Grayson, of New York City, consists of a cylindrical casing with compartments for holding cracked ice and air ducts distributed through the casing. These air ducts open at the top into a compartment containing a fan and at the bottom terminate in nozzles which direct the air, blown downward by the fan, out into the room. The fan is driven by an electric motor mounted on the top of the casing.

ELECTRIC REDUCTION FURNACE.

Karl Kaiser of Berlin, Germany, has obtained an American patent on a furnace for obtaining metals from their ores. Suitable ores or products of smelting works are introduced into an electric furnace shown in the cut and exposed to the heat of the current entering and leaving through the two electrodes. Fluxes, such as limestone and quartz, are added if necessary. As soon as the necessary temperature has been attained, in most cases the melting temperature of the mixture, an oxidizing gas such as atmospheric air is introduced into the heated mass, this oxidizing gas serving to oxidize all combustible impurities in the ore, the gaseous products resulting being led off from the furnace. When this stage of the process is complete a reducing gas is introduced into the heated mass. For this purpose, gaseous carbon compounds and hydrogen can be employed, the most suitable being carbon monoxid, water gas and Dowson gas. The volatile metals escaping in gaseous

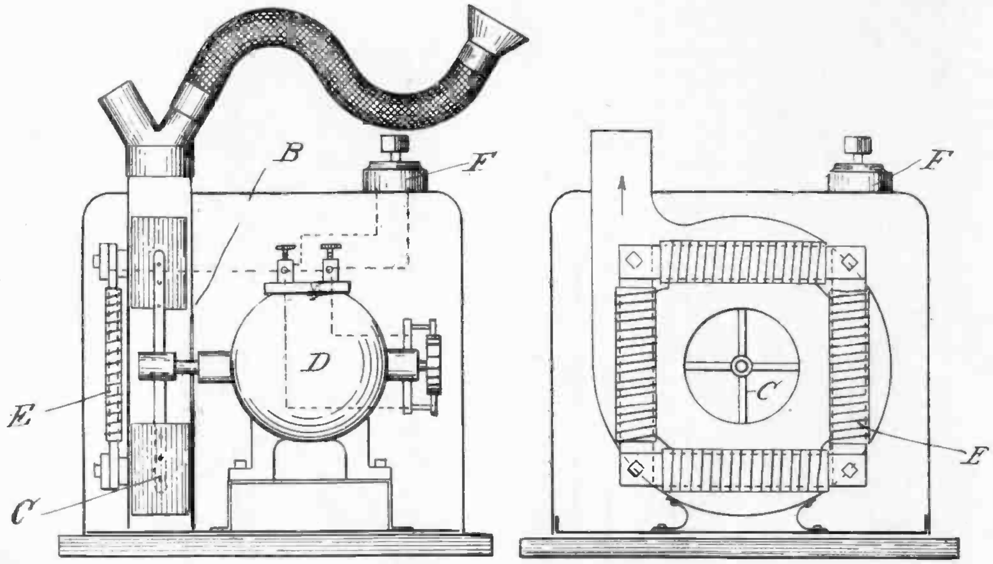


ELECTRIC REDUCTION FURNACE.

form, for example, the zinc, are led out of the furnace and collected in a suitable receiver where they are condensed and thus separated from any gases which pass out with them. The liquid constituents, for example, the iron, are led off from the lower part of the furnace.

ELECTRIC HAIR DRIER.

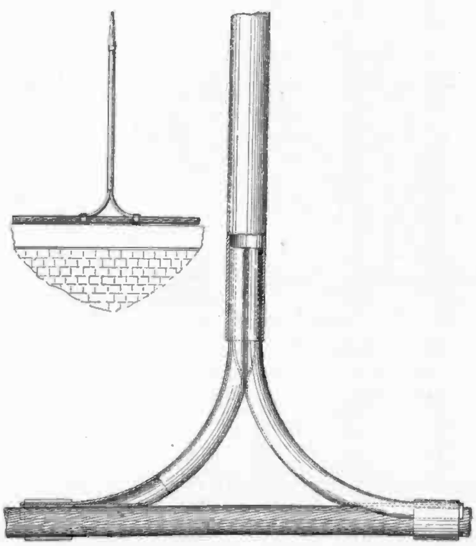
The accompanying diagram shows a side and an end elevation of an improved electric hair drier invented by Mathias Thome of Chicago. A motor (D) is mounted inside of a casing and drives the fan (C) which forces the air out through the tube. In entering the casing the air must pass over the heating coils (E), raising its temperature to the proper point for rapidly drying the hair. Current to the motor and heating coil is controlled by the snap switch (F).



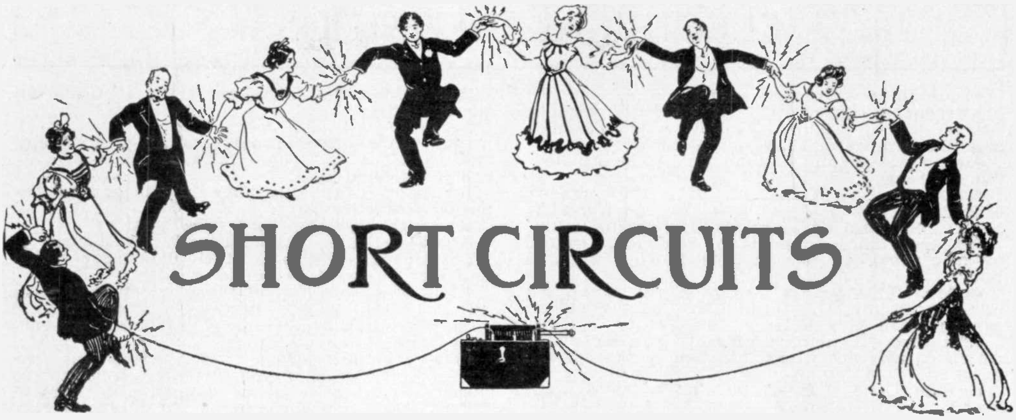
ELECTRIC HAIR DRIER.

LIGHTNING ROD.

A form of lightning rod which is very easy to install is shown in the diagram. It is designed to fasten to a stranded copper cable now acknowledged by experts to be one of the best forms of lightning conductor. The device comprises a Y-shaped connecting joint which is fastened by clamps or collars to the copper cable, which runs along the ridge of the roof or other exposed points. Over the upwardly projecting end of the Y is slipped a hollow tube of copper of any length desired which bears on its upper end the usual point. Any number of these points are easily installed on a length of cable and when properly joined and soldered offer a continuous path for the lightning and one free from sharp angles, from which the lightning would be inclined to jump to the wood or brick work.



LIGHTNING ROD.



SHORT CIRCUITS

Jeweler (to grocer)—I beg your pardon, but didn't I see you put two or three finger rings and a scarf pin in your pocket?

Grocer—Certainly. When you come into my place, aren't you always picking up things and putting them in your mouth?

* * *

Santa Fe Employes Magazine.

"Hello! Santa Fe?"
"Yes, mum."
"How is No. 2, please?"
"On time."
"What time is it due here?"
"Nine o'clock."
"What time is it now, please?"
"Eight forty."
"How long will it be before No. 2 gets here, please?"
"Twenty minutes."
"Is it out of Marceline yet?"
"I think not."
Then the receiver went up.

Noopopp—"Quick! tell me, nurse, is it a boy?"
Nurse—"No; guess again."

* * *

The Town Grumbler—"I dun'no' what things is comin' to. Poor old Henry gone; Aunt Jane's busted her leg; the old woman's ill abed; an' now, doggone me, if I 'aven't lost my knife."—Harper's Weekly.

* * *

"Are you a believer in spiritualism?"

"Yes; the ghost walks every Saturday, and by Monday I have nothing left but a hallucination."

* * *

"Have you heard that Jim has quit smoking?"

"No."

"Yes; you see, he is a little near-sighted, and the other day he emptied his pipe in a powder barrel."

* * *

"Your husband will be all right now," said an English doctor to a woman whose husband was dangerously ill.

"What do you mean?" demanded the wife. "You told me he couldn't live a fortnight."

"Well, I'm going to cure him, after all," said the doctor. "Surely you are glad?"

The woman wrinkled her brows.

"Puts me in a bit of a 'ole," she said. "I've bin an' sold all his clothes to pay for his funeral."

* * *

"Well now, Pat,," said the magistrate to an old offender, "what brought you here again?"

"Two policemen, sor," was the laconic reply.

"Drunk, I suppose?" queried the magistrate.

"Yes, sor," said Pat, "both of thim."

* * *

Little grains of sawdust—little strips of wood, treated scientifically make the breakfast food.

* * *

Master—"I'm sorry to hear, Pat, that your wife is dead."

Patrick—"Faith an' 'tis a sad day for us all, sir! The hand that rocked the cradle has kicked the bucket."

* * *

"Just throw me half a dozen of the biggest of those trout," said a citizen to the fish dealer.

"Throw them!" queried the dealer.

"Yes, and then I'll go home and tell my wife I caught 'em. I may be a poor fisherman, but I'm no liar."

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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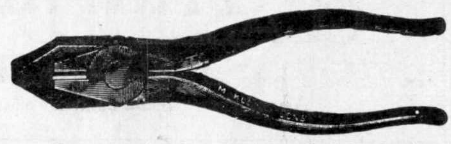

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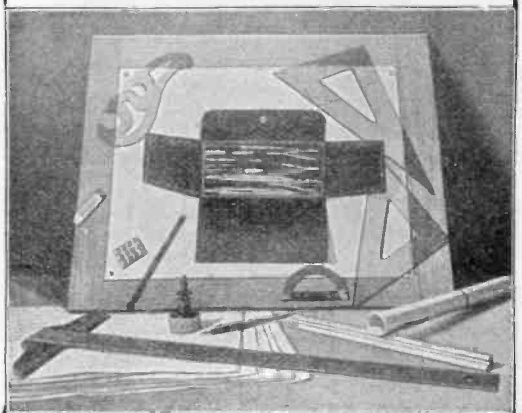

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REMEMBER! TRAINED MEN ARE IN DEMAND. Our Practical training combines THEORY and PRACTICE. Mark the coupon and mail it to us.

How Our Students Like It

Freeport Correspondence Schools,

I am well pleased with my lessons. The instructions are very plain and easy of comprehension. Am glad I did not get a text-book course as with this system my lessons are always new and consequently interesting. C. E. BERRY, M 183
Rockford Ill.

MAY WE TRAIN YOUR HANDS and YOUR HEAD for a better position, HIGHER SALARY, more pleasant work?

Don't be discouraged because you are dissatisfied. It is a good sign. Let us give you SIMPLIFIED TECHNICAL TRAINING for then YOU WILL ADVANCE.

FREEPORT CORRESPONDENCE SCHOOLS
902 Rice Bldg., Freeport, Ill.

I would like the position before which I have marked a cross (X). Please explain, without cost to me, how I can get such a position and be sure to hold it.

....Mechanical Draftsman	....Manual Training Instr.
....Sheet Metal Draftsman	....Bookkeeper
....Architect	....Advertiser
....Architectural Draftsman	....Stenographer
....Architectural Designer	....Steam Engineer
....Carpenter and Joiner	....Stationary Fireman

Name.. Age..........

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

St. or R. F. D........................... Occupation....................

A FREE TRIAL

Sent Express Prepaid to You

Write today for a Trial Order Blank.

¶ As a **health** and **toilet** requisite, no lady's or gentleman's toilet equipment is complete without this wonderful and dainty accessory. **A daily vibratory massage is as essential as the daily bath.** After the bath it will invigorate, revitalize and give you the exquisite feeling of the vigorous, young athlete. **After a shave,** well, all you men know by experience how good the massage given you by the barber makes you feel and look, **but think how fine and unselfish** it would be for you to have your own vibratory massage outfit AT HOME, then YOUR WIFE and **the whole family** could have a DAILY **massage.** Brings the BLOOM OF YOUTH to faded cheeks, **THE KIND THAT WON'T COME OFF.**

Takes out the wrinkles and keeps them out.
Banishes the signs of age and keeps you young.

¶ 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.

Removing double chin

¶ Send for our **FREE BOOK**—It tells and shows a lot. **Charts and diagrams** how to use to produce desired results.

¶The Swedish Electric Massage Vibrator is pronounced to be the best in every respect by eminent, scientific people. Thousands testify to the almost miraculous things it has done for them, prominent and up-to-date people, many social leaders, the most **noted and beautiful actresses, prominent actors, judges, athletes, men high in the greatest commercial, financial, political and medical walks of life.**

¶ 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

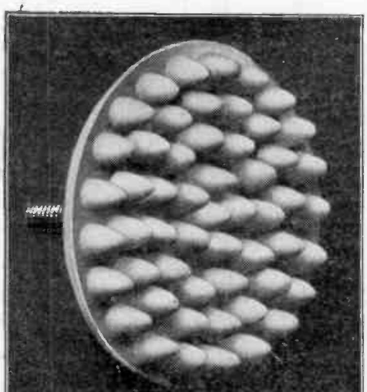
THE BEST VIBRATOR ON THE MARKET AT ANY PRICE.

THE ONLY Vibrator **properly** adapted **for home, traveling** and **professional** use.

If you have no electric wire in your home we have a Vibrator operated by Dry Batteries.

¶ 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.

¶ A postal will bring you a booklet and a FREE TRIAL Order Blank.

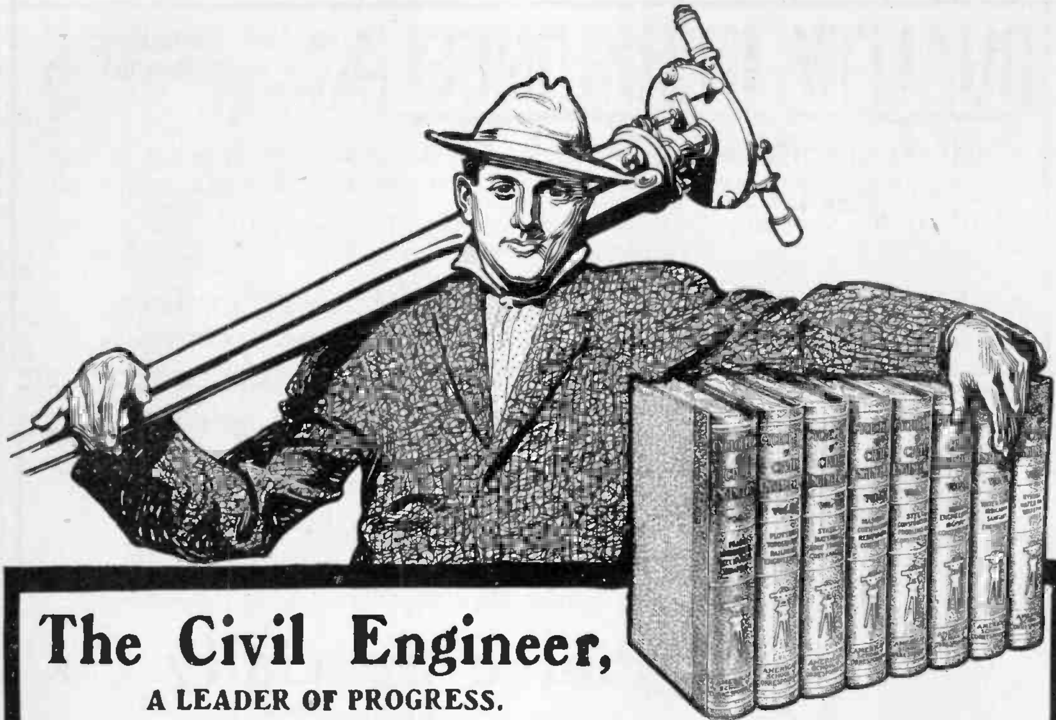


One of the Six Applicators.

Swedish Electric Vibrator Co.

CHICAGO, ILL.

602-640 Farragut Avenue.



DO YOU HEAR WELL?

The Stolz Electrophone—A New, Electrical, Scientific and Practical Invention for those who are Deaf or Partially Deaf—
MAY NOW BE TESTED IN YOUR OWN HOME.

Deaf or partially deaf people may now make a month's trial of the Stolz Electrophone at home. This personal practical test serves to prove that the device satisfies, *with ease*, every requirement of a perfect hearing device. Write for particulars at once, before the offer is withdrawn, for by this *personal test* plan the *final* selection of the *one completely satisfactory hearing aid* is made easy and inexpensive for every one.

Mrs. C. Lidecka, 228 12th Ave., Maywood, Ill., wears an Electrophone. Less conspicuous than eyeglasses

This new invention, the Stolz Electrophone (U. S. Pat. No. 763,575) renders unnecessary such clumsy, unsightly and frequently harmful devices as trumpets, horns, tubes, ear drums, fans, etc. It is a tiny electric telephone that fits on the ear and which, the instant it is applied, *magnifies* the sound waves in such manner as to cause an *astonishing increase* in the *clearness of all sounds*. It overcomes the buzzing and roaring ear noises and, also, so constantly and electrically exercises the vital parts of the ear that, usually, the natural unaided hearing itself is gradually restored.

What Three Business Men Say.

The Electrophone is very satisfactory. Being small in size and great in hearing qualities makes it preferable to any I have tried and I believe I have tried all of them. M. W. HOYT, Wholesale Grocer, Michigan Av. and River St., Chicago.

I got so deaf I could not hear with my speaking tube and was advised to try the Electrophone. After 15 years of deafness, discomfort and worry, I now hear perfectly at church and at concerts. W. R. UTLEY, Sales Mgr., S. A. Maxwell & Co., Chicago.

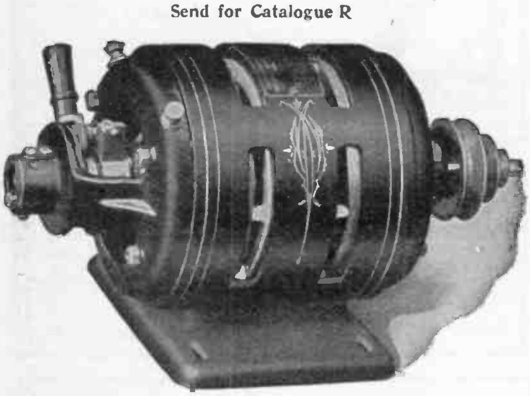
I have now used your Electrophone over a year and know that it is a first-class, scientific hearing device. Without it people have to shout directly in my ear to make me hear. With it, I can hear distinctly when spoken to in an ordinary tone. Best of all, *it has stopped my head noises*, which was a terrible aggravation. LEWIS W. MAY, Cashier, 100 Washington St., Chicago.

Write to, or call (call if you can) at our Chicago offices for particulars of our personal test offer and list of other prominent endorsers who will answer inquiries. Physicians cordially invited to investigate aurists' opinions.

STOLZ ELECTROPHONE CO., 1684 Stewart Bldg., 7th Floor, CHICAGO
Branch Offices: Philadelphia, Cincinnati, Seattle, Indianapolis, Des Moines, Toronto. Foreign Office, 82-85 Fleet St., London, Eng.

THE KIMBLE VARIABLE SPEED SINGLE PHASE A. C. MOTORS

Send for Catalogue R



⅛ H.P., 110 Vts., 60 Cycle	$27.00
¼ H.P., 110 Vts., 60 Cycle	50.00
⅓ H.P., 110 Vts., 60 Cycle	60.00

All Motors Guaranteed 2 Years.

KIMBLE ELECTRIC CO.

617 West Adams Street
CHICAGO

STARTLING Watch Offer

The Great Burlington Special at a No-Trust Price!

The world's masterpiece of watch manufacture now sold direct!—

The most amazing offer ever made in the whole history of the watch industry — an offer which has absolutely PARALYZED competition — the offer of the genuine **Burlington Special direct to the public at the rock-bottom NO-TRUST PRICE**, without middlemen's profits.

The Fight is On!

We will not be bound by any system of price-boosting contracts with dealers. We will not submit to any "high profit" selling scheme. We will not be dictated to by ANY Trust.

NO MATTER WHAT IT COSTS, we are determined to push our independent line even if we should have to fight a combination of all the Watch Manufacturers of the country!

And so we are making this offer—the most sweeping, astounding offer ever made on a high-grade watch. The famous BURLINGTON direct and at the same price WHOLESALE Jewelers must pay.

And in order to make the proposition doubly easy for the public we will even allow this rock-bottom price, if desired, on terms of **$2.50 a Month** Don't miss this wonderfully liberal offer. Sign and mail coupon now. Rock-bottom, no-trust price, whether you buy for cash or time.

POST YOURSELF!

Be sure to get posted on watches and watch values, trust-method prices and no-trust prices before you buy a watch. Learn to judge watch values!

Get the Burlington Watch Company's

FREE WATCH BOOK

Read our startling exposure of the amazing conditions which exist in the watch trade today. Read about the anti-trust fight. Read about our great $1,000.00 Challenge. Learn how you can judge watch values. Send your name and address for this valuable FREE BOOK now — TODAY. Sign & mail coupon.

BURLINGTON WATCH CO.
Dept. 1392
Millard Sta.
Chicago, Ills.

Burlington Watch Co., Dept. 1392, Millard Station, Chicago, Illinois

Please send me, *without obligation* and prepaid, your free book on watches and copy of your $1,000.00 challenge, with full explanations of your cash or $2.50 a month offer on the superb NO-TRUST Burlington Watch.

Name..

Address..

No letter necessary, coupon will do.

There Are Very Few Central Stations

that cannot use the newspaper profitably to sell their juice. If you are considering newspaper advertising, better write us and learn what we are doing for the Commonwealth Edison Company of Chicago; the Buffalo General Electric Company; the Illuminating Company of Cleveland.

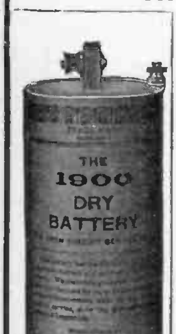
Wm. D. McJunkin Advertising Agency

BUSINESS BUILDERS

167 Dearborn Street, CHICAGO

1900 Dry Batteries
Are What You Should Use

THEY HAVE STOOD THE TEST OF TIME



1900 Dry Batteries

are becoming more popular every year. There is a reason Why.

They make satisfied customers.

We want your Battery business.

The Nungesser Electric Battery Co.

CLEVELAND, OHIO

General Sales Office:
128 West Jackson Boulevard CHICAGO, ILL.

Cure Yourself

Right at Home With Vibration

Health is waiting for you! Perfect, abounding, glowing health—such health as you have not known for years, perhaps. And without the aid of doctors, drugs or medicines! No matter what ails you; no matter even if your case has been pronounced incurable—**don't give up hope!**

Vibration, the marvel of the 20th century, has cured uncounted thousands of people who thought they were hopeless invalids.

THE WHITE CROSS ELECTRIC VIBRATOR

is the greatest boon that suffering humanity has ever known. It gives life and health, strength and beauty to all. It sends the good red blood leaping and coursing through your veins, puts new life into disused muscles and nerves. It shakes the disease **right out of your system.**

The White Cross Electric Vibrator is the only instrument in the world which enables you to make use of the **three great natural forces, Vibration, Faradic and Galvanic Electricity**—right in your own home! It is a perfect Massage Vibrator and Medical Battery combined for less than the usual price of **either.**

VIBRATING CHAIR FREE With a simple attachment you can transform any chair into a perfect Vibrating Chair. You can take Vibratory treatments and **Swedish Movements** right in your own home, that physicians and sanitariums charge $2 to $3 apiece for.

CURES THESE DISEASES:

Head Ache	Asthma	Heart Trouble
Catarrh	Neuralgia	Deafness
Insomnia	Earache	Stomach Trouble
Indigestion	Weak Eyes	Skin Diseases
Weakness	Nervous Debility	Scalp Disease
Rheumatism	Constipation	Lumbago

All these and dozens of other chronic and acute diseases can be instantly relieved by Vibration and Electricity.

Valuable Book Given Away

Send us your name and address on the attached coupon at once and we will mail you a copy of the famous book, "Health and Beauty," absolutely free and postpaid. Tells how to prevent and cure disease and become healthy, hearty, happy and beautiful in a natural way. No matter how well you are now, you need **this book.** It has saved thousands of lives—it may save yours. No obligations—just your name and address.

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Get the free book at once. Let us tell you about our liberal Free Trial Offer. Get our special 60 day introductory discount. Learn how you and all your loved ones can get well without drugs or doctors. Remember, no obligations, just name and address. Get the free book today.

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Without obligations on me, please send me free your free book "Health and Beauty," Special Reduced Price Offer and Complete Catalog.

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THE . . .

Positive Electric Vacuum Cleaner

is the Acme of perfection vacuum cleaning appliances. The exploitation at this time is after the firm decision on the part of the manufacturers that they have overcome the defects and eliminated the faults of electrically applied vacuum cleaners that are now on the market.

The ambition of the manufacturer has been realized in offering to-day a vacuum cleaner that will perform the functions that vacuum cleaners were intended for, that is to clean more thoroughly and with less labor on the part of the operator than any method that has been employed in the past. Every performance of the machine has resulted in a sale.

ELECTRIC CLEANER CO.

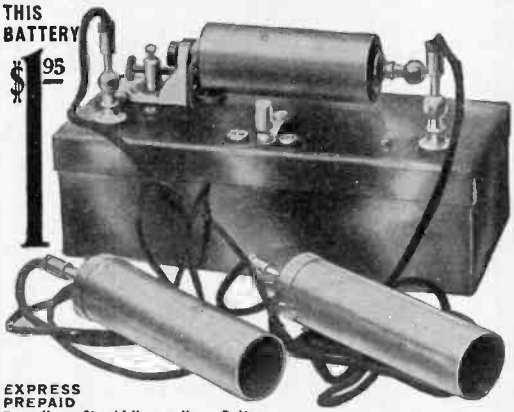
Monadnock Block :: CHICAGO, ILL.

"CURE YOURSELF BY ELECTRICITY"

New Book—Illustrated from Life—Sent FREE to all who write.

Write to-day for our new **Free Book—"Cure Yourself by Electricity"**—Illustrated with photos from life. Shows how the New Home Batteries cure **Rheumatism, Neuralgia, Lumbago, Headache, Insomnia, Constipation** and all nerve affections and diseases arising from sluggish circulation; also how they afford **electric baths** and **beauty massage** without cost at home.

THIS BATTERY $1.95



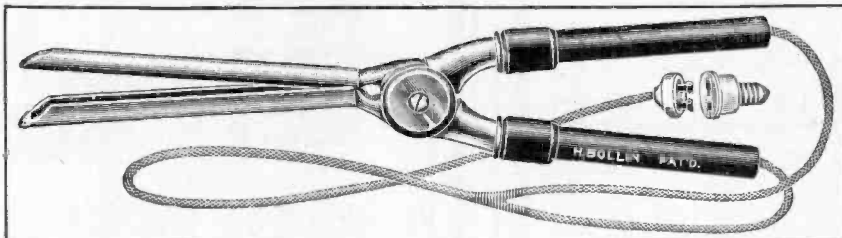
EXPRESS PREPAID

Every Home Should Have a Home Battery.

We send our batteries **Prepaid** without a cent in advance (prices $1.95 and up) and allow **10 DAYS' FREE TRIAL.** Write for our Book.

DETROIT MEDICAL BATTERY CO.,
195 Majestic Bldg., Detroit, Mich.

The "BOLLINS" PROFESSIONAL CURLING IRON

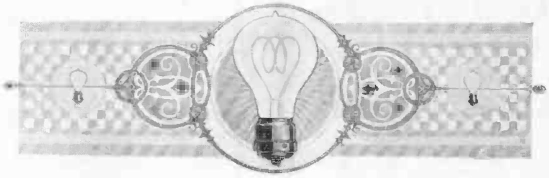


Protected By World Patents

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



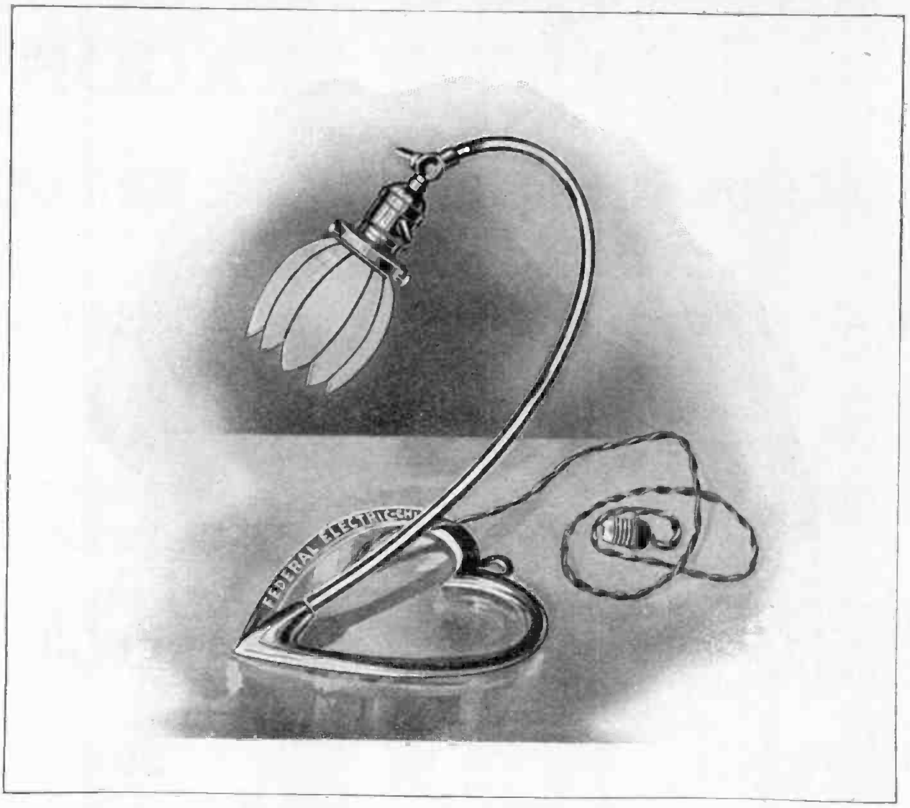
Our Offer *to* Houseowners

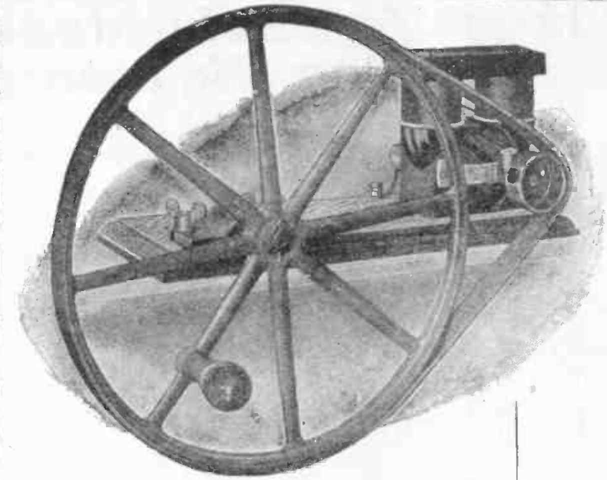
Enabling the cottage home in Chicago to enjoy Electric Light

To enable every home in Chicago—large or small—to *enjoy* the *comfort* and *convenience* of *electric light* without feeling the expense of *wiring* the premises *we offer* to do the work *at cost* payable a *little* each month for two years. Any house owner, whose property is located on any of *our lines* may avail himself of this offer. *Call* Main 1280

Commonwealth Edison Company
139 Adams St.

WM. D. McJUNKIN ADVERTISING AGENCY


FEDERAL ELECTRIC



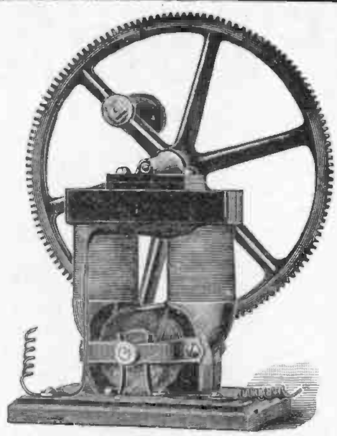
No. 23=B. 40=Watt Dynamo with Belt Drive

Price, $11.00

The above illustration shows our 40-Watt Dynamo No. 23, arranged to be operated by a hand wheel and belt. This is in many ways better than the gear drive and it is not noisy.

Weight of dynamo and hand wheel on base, not boxed, 22½ pounds. Price includes the hand wheel and belt.

The hand wheel, belt, board and bracket bearing, without the dynamo, will be sold for $2.50.



No. 7. Hand=Power Dynamo.

Price, $6.50.

This is a powerful hand-dynamo, operated by gearing. It is very compact, and gives a large current for a machine of such small size. It is the most neatly designed and finished small dynamo that has ever been put upon the market. Is mounted on hardwood base, has tool steel shaft and brasss bearings, and is neatly painted.

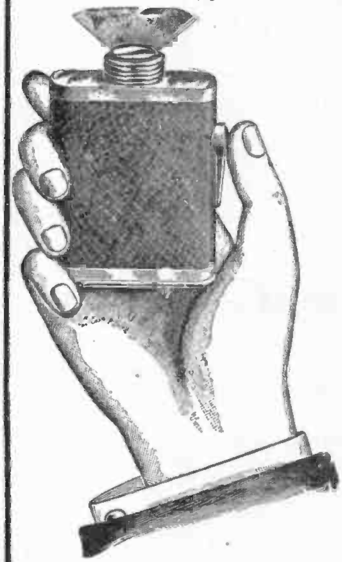
It will light a 10-candle-power, 12 volt incandescent lamp, furnish current to run any of our electrical toys, or perform any electrical experiment. Among other things, it will decompose water, electroplate metals, fire blasting fuses, etc.

When used with any of the railways it makes an ideal miniature power plant. There are no batteries to be considered and the power is ever ready, and the speed of the car can be varied by changing the speed of the dynamo.

Weight of dynamo, packed in wooden box, 16½ lbs.

VEST POCKET TANTALUM

500% More Light



LATEST

We are now making a 3½ Volt Flat Tantalum Bulb for use in the Vest Pocket Cases.

Insert our 3½ Volt Tantalum Bulb in your old carbon cases—either Tubular or Vest Pocket Styles. It will make them up-to-date. They will appeal to the purchasers.

It Will Pay You to use

TANTALUM LAMPS.

The Light Will Amaze You!

The Life Will Surprise You!

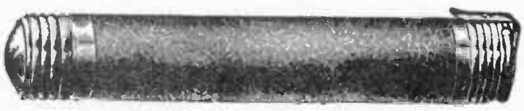
The Appearance Will Please You!

98 Cents, Postpaid.

TANTALUM TUBULAR

500% More Light

obtained over same kind made in carbon.



Our one or two cell special.

Weighs ⅓ less,—2 inches shorter,—costs less to maintain than old 3 cell carbon types.

Two cells of the regular tubular standard battery will fit for 2½ v. bulb.

$1.25, Postpaid.

One cell of the regular 2 cell standard Ever Ready Range Lighter Battery detached makes two renewals.

We carry in stock a full line of batteries for convenience of our customers.

COMMERCIAL ELECTRIC CO., Kewanee, Ill.

WING PIANOS

Ask a Hearing

and - - - Nothing More!

YOURSELF AND YOUR FRIENDS THE JUDGE AND JURY

EVEN IF YOU ARE NOT MUSICAL, the Wing Piano will be sent to you on trial without the payment of even one dollar. We deliberately claim that the 21 largest styles of Wing Pianos have the most majestic tone under heavy playing and the sweetest tone under light playing of any upright pianos whatever, irrespective of the price or maker.

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.

For we are neither young nor trifling. We have been nearly half a century in the piano business, and during all of forty years have been scientifically studying tone and durability in preference to dollar making. This is the reason why the Wing Pianos ring with music.

The forty years' business experience has *also* taught us to weigh our WORDS carefully whether printed or spoken. Our WORD, black on white and over our name (which will be found at the foot of this notice), is that the Wing Piano is the sweetest of all in tone.

Our commercial standing and references will guarantee you that our WORD is good and contract gilt-edged. The publishers of any prominent magazine will also tell you this. Read this exact copy of one of our trial blanks:

TRIAL BLANK

WING & SON, New York. Wood.......... Style..........

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.

Yours respectfully..............................

We Refuse to Sell Through Dealers

Their profits would double the price of the WING PIANO. Buy without the dealers' profits!

You Save From $75 to $200

when you buy a WING PIANO; for you buy direct--absolutely. You pay the cost of building it with only one moderate profit added.

With railroads everywhere, and business of all kinds done by mail, the piano dealer or agent is now *unnecessary*. As the cheap kinds cost less than half, the dealers "talk up" and push the cheap pianos--but often call them high grade.

You Need these Books—They are FREE

We send two good books, "The Book of Complete Information About Pianos" is a Complete Reference Book on the Piano. Technical Descriptions--Illustrates how all pianos are made--With large lithographed pictures of 1908 models of WING PIANOS--Difference between excellent materials and labor and cheap substitutes--Reveals agents' methods, etc. A handsomely illustrated book of 162 pages.

THE WING PIANO is broadly guaranteed in writing for 12 years.

Wing & Son 361 - 368 W. 13th Street, New York

Write for the books and Wing Catalogue at once, or fill in the coupon. Cut or tear it out and mail to us now while you think of it (and while you have the coupon.) You will be under no obligations whatever.

The Instrumental Attachment

is added to certain styles *when ordered.* It produces almost to perfection the tones of the Harp, Zither, Banjo, Guitar and Mandolin. It saves wear and prolongs the life of the Piano. The usual playing of the keys operates the Instrumental Attachment.

Easy Payments Accepted

and old pianos and organs taken in part exchange.

A PIN MAY BE USED TO CUT ALONG THIS LINE

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361-368
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Send to the name and address written below, the "Book of Complete Information about Pianos," "Story Book" and catalogue, without any cost or obligation on my part.

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STANDARD HOT POINT

AUTOMATIC HOT POINT

Two Models for 1909 the well-known Pacific Electric Iron

Standard Type with improvements—Same with Automatic Cut-Out applied

OUR 1909 MODEL STANDARD HOT POINT IRON is the same as the iron we sold with great success during 1908, with a number of decided imporvements.

This iron is extremely economical because it has such great heat-storing capacity. When heated up the swi'ch plug can be pulled out and the iron used fully half the time on light work without the current.

In one city where 1100 irons were sold in 1907 and 1950 irons were sold in 1908, the number of bum-outs was so small that the company wrote us that it was not worth keeping track of. This means that the iron has long life and can be used for years.

The heating elements are easily removable. Only a screw driver needed to put in a new pair of heating elements.

Every Hot Point Iron is guaranteed to the lighting company or dealer for twelve months. Should the user have any trouble with it the lighting company or dealer stands ready to make it good.

Pacific Electric Irons are on sale in many cities all over the country. Inquire first of your Lighting Company. If they do not handle it they can probably direct you to a Dealer who does.

If neither lighting company nor dealer have Pacific Electric Irons, **write to us for our special introductory price.**

OUR 1909 AUTOMATIC HOT POINT IRON is exactly the same as our "Standard" model, but with our new automatic cut-off device applied.

This automatic device throws the switch out when the iron exceeds working temperature so that it is impossible to injure the heating elements of the iron or to do any damage.

This does away with all risks of fire, which has been the only real objection against electric flat irons.

The automatic device is positive in action. When the iron has passed a certain temperature the switch plug is thrown out and the iron immediately begins to cool off.

It operates on an entirely new principle and is not a thermostat. There is no other electric iron with an automatic control.

An electric iron saves time and work. It makes ironing a pleasure instead of drudgery. It is economical, costing only 4 to 7 cents for an hour's ironing. And so handy—simply put in the plug and begin to iron.

This Automatic Model of the Hot Point Iron is just being introduced. It is the first automatic iron placed on the market and possibly your Lighting Company or Dealer will not have a sample. But ask them first. If they can not show it to you, **write us for our special introductory price.**

Central Station Managers and dealers should write for our special sample proposition. This allows ample time to test the iron and if not satisfied you can return it at our expense. Orderasamplenow.

See these

IRONS

at the

CHICAGO SHOW

Jan. 16 to 30

(Space No. 8 in Section "G")

or better yet, order a sample.

PACIFIC ELECTRIC HEATING CO.

Ontario, California

Factories at

63-65 W. Washington St., Chicago

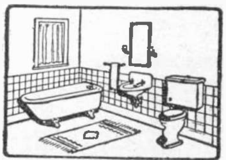
Readers of Popular Electricity who have Inventions to Patent can refer to Advertisers appearing on this page with the assurance that their interests will be absolutely protected to the smallest detail.

Money Saving Catalog Free

PLUMBING AND HEATING MATERIAL

Direct to the Consumer at Factory Prices

Our perfect ALL IRON PIPE system of plumbing will enable any handy mechanic to install the material on farm or in city. Send us a list of your needs. *All we ask is an opportunity to figure on your wants.* We carry everything necessary for installing this class of work. Soil pipe, lead and water pipe and fittings of all kinds, etc. All goods are brand new and high grade.



COMPLETE BATHROOM OUTFITS, from $24.50 to $126.00.

HEATING PLANTS

Don't think you cannot afford a modern Hot Water or Steam Heating Plant till you get our figures. Special price for first plant in each locality. Plans free. Tools loaned.

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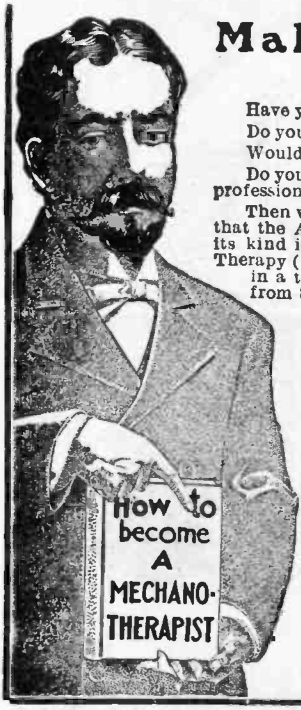

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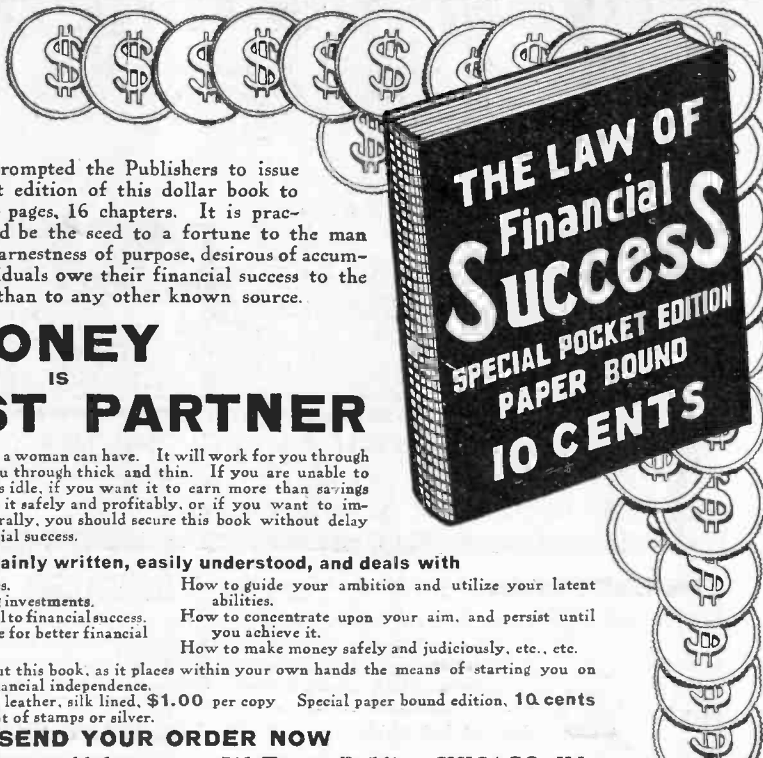

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